SCS ENGINEERS

Odor Mitigation Pilot Study Report

Bridgeton Landfill

Presented to:

Bridgeton Landfill, LLC
13570 Saint Charles Rock Road
Bridgeton, Missouri 63044

Presented by:

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November 2014
File No. 23211003.17

Offices Nationwide
www.scsengineers.com

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This Odor Mitigation Pilot Study Report, developed for the Bridgeton landfill located in Bridgeton, Missouri, dated November 2014, was prepared and reviewed by the following:

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1.0 INTRODUCTION

Bridgeton Landfill, LLC (Bridgeton) has retained **SCS Engineers (SCS)** to oversee and report on the implementation of an Odor Mitigation Pilot Study Workplan (Workplan) previously submitted to, and approved by, the State of Missouri, Department of Natural Resources (MDNR), Solid Waste Management Program (SWMP). The purpose of the Workplan was to evaluate a proposed odor control technology on a pilot-scale, for possible full-scale implementation at Bridgeton Landfill.

2.0 PILOT STUDY APPROACH AND METHODOLOGY

2.1 APPROACH

Based on discussions, as well as prior success with the installation and implementation of odor mitigation technology at landfills, MV Technologies (MVT) was identified as a potential candidate technology for odor mitigation at the Bridgeton Landfill. MVT has a patented biologically-enhanced iron sponge technology identified as MVT OdorFilter™ system and filter media. During initial discussions and preliminary grab sample[1] analysis of landfill gas (LFG) at the site, MVT indicated that its MVT OdorFilter™ system had a proven track record with removal of many of the odorous constituents (e.g., organic and sulfur compounds) identified in the LFG grab samples. However, additional pilot testing would be required to evaluate effectiveness of its system with the unique LFG composition at the Bridgeton Landfill, as well as on all the odorous LFG constituents identified.

Based on subsequent discussions between Bridgeton, SCS, and MVT personnel, MVT was contracted to test the effectiveness of its technology at the Bridgeton Landfill via operation of a small-scale pilot system.

Working with Bridgeton and MVT personnel, SCS developed the Workplan, and presented it to St. Louis County, SWMP on July 17, 2014, and MDNR SWMP on July 24, 2014. The Workplan submitted to MDNR described the physical setup of the pilot system and the operating scenarios under which it would be evaluated. A copy of the Workplan is provided in ***Appendix A***.

2.2 METHODOLOGY

The MVT OdorFilter™ system consists of filter media impregnated with MVT's proprietary Iron Sponge technology. A traditional "Iron Sponge" is a hydrated iron oxide on a carrier of wood particles, and has been used for many years to treat gas streams. The MVT OdorFilter™ system uses a proprietary improved reactive material, which reportedly functions as a "high-performance" upgrade of traditional Iron Sponge by adding biological agents to the Iron Sponge. This combination is designed to provide both the chemical removal of sulfurous odor-causing compounds (e.g, hydrogen sulfide [H_2S] and mercaptans) and biological removal of readily-

[1] Note that while the grab samples are not considered representative of site LFG trends, the testing results provided preliminary criteria to assess odor sources and treatment options and for the development of an initial treatment technology pilot study.

biodegradable organic compounds, which can also be the source of odors. The MVT OdorFilter™ system is reportedly capable of achieving H_2S reductions down to a level of 1 parts per million (ppm) and can handle flow rates in excess of 10,000 cubic feet per minute (cfm). Additional information on the MVT OdorFilter™ technology, as specifically implemented for this Pilot study, is contained in the MVT Pilot Study Report, which is provided in ***Appendix B***.

3.0 PILOT STUDY IMPLEMENTATION

3.1 MATERIALS AND METHODS

An as-built drawing of the pilot system equipment is provided in Appendix A of the MVT Pilot Study Report provided in ***Appendix B***. As shown in this drawing, the pilot system consists of two 95-gallon drums connected in series, filled with MVT's proprietary Iron Sponge™ media. The system was located in the main flare yard, adjacent to the main inlet to the blower/flare station. Sample ports were installed at the inlet to the first drum (Inlet), in between the two drums (Middle), and at the outlet of the final drum (Outlet). The pilot system was equipped with a rotometer to monitor gas flow rate, as well as manometers to monitor the pressure of each of the two system drums.

In order to track the operation of the pilot system between sampling events, the system was checked each day that Bridgeton personnel checked the main flare yard. As part of their check, Bridgeton personnel checked the system for accumulated liquids in the inlet line to the system and drained liquids whenever necessary. A copy of the daily field check log is provided in ***Appendix C***.

Periodically during the pilot test, gas samples were collected from the system and sent to Atmospheric Analysis & Consulting, Inc. (AAC), a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory, for analysis. During these gas sample collection events, a "Round" of gas samples was collected. A "Round" of samples includes a gas sample collected at the Inlet, the Middle, and the Outlet.

Before each sample was collected, the gas sampling train was purged for at least two minutes at a rate of 500 ml/min, and then the gas stream was analyzed with a Landtec Gas Extraction Monitor (GEM)-2000 field gas analyzer for general gas composition (methane, oxygen, carbon dioxide, and balance gas).

Following field gas composition analysis, a gas sample was collected into an evacuated Summa canister. Sampling procedures ensured that the canister remained under vacuum following sample collection in order to ensure sample integrity. Copies of the field gas sampling forms are provided in ***Appendix D***.

3.2 TIMELINE AND OPERATIONAL SUMMARY

The major milestones and operational parameters are described below.

August 1 – Workplan Approval

As discussed in Section 2.1, following submittal of the Workplan on July 24, 2014, MDNR approved implementation of the Workplan on August 1, 2014. MDNR approval was for a 4-week period following system startup. A copy of the MDNR approval letter is provided in ***Appendix E***.

August 4-5 – Initial Startup

System assembly and initial startup occurred on August 4, 2014. Initial gas flow was set at 5 scfm through the system. Following startup, an initial set (1st Round) of gas samples was collected from the Inlet, Middle, and Outlet of the system on the morning of August 5, 2014. After the gas sampling was finished, the gas flow rate was increased to 10 scfm.

Following the flow adjustment, an additional set (2nd Round) of gas samples (from the Inlet, Middle, and Outlet) was taken in the afternoon of August 5, 2014. After the gas sampling, the gas flow rate was decreased back to 5 scfm.

After the second round of gas samples was collected, it was noticed that some liquids were collecting in the inlet hose of the pilot system. The system was temporarily shut down at 3:30pm to install a bypass line so that liquids could be evacuated from the system. The system was started back up at 4:45pm on August 5, 2014.

Based on the startup date of August 4, 2014, the expected shut-down of the pilot system would occur on September 1, four weeks following startup.

August 14 – Primary Evaluation

The system continued to run at 5 scfm through August 14, 2014. A 3rd Round of gas samples (Inlet, Middle, and Outlet) was taken in the afternoon of August 14, 2014.

August 19 – System Media Adjustment

Based on analytical results from the 3rd Round of sampling, on August 19, 2014, a biological additive was introduced into both vessels of the pilot system. The system flow rate was kept at 5 scfm.

August 27 – Additional Evaluation

On the afternoon of August 27, 2014, a 4th Round of gas samples (Inlet, Middle, and Outlet) was collected from the pilot system. The system flow rate was kept at 5 scfm.

August 29 – MDNR Timeline Extension Approval

On August 29, 2014, MDNR granted a two-week extension, as requested by Bridgeton personnel. This approval extended the system shutdown date to September 15, 2014. A copy of the MDNR approval letter is provided in ***Appendix E***.

September 11 – Additional Evaluation

A 5th Round of samples (Inlet, Middle, and Outlet) was collected on September 11, 2014 in the afternoon. The system flow rate was kept at 5 scfm.

September 15 – System Shutdown

In accordance with the approved extension timeframe from MDNR, the system was shut down on September 15, 2014.

Analytical results received back from the 5th Round of samples collected indicated a reduction in some odorous sulfur compounds. Based on this data, Bridgeton requested permission to restart the Pilot System and continue testing for an additional four-week period.

September 19 – MDNR Restart Approval and System Restart

On September 19, 2014, MDNR granted a system restart and four-week pilot study extension, as requested by Bridgeton personnel. This approval extended the system shutdown date to October 17, 2014. A copy of the MDNR approval letter is provided in ***Appendix E***.

Based on this approval, the system was restarted on September 19, 2014. The gas flow rate was set at 5 scfm.

September 25 – Additional Evaluation

A 6th Round of gas samples (Inlet, Middle, and Outlet) was collected on September 25, 2014 in the afternoon.

October 3 – Pilot Test Final Shutdown

Based on lab results from the 6th Round of gas samples, the pilot system was shut down on October 3, 2014 and no further sampling was conducted.

4.0 RESULTS

A summary of analytical data collected during the Pilot Study is presented in tabular format in the MVT Report provided in ***Appendix B***. In addition, copies of all analytical laboratory reports and chain-of-custody documentation are contained in Appendix B of the MVT Pilot Study Report provided in ***Appendix B***.

5.0 DISCUSSION AND CONCLUSIONS

Based on review of the analytical data, SCS concurs with the results discussion contained in the MVT Pilot Study Report provided in ***Appendix B***, which states:

> *The pilot system, as designed and installed, performed well from a process standpoint. Gas flow was controllable, and very few mechanical problems were experienced. The total reduced sulfur (TRS) concentration across the various lab*

analyses showed a range of an 11.73% increase, to a 41.97% reduction in concentrations.

There does appear a correlation between TRS concentration and the addition of bacteria. At the tested flow rates, the iron sponge does show effective reduction for hydrogen sulfide (H_2S) and lighter mercaptans (methyl/ethyl). It appears that a decrease in dimethyl sulfide (DMS) appears concurrent with an increase in dimethyl disulfide (DMDS), a phenomena reported by other researchers. Although the addition of bacteria does correlate to a positive reduction in TRS, it is expected that a final conclusion for this phenomenon would likely require a longer testing period.

In addition, the Pilot Study initially focused on mitigation of various odor-causing constituents in LFG, most prominently H_2S, which is a typical LFG constituent, with a default concentration in LFG of 35.5 ppmv (per AP-42, Section 2.4, Table 2.4-1, and provided in ***Appendix F***). H_2S concentrations identified in Inlet samples ranged from below detectable limits to 32.6 ppmv, which is below the AP-42 default for LFG. H_2S and mercaptan reduction during the Pilot Study ranged from 99.9 to 100%. Since H_2S has an odor threshold of approximately 0.0005 ppmv, a reduction from a high concentration of 32.6 ppmv to below detectable concentration illustrates a success with regard to the reduction of odors caused from H_2S. Additionally, since methyl mercaptan has a typical odor threshold of 0.001 ppmv, a reduction from a high concentration of 250 to 0.25 ppmv also illustrates a success with regard to the reduction of odors caused from mercaptans.

However, it should be noted that DMS, which was also identified in the Inlet samples, was identified at concentrations up to 1,079 ppmv, which is approximately 33 times higher than the identified H_2S concentration. While DMS has a higher concentration in the LFG specific to the Bridgton Landfill than the default AP-42 concentration of 7.82 ppmv, it has an odor threshold that is almost 5 times higher than that of H_2S (note that the DMS odor threshold is 0.0025 ppmv). In addition, it should be noted that there were limited reductions, and some increases in DMS across the Pilot system. This indicates that the MVT OdorFilter™ technology is not effective at the removal of this odor-causing compound.

Therefore, it can be concluded that, although the Pilot study was effective at the mitigation of odors associated with H_2S and mercaptans, the failure of the Pilot Study to reduce the concentrations of other sulfur compounds, such as DMS, infers that the proposed technology alone, will not mitigate the odors associated with LFG at the Bridgeton Landfill.

6.0 RECOMMENDATIONS

Based on the findings of the MVT Pilot Study, as well as the analytical data collected during the implementation of the Pilot Study, it is recommended that additional odor mitigation technologies be evaluated, focusing specifically on sulfurous compounds, including DMS and DMDS. To this extent, an additional technology evaluation is already underway, with an anticipated completion date before the end of November 2014.

APPENDIX A

Odor Mitigation Pilot Study Workplan

From:	Getting, James
To:	Nagel, Chris; Jeremy Rogus (JRogus@stlouisco.com)
Cc:	Ardrey, Brenda; Power, Brian; Kathrina Donegan KDonegan@stlouisco.com)
Subject:	Bridgeton - LFG stream Odor Treatment Pilot Test - Draft Work Plan
Date:	Thursday, July 24, 2014 2:04:48 PM
Attachments:	Bridgeton - LFG Odor Evaluation Work Plan 24July2014.pdf

Chris and Jeremy:

As per amended Paragraph 27-Odor Control, Item E, of the First Agreed Order, Bridgeton Landfill has engaged SCS Engineers to conduct an odor analysis and evaluation as outlined in their June 16, 2014 memorandum.

This submittal presents a draft of the relevant work plan for investigation, pilot test, and assessment to treat the odoriferous compounds. Per the Second Amendment conditions, this work plan is to be provided for review to MDNR and SLCHD by July 31, 2014. However, to be proactive on this item, Bridgeton Landfill has ordered the equipment for the onsite pilot test, and it is being received at the site next week. SCS is scheduled to assemble the equipment August 4, 2014 and begin the four week pilot test. Your review comments/approval of the work plan would be appreciated in order to meet the above project schedule.

Respectfully Submitted,

James Getting, PE
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SCS ENGINEERS

July 24, 2014

WORK PLAN

ODOR EVALUATION PILOT STUDY

SCS Engineers (SCS) has been contracted to assist Bridgeton Landfill (Site) in conducting an analysis of compounds within the landfill gas that may contribute to odors from the gas collection and control system, and evaluating potential control mechanisms to remove odor causing compounds. As part of this assessment, SCS has proposed to evaluate a pilot test system that may be used to help remove compounds found in the landfill gas that could contribute to odors from the gas system at the site. This Work Plan provides an overview of the proposed scope and approach to complete this assessment.

INTRODUCTION

SCS was contracted to evaluate the gas system infrastructure and operations at the Bridgeton Landfill and to identify potential sources of, and potential treatment technologies for, odors that may be associated with the gas collection system. As an initial part of the evaluation, two rounds of grab samples were taken from various points within the gas system. While the grab samples are not considered representative of the site because they were not duplicated at any one sampling location and were not sampled over multiple times to replicate results, the preliminary results provide guidance for development of an initial pilot study to assess odor sources and treatment options.

Based on these preliminary sampling results, the pilot test will be focused on the test system effectiveness of removing total reduced sulfurs (TRS) from the total gas stream. As the pilot study and assessment continues, additional testing may be appropriate to further the odor evaluation.

PILOT TEST SETUP

To evaluate a gas treatment system for potential utilization on site, a small-scale pilot test system is being constructed by MV Technologies (MVT) for use at the site. The pilot test will utilize their "OdorFilter" unit. The test unit will only use a small amount of collected landfill gas to test the removal capabilities of the filter media. The following describes the installation of the pilot test system at the Bridgeton Landfill.

Installation

The pilot system will be installed in the main flare yard, with the inlet of the pilot equipment being connected to the outlet of the existing blower skid (pressure side). The outlet of the pilot system will be piped back to the inlet side of the existing blower skid (vacuum side), to create a closed loop system, and minimize potential landfill gas odors. The inlet pipe will be connected to the pilot test system which consists of two over-pack drums of filter media, arranged in series. The pilot treatment system will treat 3 to 25 scfm of landfill gas.

Installation of the pilot test equipment will require one day of onsite assembly. Site configuration, sample train schematic, and equipment photo are shown in Figure 1, 2, and 3, attached.

Media Adjustments

The goal of the pilot study will be to assess effectiveness of the treatment media on the landfill gas at Bridgeton Landfill and to assess preferred treatment conditions. To determine the efficiency of the pilot treatment system, gas samples will be taken at the inlet, between the first and second stage media, and the outlet of the pilot treatment system. Initial gas samples will be taken about two hours after system initiation, so as to provide a base line value of comparison to future sampling. Gas samples will be collected during each phase, as the microbes within the media reach a repeatable state of sulfur removal. The media must be kept at the target moisture level with the manual periodic addition of water. After each round of gas samples, the results will be analyzed by MVT to determine modifications to the media to affect the sulfur compound(s) removal efficiency of the pilot system.

The initial run of the test will likely be 5 to 7 days before repeatable results can be expected. Thereafter, the number of tests will be based on the removable efficiencies of the initial test. Three iterations are expected so as to push the variable limits and estimate the functional relationship curve. If there is no immediate removal success, additional attempts will be made to confirm the results. The results will then be used to assess the next evaluation phase of the pilot study. Four weeks total time is estimated to complete this reiterative process.

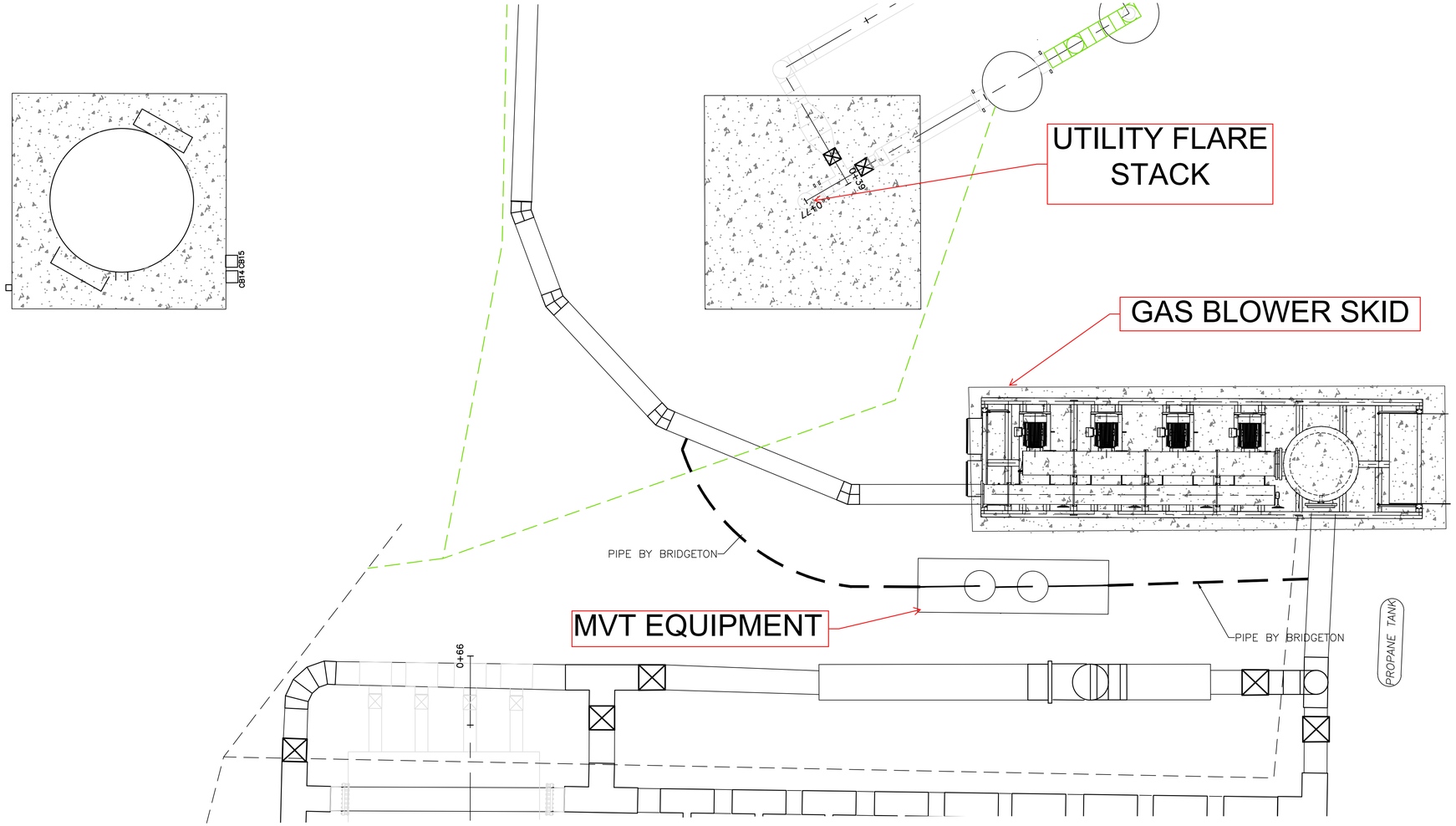
Gas Sampling

At various times during the pilot study, as described above, gas samples will be collected from the sampling ports of the pilot system. The gas samples will be collected in silonite SUMMA canisters sent to a laboratory for analysis by ASTM D-5504 (TRS constituents) and Method 3C (major gas compositions).

CONCLUSIONS

After the various test phases, MVT will prepare a summary report detailing the lab results and the pilot test system's effectiveness at removing total reduced sulfurs (TRS) from the total gas stream. While individual sulfur compounds may be reviewed for individual removal effectiveness, the TRS removal effectiveness is what will be reported and compared to other technologies to determine success of the pilot study. If the pilot treatment system is successful, MVT will develop a design to implement the most successful phase on a full-scale basis. A preliminary report will be prepared within 45 days after that last round of gas sample results having been received.

If the pilot treatment system testing with MVT is unsuccessful in reducing TRS, alternate technologies will be reviewed for appropriateness to the Bridgeton landfill gas constituents.

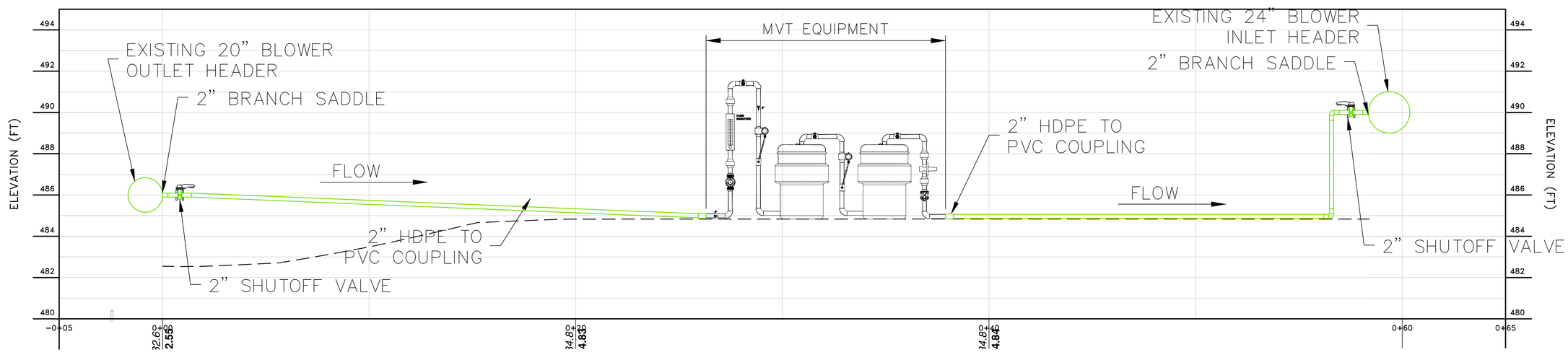


NOTES:
- ALL NEW PIPING TO BE HDPE SDR 26 (PE 4710)

LEGEND:

—OE—	EXISTING OVERHEAD ELECTRIC
	NEW HDPE PIPE
	DEMO HDPE PIPE AND COMPONENTS
	EXISTING HDPE PIPE
	EXISTING LFG PERIMETER HDPE HEADER (BURIED)
	EXISTING 2" HDPE DRAIN LINES
	VALVE
	HDPE TEE
	HDPE 22.5° ELBOW
	HDPE DOWNWARD FACING 90° ELBOW
	HDPE 90° ELBOW

LONGITUDINAL PROFILE Pilot Test Alignment



REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE: PLAN/PROFILE SHEET SECTION I-I (PROPOSED LINE TO ZINK FLARE)

PROJECT TITLE: BRIDGETON LANDFILL 2014 BLOWER/FLARE STATION MODIFICATIONS

CLIENT: BRIDGETON LANDFILL, LLC. 13570 ST. CHARLES ROCK ROAD BRIDGETON, MO 63044

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PROJ. NO. 232111003.06 | DWN. BY: FDB | Q/A RVW BY: MSB
DSN. BY: FDB | CHK. BY: MSB

CADD FILE: DraftEnclosed

DATE: 04/24/14

SCALE: AS SHOWN

FIGURE 1 of 1

D:\WORK\232111003.17 BRIDGETON GCCS INFRASTRUCTURE ENGINEERING\BRIDGETON SCS DRAFT PILOT LAYOUT 7-15-14.DWG

ODOR CONTROL TEST UNIT ATTACHED TO EXISTING FAN

MV TECHNOLOGIES
303.277.1625
751 PINE RIDGE Rd.
GOLDEN, CO 80403

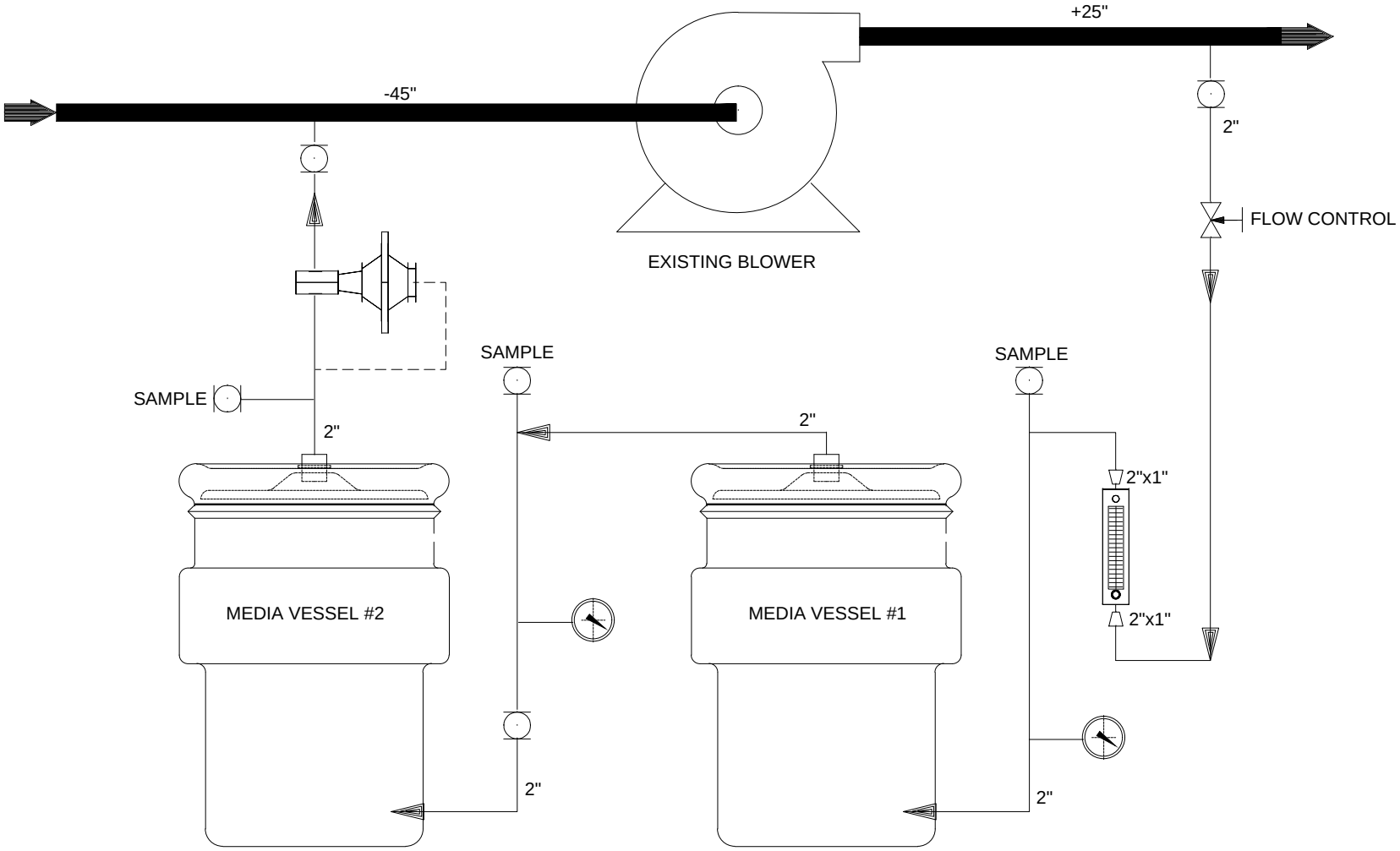


FIGURE 2

FLOW = 3 - 25 CFM

MV 7-7-14

ODOR CONTROL TEST UNIT - EQUIPMENT SETUP

MV TECHNOLOGIES
303.277.1625
751 PINE RIDGE Rd.
GOLDEN, CO 80403

FIGURE 3

MV 7-7-14

APPENDIX B

MVT Pilot Study Report

Bridgeton Landfill Gas Pilot Study: Efficacy of Enhanced Iron Sponge Media for Site-Specific Odor Reduction

Fred Varani and Sarah Parsons
MV Technologies, LLC – Golden, Colorado

Republic Services, in consultation with SCS Engineers, commissioned MV Technologies to design and conduct a test program to determine the efficacy of MV's modified iron sponge on reduction of odor-causing compounds in the landfill gas at the Bridgeton Landfill in Missouri. Two in-series vessels were installed in a slipstream of the landfill gas, and lab analyses were conducted at three points in the process flow over several weeks to determine the removal capabilities of the iron sponge, with and without bacterial additives. The removal capacity of iron sponge for hydrogen sulfide and mercaptans is well-known, so the main focus of interest for this pilot was to determine what level of reaction, if any, would occur on the high levels of other odiferous compounds, including organics, dimethyl sulfide, and dimethyl disulfide present in the landfill gas.

I. INTRODUCTION

As part of the Bridgeton Landfill's review of available options for mitigation of odors associated with landfill gas, a study was conducted to determine whether or not, and in what capacity, iron sponge would contribute to reducing odiferous compounds in the landfill gas stream.

Iron sponge is hydrated iron oxide on a carrier of wood shavings and wood chips. The media is most frequently supplied with 15 pounds of iron oxide per bushel of product and works to effectively remove the hydrogen sulfide (H_2S) and mercaptans from the gas stream by forming stable iron sulfide.

The chemical reaction within iron sponge for H_2S is well understood:

$$Fe_2O_3.H_2O + 3H_2S \rightarrow Fe_2S_3 + 4H_2O \text{ and}$$

$$Fe_2O_3.H_2O + 3H_2S \rightarrow 2FeS + S + 4H_2O \text{ (removal of } H_2S\text{)}$$

$$2Fe_2S_3 + 3O_2 + 2H_2O \rightarrow 2Fe_2O_3.H_2O + 6S \text{ (regeneration of iron oxide)}$$

MV Technologies had anecdotal evidence of the effective use of iron sponge media to reduce dimethyl sulfide (DMS) and dimethyl disulfide (DMDS) related odors and was recently provided with spectrometry data indicating reduced levels of DMS and DMDS in an iron sponge treated gas stream in South Carolina, although specifically quantifiable results were not available at time of study.

In an effort to reduce the odor issues at Bridgeton Landfill, a pilot unit was installed in early August 2014. The unit included two 95-gallon drums, fitted with inlet/outlets for the gas stream, a water addition port and drain port, and engineered gas distribution. The two vessels were placed in series with access for sampling on the "inlet" and "outlet" of the unit, as well as in between the units, indicated as "middle" in lab analysis.

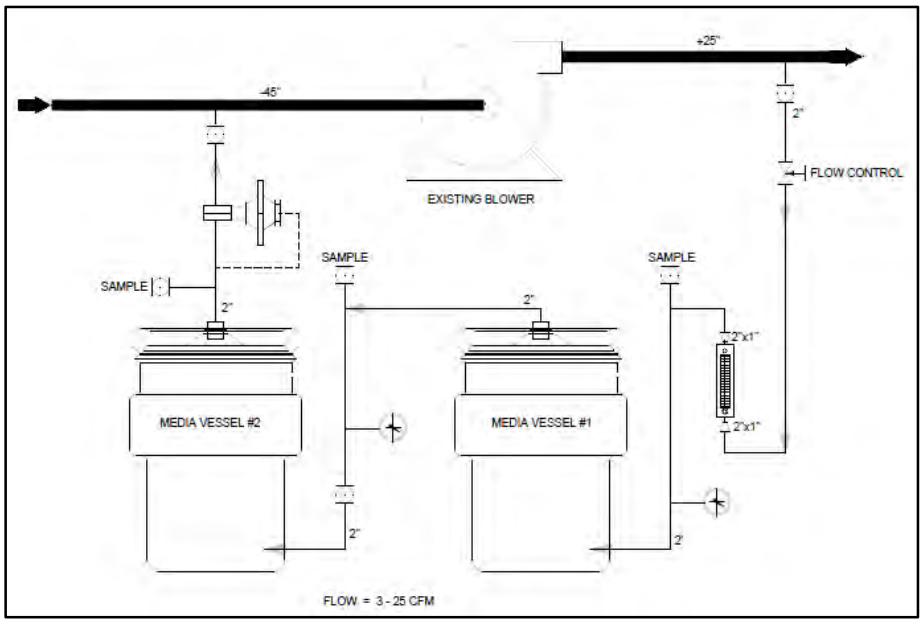


FIGURE 1. Odor Control Test Unit Process Flow

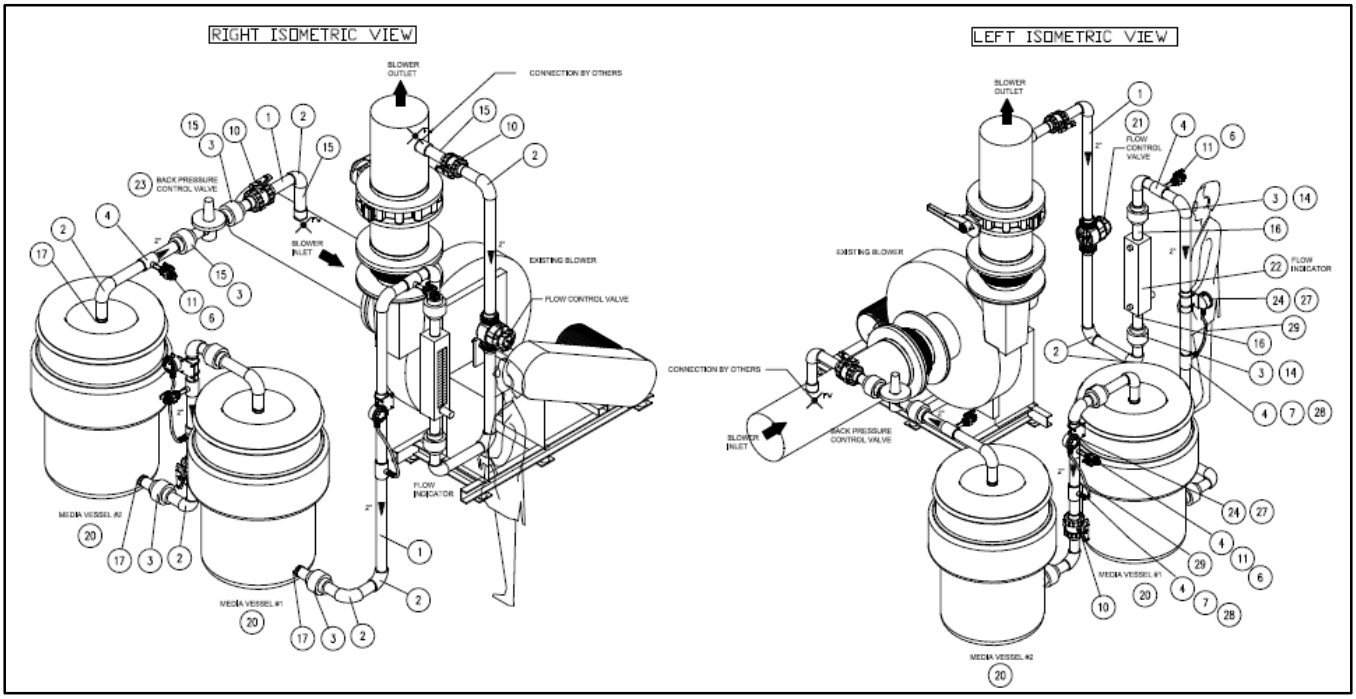


FIGURE 2. Isometric Views of Odor Control Test Unit

II. METHODOLOGY

Sampling of the inlet, middle, and outlet was conducted weekly for a period of several weeks to determine changes in sulfur compound analysis. The first two sets of samples were taken at the same time with varying flow rates to determine a difference, if any, of gas velocity on removal efficiency across the various sulfur compounds analyzed. Once a standard flow rate was established, subsequent samples were taken to determine any changes in efficacy over time. Upon stabilization of the results, MV Technologies then supplied a bacterial additive utilized in their larger-scale operations. The sampling frequency and details are shown in Table 1, below.

TABLE 1. Sampling Frequency

Sample Round	Date	Flow Rate (scfm)	Notes
1	8/5/14	5	Initial sample
2	8/5/14	10	Effect of increased flow rate
3	8/14/14	5	Determine effect of time on results
4	8/27/14	5	One week after bacteria addition
5	9/11/14	5	Two weeks after bacteria addition
6	9/25/14	5	Stabilization after bacteria

Gas samples were taken utilizing six-liter Summa Canisters for Fixed Gases analysis. Upon sampling and numbering of the gas samples on-site, the vacuum was recorded on the canisters, then subsequently verified upon receipt at the laboratory, to confirm quality assurance of the samples and verify no leakage occurred during transit. Atmospheric Analysis & Consulting, Inc. (AAC) was utilized in all sample analyses. The complete laboratory reports from AAC are provided in Appendix B.

Important dates to note are 8/20/14 when the bacterial additive was decanted and introduced into the system, as well as a shutdown period between 9/15/14 and 9/19/14, at which time an extension for sampling was granted.

Picture 1. Sampling Process

III. RESULTS

The following tables represent the results of the Total Reduced Sulfur Compounds Analysis in parts per million by volume (ppmv), as reported by AAC. Any value reported with "<" indicates a value of less than the Reporting Limit or "non-detectable". Any analyte highlighted in the results represents an overall qualitative reduction across the test unit.

TABLE 2. Sample Round 1- Initial Sample at 5cfm

CLIENT ID	INLET ROUND 1	MIDDLE ROUND 1	OUTLET ROUND 1
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	**32.6**	<0.870	<0.090
Carbonyl Sulfide	<0.888	<0.870	**0.264**
Sulfur Dioxide	<0.888	<0.870	<0.090
Methyl Mercaptan	**199**	<0.870	**0.333**
Ethyl Mercaptan	**1.96**	<0.870	<0.090
Dimethyl Sulfide	**736**	**731**	**864**
Carbon Disulfide	<0.888	<0.870	**0.811**
Isopropyl Mercaptan	<0.888	<0.870	<0.090
tert-Butyl Mercaptan	<0.888	<0.870	<0.090
n-Propyl Mercaptan	**4.76**	<0.870	<0.090
Methylethylsulfide	**7.94**	**4.45**	**5.38**
sec-Butyl Mercaptan	<0.888	**7.33**	**9.42**
Thiopene	<0.888	<0.870	**0.524**
iso-Butyl Mercaptan	<0.888	<0.870	<0.090
Diethyl Sulfide	**1.04**	<0.870	**0.626**
n-Butyl Mercaptan	**40.9**	**0.900**	**1.15**
Dimethyl Disulfide	**4.20**	**62.8**	**105**
2-Methylthiophene	<0.888	**4.07**	**6.21**
3-Methylthiophene	<0.888	<0.870	**0.583**
Tetrahydrothiophene	<0.888	<0.870	**0.559**
Bromothiophene	<0.888	<0.870	<0.090
Thiophenol	<0.888	<0.870	<0.090
Diethyl disulfide	<0.888	<0.870	<0.090
Total Unidentified Sulfur	**4.35**	**2.66**	**3.49**
Total Reduced Sulfur	**1033**	**813**	**998**

Preliminary Results Notes:

H2S Reduction = 100%
Methyl Mercaptan Reduction = 100%
DMS Increase = 17.4%
DMDS Increase = 2500%
TRS Reduction = 3.38%

TABLE 3. Sample Round 2 - Initial Sample at 10cfm

CLIENT ID	INLET ROUND 2	MIDDLE ROUND 2	OUTLET ROUND 2
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	<0.805	<0.822	<0.827
Carbonyl Sulfide	<0.805	<0.822	<0.827
Sulfur Dioxide	<0.805	<0.822	<0.827
Methyl Mercaptan	<0.805	**1.64**	<0.827
Ethyl Mercaptan	<0.805	<0.822	<0.827
Dimethyl Sulfide	**735**	**811**	**895**
Carbon Disulfide	**0.858**	**1.01**	**1.17**
Isopropyl Mercaptan	<0.805	<0.822	<0.827
tert-Butyl Mercaptan	<0.805	<0.822	<0.827
n-Propyl Mercaptan	<0.805	<0.822	<0.827
Methylethylsulfide	**4.58**	**5.79**	**6.33**
sec-Butyl Mercaptan	**7.11**	**9.94**	**12.7**
Thiopene	<0.805	<0.822	<0.827
iso-Butyl Mercaptan	<0.805	<0.822	<0.827
Diethyl Sulfide	<0.805	<0.822	<0.827
n-Butyl Mercaptan	<0.805	**1.22**	**1.57**
Dimethyl Disulfide	**229**	**96.2**	**169**
2-Methylthiophene	**3.38**	**6.54**	**11.1**
3-Methylthiophene	<0.805	<0.822	**1.17**
Tetrahydrothiophene	<0.805	<0.822	**1.32**
Bromothiophene	<0.805	<0.822	<0.827
Thiophenol	<0.805	<0.822	<0.827
Diethyl disulfide	**1.72**	<0.822	<0.827
Total Unidentified Sulfur	**7.61**	**3.79**	**6.98**
Total Reduced Sulfur	**989**	**937**	**1105**

Preliminary Results Notes:

H2S Reduction = None Present
Methyl Mercaptan Reduction = None Present
Dimethyl Sulfide Increase = 21.8%
Dimethyl Disulfide Reduction = 26.2%
TRS Increase = 11.73%

TABLE 4. Sample Round 3 - After One Week of System Running

CLIENT ID	INLET ROUND 3	MIDDLE ROUND 3	OUTLET ROUND 3
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	**19.0**	<0.071	<0.070
Carbonyl Sulfide	**0.437**	**0.425**	**0.429**
Sulfur Dioxide	<0.072	<0.071	<0.070
Methyl Mercaptan	**250**	**2.21**	**0.190**
Ethyl Mercaptan	**1.58**	<0.071	<0.070
Dimethyl Sulfide	**1079**	**1279**	**1191**
Carbon Disulfide	**1.09**	**1.10**	**1.30**
Isopropyl Mercaptan	**0.674**	<0.071	<0.070
tert-Butyl Mercaptan	<0.072	<0.071	<0.070
n-Propyl Mercaptan	5.69	5.78	7.27
Methylethylsulfide	<0.072	<0.071	<0.070
sec-Butyl Mercaptan	<0.072	<0.071	<0.070
Thiopene	<0.072	<0.071	<0.070
iso-Butyl Mercaptan	<0.072	<0.071	<0.070
Diethyl Sulfide	<0.072	<0.071	<0.070
n-Butyl Mercaptan	**0.650**	**0.907**	**1.20**
Dimethyl Disulfide	**87.0**	**154**	**258**
2-Methylthiophene	**0.151**	**1.28**	**1.79**
3-Methylthiophene	<0.072	<0.071	<0.070
Tetrahydrothiophene	**5.59**	**8.86**	**16.0**
Bromothiophene	<0.072	<0.071	<0.070
Thiophenol	<0.072	<0.071	<0.070
Diethyl disulfide	**10.1**	**1.70**	**3.06**
Total Unidentified Sulfur	**11.1**	**12.9**	**19.2**
Total Reduced Sulfur	**1472**	**1467**	**1499**

Preliminary Results Notes:

H2S Reduction = 100%
Methyl Mercaptan Reduction = 99.9%
Dimethyl Sulfide Increase =10.4%
Dimethyl Disulfide Increase = 196%
TRS Increase = 1.83%

TABLE 5. Sample Round 4 - One Week after Bacteria Added

CLIENT ID	INLET ROUND 4	MIDDLE ROUND 4	OUTLET ROUND 4
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	**4.29**	<0.810	<0.813
Carbonyl Sulfide	<0.805	<0.810	<0.813
Sulfur Dioxide	<0.805	<0.810	<0.813
Methyl Mercaptan	**101**	<0.810	<0.813
Ethyl Mercaptan	<0.805	<0.810	<0.813
Dimethyl Sulfide	**979**	**938**	**977**
Carbon Disulfide	**2.05**	**1.88**	**1.66**
Isopropyl Mercaptan	<0.805	<0.810	<0.813
tert-Butyl Mercaptan	<0.805	<0.810	<0.813
n-Propyl Mercaptan	**5.93**	**6.05**	**6.40**
Methylethylsulfide	<0.805	<0.810	<0.813
sec-Butyl Mercaptan	<0.805	<0.810	<0.813
Thiopene	<0.805	<0.810	<0.813
iso-Butyl Mercaptan	<0.805	<0.810	<0.813
Diethyl Sulfide	<0.805	<0.810	<0.813
n-Butyl Mercaptan	<0.805	**0.937**	**1.39**
Dimethyl Disulfide	**128**	**135**	**192**
2-Methylthiophene	**0.943**	**1.39**	**1.79**
3-Methylthiophene	<0.805	<0.810	<0.813
Tetrahydrothiophene	**7.01**	**9.47**	**13.1**
Bromothiophene	<0.805	<0.810	<0.813
Thiophenol	<0.805	<0.810	<0.813
Diethyl disulfide	**44.8**	**3.46**	**3.65**
Total Unidentified Sulfur	**12.8**	**10.8**	**13.1**
Total Reduced Sulfur	**1285**	**1107**	**1211**

Preliminary Results Notes:

H2S Reduction = 100%
Methyl Mercaptan Reduction = 100%
Dimethyl Sulfide Reduction = 0.2%
Dimethyl Disulfide Increase = 50%
TRS Reduction = 5.75%

TABLE 6. Sample Round 5 - Two Weeks after Bacteria Added

CLIENT ID	INLET ROUND 5	MIDDLE ROUND 5	OUTLET ROUND 5
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	**29.6**	<0.134	<0.133
Carbonyl Sulfide	**0.423**	**0.481**	**0.449**
Sulfur Dioxide	<0.134	<0.134	<0.133
Methyl Mercaptan	**221**	**0.185**	**0.327**
Ethyl Mercaptan	**1.44**	<0.134	<0.133
Dimethyl Sulfide	**902**	**755**	**630**
Carbon Disulfide	**0.788**	**0.755**	**0.793**
Isopropyl Mercaptan	**0.758**	<0.134	<0.133
tert-Butyl Mercaptan	<0.134	<0.134	<0.133
n-Propyl Mercaptan	**3.37**	**3.67**	**3.91**
Methylethylsulfide	<0.134	<0.134	<0.133
sec-Butyl Mercaptan	<0.134	<0.134	<0.133
Thiopene	<0.134	<0.134	<0.133
iso-Butyl Mercaptan	<0.134	<0.134	<0.133
Diethyl Sulfide	<0.134	<0.134	<0.133
n-Butyl Mercaptan	<0.134	**0.284**	**0.255**
Dimethyl Disulfide	**15.1**	**34.7**	**43.6**
2-Methylthiophene	**0.212**	**0.434**	**0.541**
3-Methylthiophene	<0.134	<0.134	<0.133
Tetrahydrothiophene	**0.731**	**1.55**	**1.93**
Bromothiophene	<0.134	<0.134	<0.133
Thiophenol	<0.134	<0.134	<0.133
Diethyl disulfide	**5.63**	**1.46**	<0.133
Total Unidentified Sulfur	**3.23**	**5.40**	**5.64**
Total Reduced Sulfur	**1,184**	**804**	**687**

Preliminary Results Notes:

H2S Reduction = 100%
Methyl Mercaptan Reduction = 99.9%
Dimethyl Sulfide Reduction = 30.2%
Dimethyl Disulfide Increase = 188.7%
TRS Reduction = 41.97%

TABLE 7. Sample Round 6 - Final Point after Restart of System

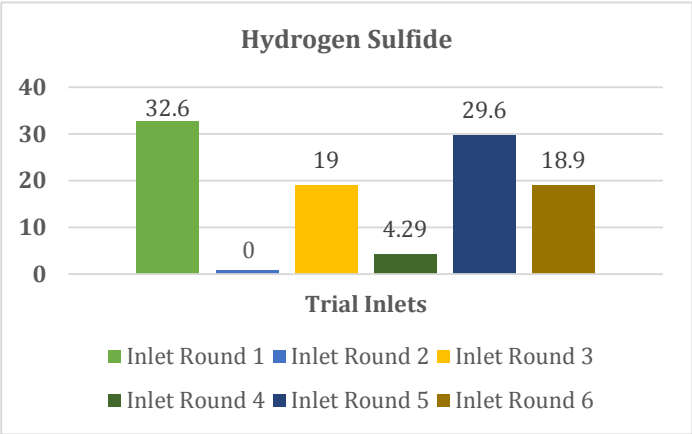
CLIENT ID	INLET ROUND 6	MIDDLE ROUND 6	OUTLET ROUND 6
ANALYTE	*RESULT*	*RESULT*	*RESULT*
Hydrogen Sulfide	**18.9**	< 0.085	< 0.082
Carbonyl Sulfide	**0.491**	**0.482**	**0.511**
Sulfur Dioxide	< 0.073	< 0.085	< 0.082
Methyl Mercaptan	**170**	**1.49**	< 0.082
Ethyl Mercaptan	**1.14**	< 0.085	< 0.082
Dimethyl Sulfide	**1050**	**955**	**911**
Carbon Disulfide	**1.13**	**1.03**	**1.19**
Isopropyl Mercaptan	**0.529**	< 0.085	< 0.082
tert-Butyl Mercaptan	**6.274**	**6.93**	**8.92**
n-Propyl Mercaptan	**4.34**	**4.22**	**5.24**
Methylethylsulfide	< 0.073	< 0.085	< 0.082
sec-Butyl Mercaptan	< 0.073	< 0.085	< 0.082
Thiopene	< 0.073	< 0.085	< 0.082
iso-Butyl Mercaptan	< 0.073	< 0.085	< 0.082
Diethyl Sulfide	< 0.073	< 0.085	< 0.082
n-Butyl Mercaptan	**0.436**	< 0.085	< 0.082
Dimethyl Disulfide	**42.4**	**69.8**	**105.7**
2-Methylthiophene	**0.642**	**0.685**	**0.924**
3-Methylthiophene	< 0.073	< 0.085	< 0.082
Tetrahydrothiophene	**3.27**	**3.89**	**5.50**
Bromothiophene	< 0.073	< 0.085	< 0.082
Thiophenol	< 0.073	< 0.085	< 0.082
Diethyl disulfide	< 0.073	< 0.085	< 0.082
Total Unidentified Sulfur	< 0.073	< 0.085	< 0.082
Total Reduced Sulfur	**1299**	**1043**	**1038**

Preliminary Results Notes:

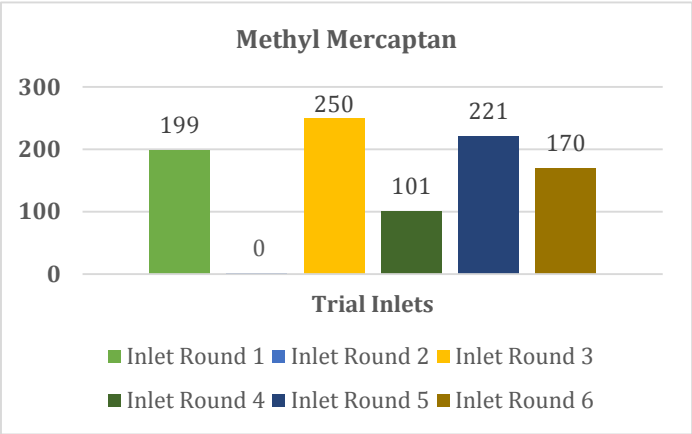
H2S Reduction = 100%
Methyl Mercaptan Reduction = 100%
Dimethyl Sulfide Reduction = 13.2%
Dimethyl Disulfide Increase = 149.3%
TRS Reduction = 20.1%

IV. GRAPHICAL ANALYSIS

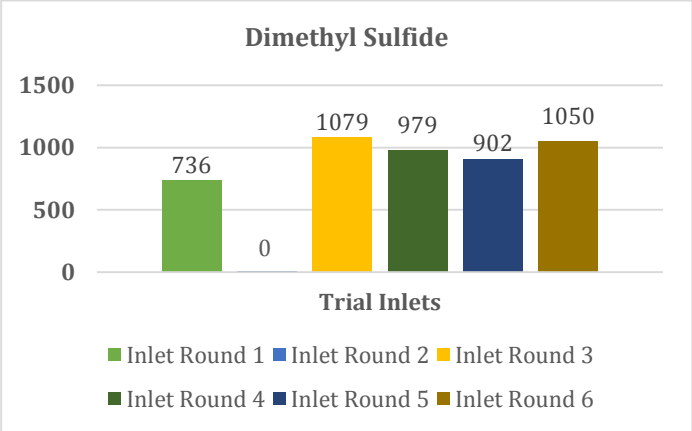
A. Variance in Inlet Concentrations



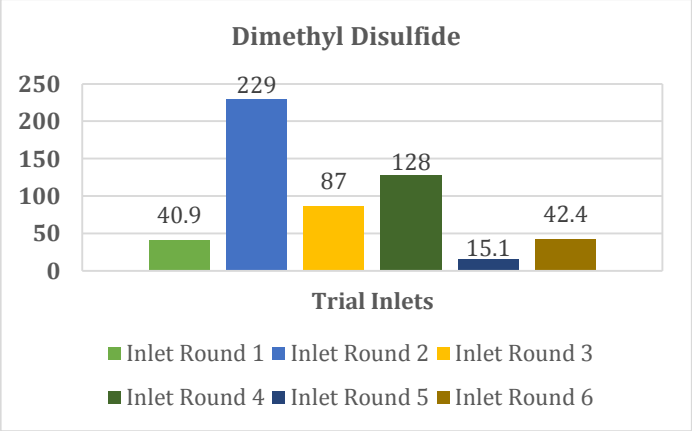
GRAPH 1. Hydrogen Sulfide (H_2S) Inlets



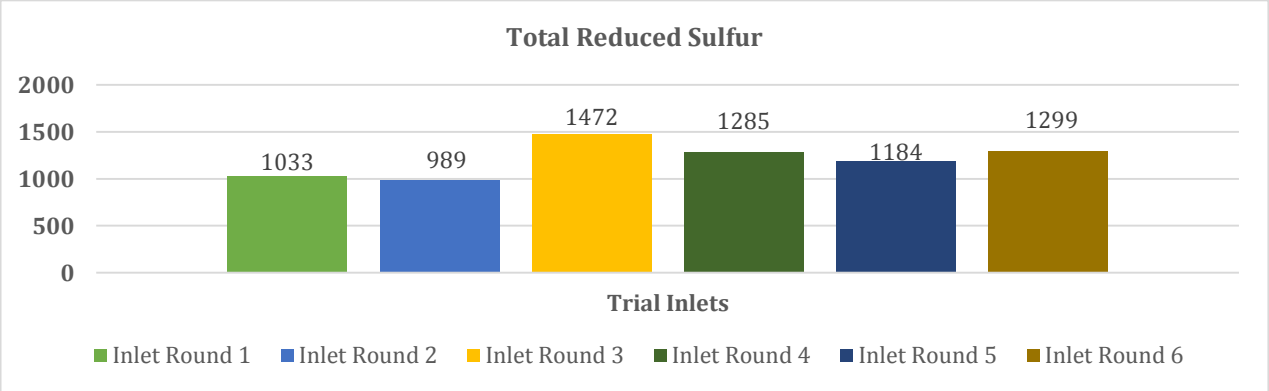
GRAPH 2. Methyl Mercaptan Inlets



GRAPH 3. Dimethyl Sulfide (DMS) Inlets

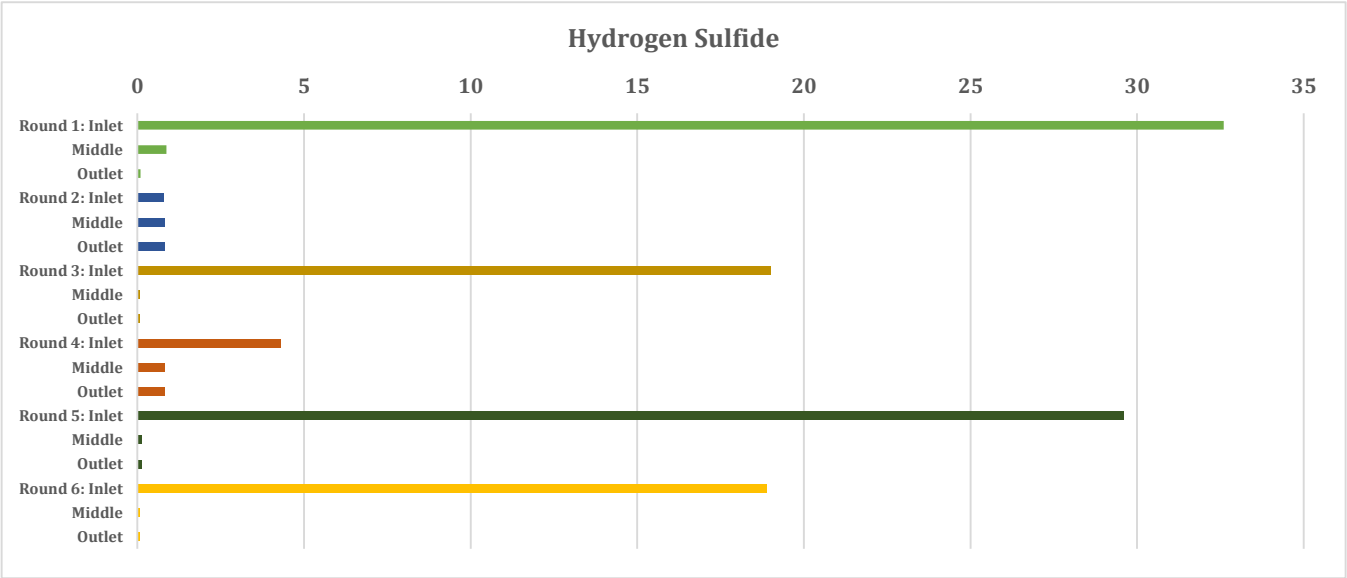


GRAPH 4. Dimethyl Disulfide (DMDS) Inlets

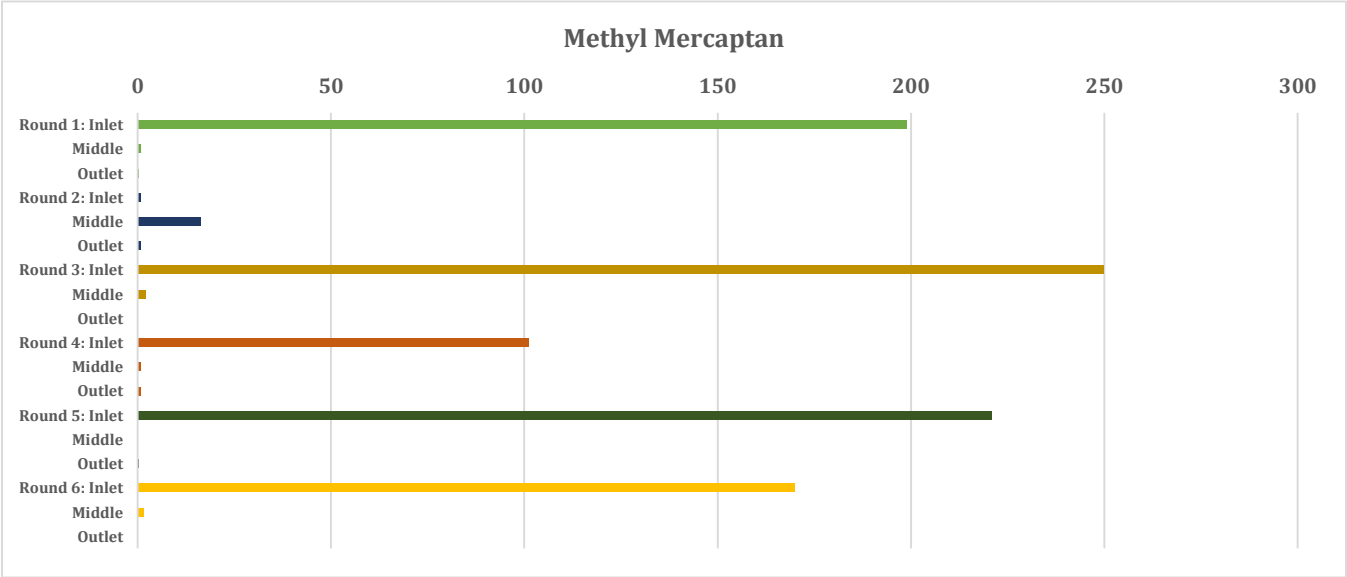


GRAPH 5. Total Reduced Sulfur Inlets

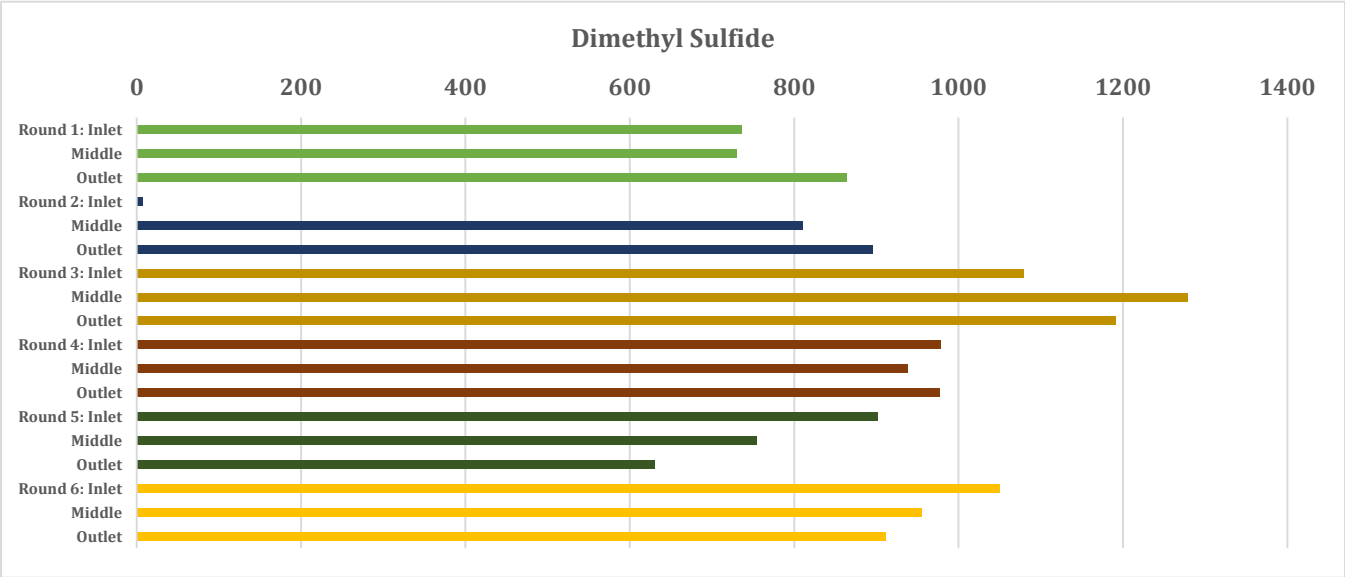
B. Inlet/Middle/Outlet Concentrations by Analyte



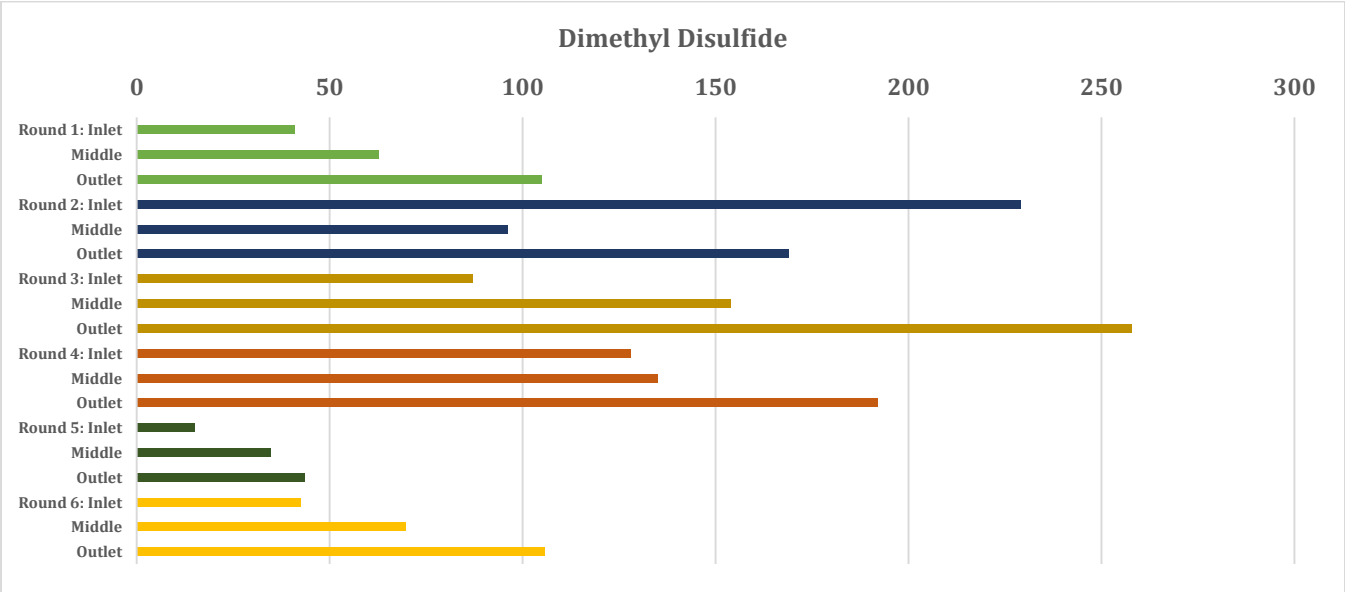
GRAPH 6. Hydrogen Sulfide (H_2S) Concentrations by Round



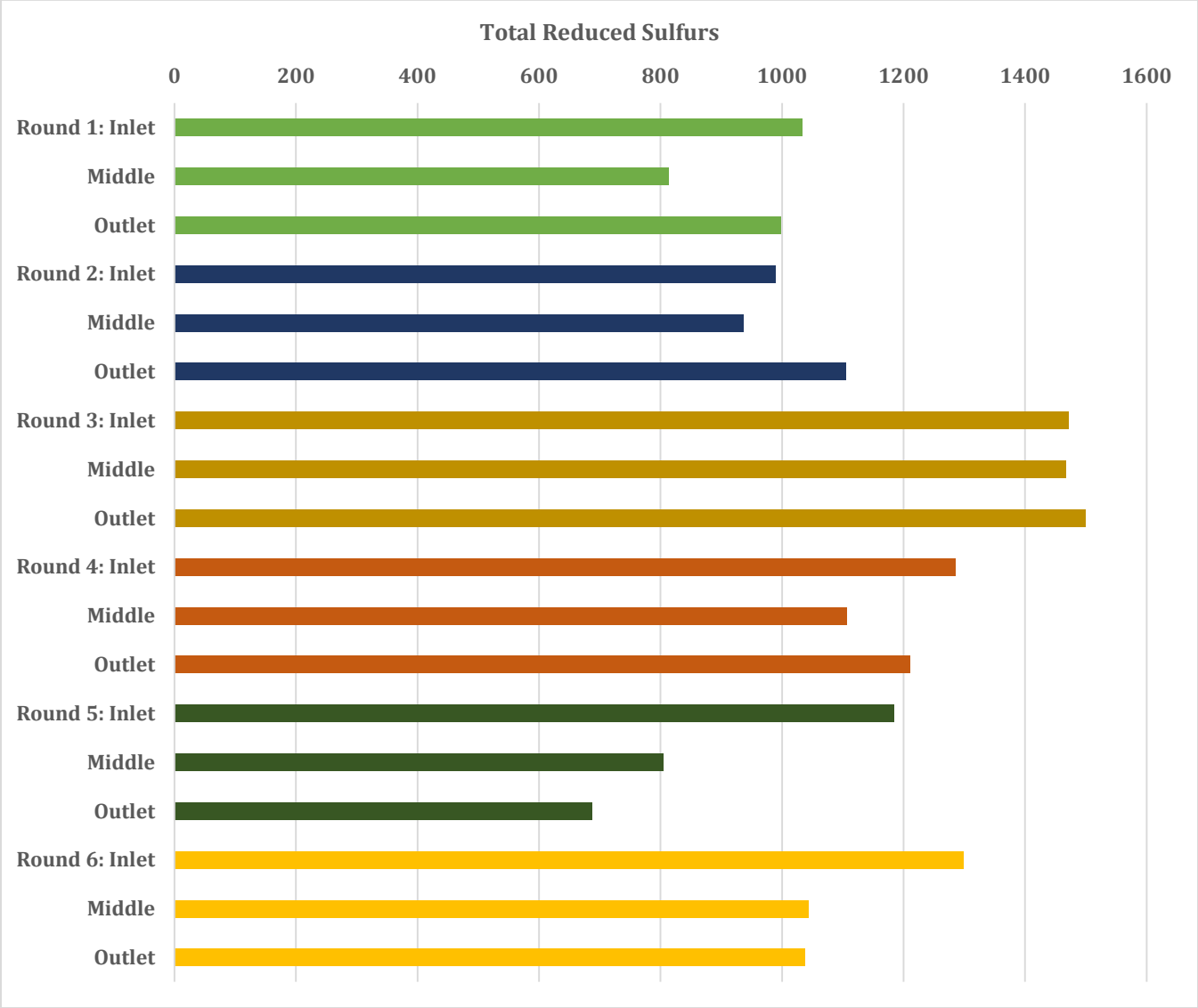
GRAPH 7. Methyl Mercaptan Concentrations by Round



GRAPH 8. Dimethyl Sulfide (DMS) Concentrations by Round



GRAPH 9. Dimethyl Disulfide (DMDS) Concentrations by Round



GRAPH 10. Total Reduced Sulfurs (TRS) Concentrations by Round

V. DISCUSSION

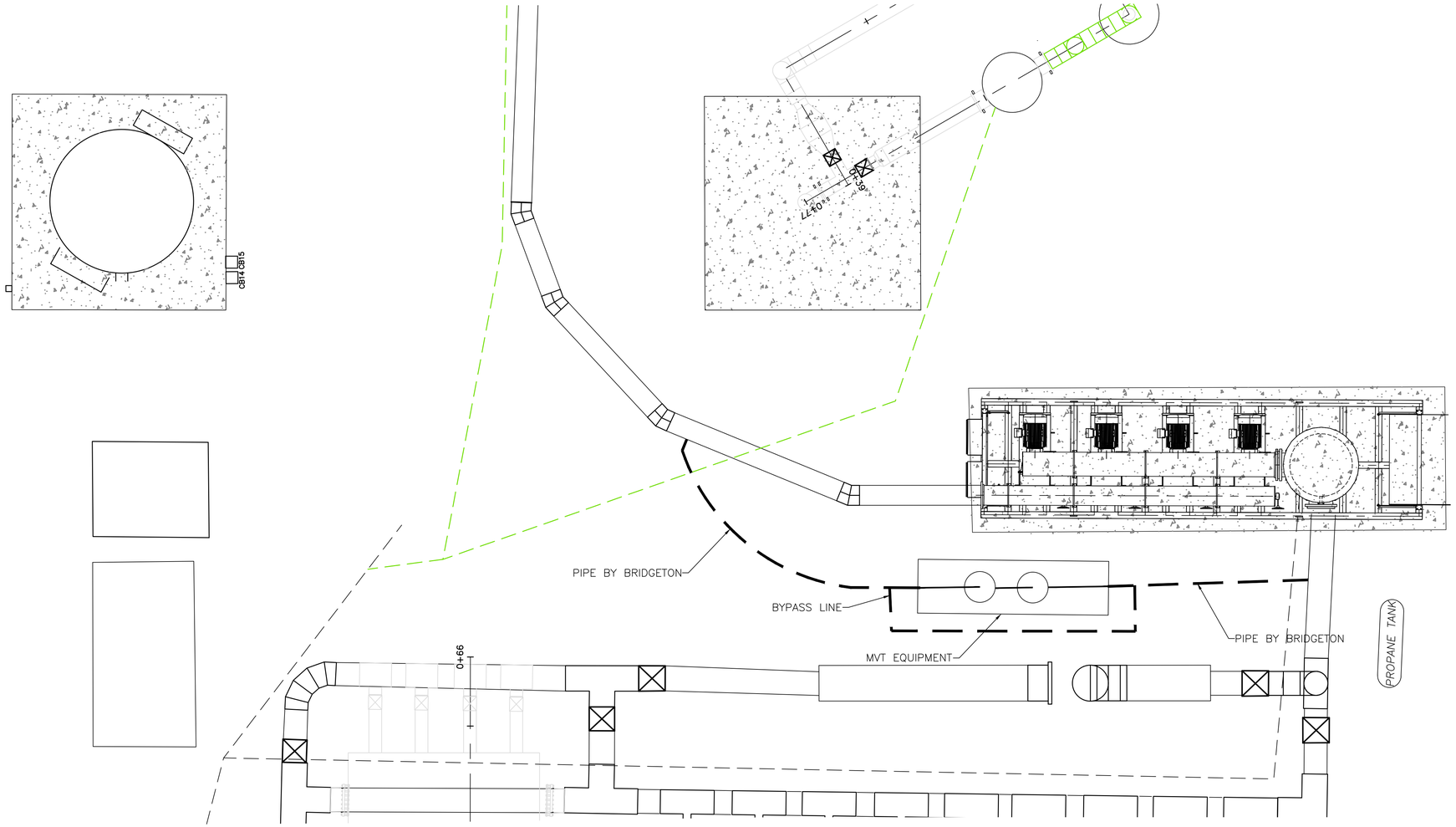
The pilot system, as designed and installed, worked well from a process standpoint. Gas flow was controllable, and very few mechanical problems were experienced. The total reduced sulfurs (TRS) across the various lab analyses showed a range of 11.73% increase to 41.97% reduction. There does appear a correlation with TRS and the bacteria addition. At the tested flow rates, the iron sponge does show effective reduction for hydrogen sulfide (H2S) and lighter mercaptans (methyl/ethyl). It appears that a decrease in dimethyl sulfide (DMS) appears as an increase in dimethyl disulfide (DMDS), a phenomena reported by other researchers. The addition of bacteria does correlate to a positive reduction in TRS, however, a final conclusion for this phenomena would require longer testing periods.

Picture 2. Pilot Study Installation at Bridgeton Landfill

APPENDICES
APPENDIX A: Pilot Unit Drawings
APPENDIX B: Gas Sample Analyses

APPENDIX A

Pilot Unit Drawings



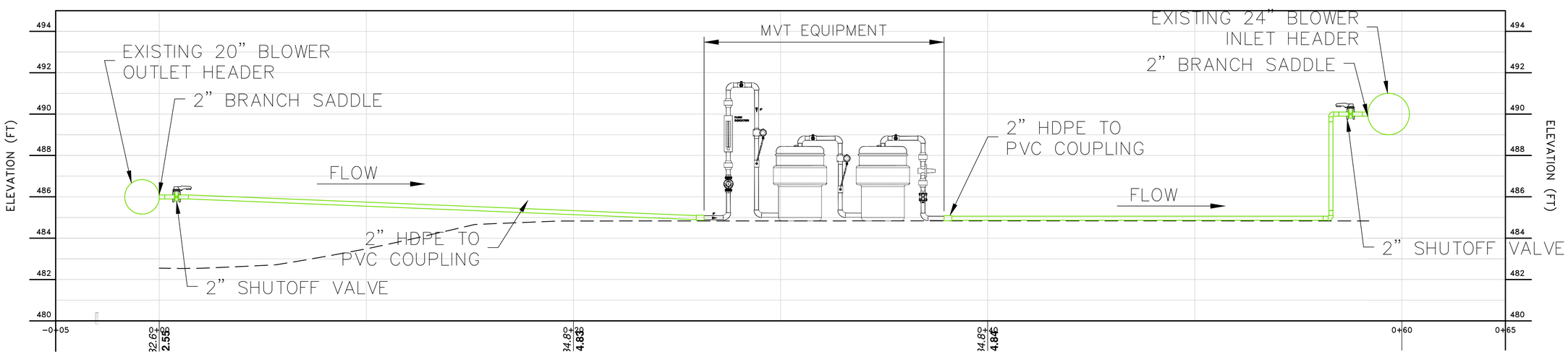
NOTES:
- ALL NEW PIPING TO BE HDPE SDR 26 (PE 4710)

LEGEND:

—OE—	EXISTING OVERHEAD ELECTRIC
	NEW HDPE PIPE
	DEMO HDPE PIPE AND COMPONENTS
	EXISTING HDPE PIPE
	EXISTING LFG PERIMETER HDPE HEADER (BURIED)
	EXISTING 2" HDPE DRAIN LINES
	VALVE
	HDPE TEE
	HDPE 22.5° ELBOW
	HDPE DOWNWARD FACING 90° ELBOW
	HDPE 90° ELBOW

5 0 5 10 15
SCALE: 1"=5'

LONGITUDINAL PROFILE Pilot Test Alignment



REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE: PLAN/PROFILE SHEET SECTION I-I (PROPOSED LINE TO ZINK FLARE)

PROJECT TITLE: BRIDGETON LANDFILL 2014 BLOWER/FLARE STATION MODIFICATIONS

CLIENT: BRIDGETON LANDFILL, LLC. 13570 ST. CHARLES ROCK ROAD BRIDGETON, MO 63044

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
2060 READING ROAD, SUITE #200, CINCINNATI, OHIO 45202
PH. (513) 421-5353 FAX NO. (513) 421-4847

PROJ. NO. 23211003.06 | DWN. BY: FDB | Q/A RVW BY: MSB | TASK BY: FDB | CHK. BY: MSB

CADD FILE: DraftEnclosed

DATE: 04/24/14

SCALE: AS SHOWN

DRAWING NO. 1 of 1

D:\WORK\23211003.17 BRIDGETON GCCS INFRASTRUCTURE ENGINEERING\DELIVERABLES\TASK 1 - PILOT STUDY\REPORT\BRIDGETON SCS AS-BUILT PILOT LAYOUT 10-14-14.DWG

APPENDIX B

Gas Sample Analyses

Atmospheric Analysis & Consulting, Inc.

CLIENT : SCS Tracer Environmental
PROJECT NAME : Republic Services - Bridgeton Landfill
AAC PROJECT NO. : 140465
REPORT DATE : 04/11/2014

On April 9, 2014, Atmospheric Analysis & Consulting, Inc. received one (1) Six-Liter Summa Canister for Volatile Organic Compounds analysis by EPA method TO-15. Upon receipt each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab ID	Return Pressure (mmHga)
CT-14 Grab Sample	140465-70143	600.4

An initial reading of each canister's vacuum was taken and recorded. Subsequently, each canister was brought to positive pressure using UHP-He and the final pressure was recorded.

TO-15 Analysis - Up to a 500 mL aliquot of sample is concentrated, put through a water and CO_2 management system, cryofocused and injected into the GC/MS (full scan mode) for analysis following EPA Method TO-15 as specified in the SOW.

No problems were encountered during receiving, preparation and/ or analysis of this sample. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# TO.15.10.

I certify that this data is technically accurate, complete and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized the release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

This report consists of 12 pages.

ACCREDITED IN ACCORDANCE WITH nelac Certificate#E87837

1534 Eastman Ave., Ste. A • Ventura, • CA 93003 www.aaclab.com • (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140465
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 04/09/2014
DATE REPORTED : 04/11/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	CT-14 Grab Sample			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140465-70143				
Date Sampled	04/07/2014				
Date Analyzed	04/10/2014				
Can Dilution Factor	1.71				
	Result	Qualifier	Analysis DF		
Chlorodifluoromethane	<SRL	U	100	86	0.5
Propene	116000		10000	17122	1.0
Dichlorodifluoromethane	<SRL	U	100	86	0.5
Chloromethane	15800		10000	8561	0.5
Dichlorotetrafluoroethane	<SRL	U	100	86	0.5
Vinyl Chloride	<SRL	U	100	86	0.5
Methanol	5400000		100000	856096	5.0
1,3-Butadiene	812		100	86	0.5
Bromomethane	<SRL	U	100	86	0.5
Chloroethane	2650		100	86	0.5
Dichlorofluoromethane	<SRL	U	100	86	0.5
Ethanol	582000		100000	342438	2.0
Vinyl Bromide	<SRL	U	100	86	0.5
Acetone	827000		100000	342438	2.0
Trichlorofluoromethane	<SRL	U	100	86	0.5
2-Propanol (IPA)	149000		10000	34244	2.0
Acrylonitrile	<SRL	U	100	171	1.0
1,1-Dichloroethene	<SRL	U	100	86	0.5
Methylene Chloride (DCM)	<SRL	U	100	171	1.0
Allyl Chloride	<SRL	U	100	86	0.5
Carbon Disulfide	795		100	86	0.5
Trichlorotrifluoroethane	<SRL	U	100	86	0.5
trans-1,2-Dichloroethene	<SRL	U	100	86	0.5
1,1-Dichloroethane	<SRL	U	100	86	0.5
Methyl Tert Butyl Ether (MTBE)	532		100	86	0.5
Vinyl Acetate	<SRL	U	100	171	1.0
2-Butanone (MEK)	457000		100000	171219	1.0
cis-1,2-Dichloroethene	<SRL	U	100	86	0.5
Hexane	2370		100	86	0.5
Chloroform	<SRL	U	100	86	0.5
Ethyl Acetate	53000		10000	8561	0.5
Tetrahydrofuran	311000		100000	85610	0.5
1,2-Dichloroethane	<SRL	U	100	86	0.5
1,1,1-Trichloroethane	<SRL	U	100	86	0.5

1534 Eastman Ave., Ste. A • Ventura, • CA 93003 www.aaclab.com • (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140465
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 04/09/2014
DATE REPORTED : 04/11/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	CT-14 Grab Sample			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140465-70143				
Date Sampled	04/07/2014				
Date Analyzed	04/10/2014				
Can Dilution Factor	1.71				
	Result	Qualifier	Analysis DF		
Benzene	341000		100000	85610	0.5
Carbon Tetrachloride	<SRL	U	100	86	0.5
Cyclohexane	861		100	86	0.5
1,2-Dichloropropane	<SRL	U	100	86	0.5
Bromodichloromethane	<SRL	U	100	86	0.5
1,4-Dioxane	4150		100	86	0.5
Trichloroethene (TCE)	<SRL	U	100	86	0.5
2,2,4-Trimethylpentane	939		100	86	0.5
Heptane	1790		100	86	0.5
cis-1,3-Dichloropropene	<SRL	U	100	86	0.5
4-Methyl-2-pentanone (MiBK)	12700		2500	2140	0.5
trans-1,3-Dichloropropene	<SRL	U	100	86	0.5
1,1,2-Trichloroethane	<SRL	U	100	86	0.5
Toluene	45400		2500	2140	0.5
2-Hexanone (MBK)	5520		100	86	0.5
Dibromochloromethane	<SRL	U	100	86	0.5
1,2-Dibromoethane	<SRL	U	100	86	0.5
Tetrachloroethene (PCE)	<SRL	U	100	86	0.5
Chlorobenzene	409		100	86	0.5
Ethylbenzene	11300		2500	2140	0.5
m & p-Xylenes	17400		2500	4281	1.0
Bromoform	<SRL	U	100	86	0.5
Styrene	<SRL	U	100	86	0.5
1,1,2,2-Tetrachloroethane	<SRL	U	100	86	0.5
o-Xylene	5560		2500	2140	0.5
4-Ethyltoluene	438		100	86	0.5
1,3,5-Trimethylbenzene	485		100	86	0.5
1,2,4-Trimethylbenzene	1030		100	86	0.5
Benzyl Chloride (a-Chlorotoluene)	<SRL	U	100	86	0.5
1,3-Dichlorobenzene	402		100	86	0.5
1,4-Dichlorobenzene	385		100	86	0.5
1,2-Dichlorobenzene	<SRL	U	100	86	0.5
1,2,4-Trichlorobenzene	<SRL	U	100	86	0.5
Hexachlorobutadiene	<SRL	U	100	86	0.5
BFB-Surrogate Std. % Recovery	100%				70-130%

U - Compound was analyzed for, but was not detected at or above the SRL.

Marcus Hueppe
Laboratoy Director

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT	: SCS Tracer Environmental	DATE RECEIVED	: 04/09/2014
PROJECT NO	: 140465	DATE REPORTED	: 04/11/2014
MATRIX	: AIR		
UNITS	: PPB (v/v)		

TENTATIVELY IDENTIFIED COMPOUNDS

Client ID	CT-14 Grab Sample	
AAC ID	140465-70143	
Date Sampled	04/07/2014	
Date Analyzed	04/10/2014	
Can Dilution Factor	1.71	
Compound	*PPB(V/V)*	*Spectra Identification Quality*
C4H8 Compound #1	36000	90
C4H8 Compound #2	22200	87
C4H8 Compound #3	19100	90
Methyl ester acetic acid	208000	86
1-Propanol	30200	78
2-Methyl-furan	151000	91
Methyl ester propanoic acid	112000	90
1-Butanol	104000	86
Tetrahydro-2-methyl-furan	19200	94
2-Pentanone	38300	90
2-Methyl-methyl ester propanoic acid	53200	91
3,5-Dimethylcyclopentene	33100	80
1,5-Dimethylcyclopentene	43900	83
Methyl ester butanoic acid	257000	90
3-Methyl-methyl ester butanoic acid	20900	91
2-Methyl-methyl ester butanoic acid	12600	50
Ethyl ester butanoic acid	30700	95
Unknown Compound #1	34500	NA
Unknown Compound #2	13900	NA
Methyl ester pentanoic acid	39800	53
BFB-Surrogate Std. % Recovery	100%	

Marcus Hueppe
Laboratoy Director

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Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 04/10/2014
ANALYST : JJG

INSTRUMENT ID : GC/MS-02
CALIBRATION STD ID : PS031714-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

Continuing Calibration Verification of the 01/17/2014 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC**
4-BFB (surrogate standard)	10.00	9.51	95
Chlorodifluoromethane	10.40	9.81	94
Propene	10.50	10.14	97
Dichlorodifluoromethane	10.10	9.40	93
Chloromethane	10.10	10.56	105
Dichlorotetrafluoroethane	10.30	10.33	100
Vinyl Chloride	10.30	10.48	102
Methanol	20.10	22.79	113
1,3-Butadiene	10.20	10.55	103
Bromomethane	10.00	9.58	96
Chloroethane	10.00	10.18	102
Dichlorofluoromethane	10.50	9.93	95
Ethanol	10.80	10.41	96
Vinyl Bromide	10.10	10.31	102
Acetone	10.40	9.63	93
Trichlorofluoromethane	10.50	11.20	107
2-Propanol (IPA)	11.00	11.68	106
Acrylonitrile	11.90	13.16	111
1,1-Dichloroethene	10.20	10.32	101
Methylene Chloride (DCM)	10.10	9.50	94
Allyl Chloride	10.50	9.82	94
Carbon Disulfide	10.20	9.73	95
Trichlorotrifluoroethane	9.90	9.73	98
trans-1,2-Dichloroethene	9.90	9.71	98
1,1-Dichloroethane	10.10	9.82	97
Methyl Tert Butyl Ether (MTBE)	10.20	9.94	97
Vinyl Acetate	11.00	11.10	101
2-Butanone (MEK)	10.30	10.19	99
cis-1,2-Dichloroethene	10.40	10.20	98
Hexane	10.20	9.78	96
Chloroform	9.90	9.22	93
Ethyl Acetate	9.90	9.73	98
Tetrahydrofuran	10.20	10.19	100
1,2-Dichloroethane	10.30	9.76	95
1,1,1-Trichloroethane	10.20	9.27	91

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Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 04/10/2014
ANALYST : JJG

INSTRUMENT ID : GC/MS-02
CALIBRATION STD ID : PS031714-02

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

Continuing Calibration Verification of the 01/17/2014 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC**
Benzene	10.40	10.09	97
Carbon Tetrachloride	10.30	9.87	96
Cyclohexane	10.30	10.50	102
1,2-Dichloropropane	10.40	10.65	102
Bromodichloromethane	10.30	9.96	97
1,4-Dioxane	10.30	9.45	92
Trichloroethene (TCE)	10.30	10.48	102
2,2,4-Trimethylpentane	10.40	10.68	103
Heptane	10.40	10.58	102
cis-1,3-Dichloropropene	10.90	10.97	101
4-Methyl-2-pentanone (MiBK)	10.10	10.41	103
trans-1,3-Dichloropropene	10.90	10.65	98
1,1,2-Trichloroethane	10.40	10.16	98
Toluene	10.60	10.71	101
2-Hexanone (MBK)	10.70	10.68	100
Dibromochloromethane	10.60	10.58	100
1,2-Dibromoethane	10.50	10.50	100
Tetrachloroethene (PCE)	10.20	10.56	104
Chlorobenzene	10.70	10.80	101
Ethylbenzene	10.60	10.39	98
m & p-Xylenes	20.60	20.59	100
Bromoform	10.30	9.88	96
Styrene	10.70	10.53	98
1,1,2,2-Tetrachloroethane	10.70	9.68	90
o-Xylene	10.70	10.00	93
4-Ethyltoluene	10.40	9.59	92
1,3,5-Trimethylbenzene	10.50	9.59	91
1,2,4-Trimethylbenzene	10.50	9.42	90
Benzyl Chloride (a-Chlorotoluene)	10.70	9.66	90
1,3-Dichlorobenzene	10.70	9.92	93
1,4-Dichlorobenzene	10.40	9.47	91
1,2-Dichlorobenzene	10.50	9.28	88
1,2,4-Trichlorobenzene	10.40	8.26	79
Hexachlorobutadiene	10.30	8.46	82

* - %REC should be 70-130%

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

CLIENT ID	: Laboratory Control Spike	DATE ANALYZED	: 04/10/2014
AAC ID	: LCS/LCSD	DATE REPORTED	: 04/10/2014
MEDIA	: Air	UNITS	: ppbv

TO-15 Laboratory Control Spike Recovery

Compound	Sample Conc.	Spike Added	Spike Res	Dup Spike Res	Spike % Rec *	Spike Dup % Rec *	RPD** %
1,1-Dichloroethene	0.0	10.20	10.32	9.90	101	97	4.2
Methylene Chloride (DCM)	0.0	10.10	9.50	9.87	94	98	3.8
Benzene	0.0	10.40	10.09	10.42	97	100	3.2
Trichloroethene (TCE)	0.0	10.30	10.48	10.58	102	103	0.9
Toluene	0.0	10.60	10.71	11.00	101	104	2.7
Tetrachloroethene (PCE)	0.0	10.20	10.56	10.82	104	106	2.4
Chlorobenzene	0.0	10.70	10.80	10.60	101	99	1.9
Ethylbenzene	0.0	10.60	10.39	10.47	98	99	0.8
m & p-Xylenes	0.0	20.60	20.59	20.64	100	100	0.2
o-Xylene	0.0	10.70	10.00	10.10	93	94	1.0

* Must be 70-130%

** Must be < 25%

Marcus Hueppe
Laboratory Director

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Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 04/10/2014
UNITS	: ppbv	REPORT DATE	: 04/10/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	Method Blank	RL
AAC ID	MB 041014	
Chlorodifluoromethane	<RL	0.5
Propene	<RL	1.0
Dichlorodifluoromethane	<RL	0.5
Chloromethane	<RL	0.5
Dichlorotetrafluoroethane	<RL	0.5
Vinyl Chloride	<RL	0.5
Methanol	<RL	5.0
1,3-Butadiene	<RL	0.5
Bromomethane	<RL	0.5
Chloroethane	<RL	0.5
Dichlorofluoromethane	<RL	0.5
Ethanol	<RL	2.0
Vinyl Bromide	<RL	0.5
Acetone	<RL	2.0
Trichlorofluoromethane	<RL	0.5
2-Propanol (IPA)	<RL	2.0
Acrylonitrile	<RL	1.0
1,1-Dichloroethene	<RL	0.5
Methylene Chloride (DCM)	<RL	1.0
Allyl Chloride	<RL	0.5
Carbon Disulfide	<RL	0.5
Trichlorotrifluoroethane	<RL	0.5
trans-1,2-Dichloroethene	<RL	0.5
1,1-Dichloroethane	<RL	0.5
Methyl Tert Butyl Ether (MTBE)	<RL	0.5
Vinyl Acetate	<RL	1.0
2-Butanone (MEK)	<RL	1.0
cis-1,2-Dichloroethene	<RL	0.5
Hexane	<RL	0.5
Chloroform	<RL	0.5
Ethyl Acetate	<RL	0.5
Tetrahydrofuran	<RL	0.5
1,2-Dichloroethane	<RL	0.5
1,1,1-Trichloroethane	<RL	0.5
Benzene	<RL	0.5
Carbon Tetrachloride	<RL	0.5
Cyclohexane	<RL	0.5
1,2-Dichloropropane	<RL	0.5
Bromodichloromethane	<RL	0.5
1,4-Dioxane	<RL	0.5
Trichloroethene (TCE)	<RL	0.5
2,2,4-Trimethylpentane	<RL	0.5
Heptane	<RL	0.5

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Method Blank Analysis Report

MATRIX	: AIR	ANALYSIS DATE	: 04/10/2014
UNITS	: ppbv	REPORT DATE	: 04/10/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank / MB 041014	RL
cis-1,3-Dichloropropene	<RL	0.5
4-Methyl-2-pentanone (MiBK)	<RL	0.5
trans-1,3-Dichloropropene	<RL	0.5
1,1,2-Trichloroethane	<RL	0.5
Toluene	<RL	0.5
2-Hexanone (MBK)	<RL	0.5
Dibromochloromethane	<RL	0.5
1,2-Dibromoethane	<RL	0.5
Tetrachloroethene (PCE)	<RL	0.5
Chlorobenzene	<RL	0.5
Ethylbenzene	<RL	0.5
m & p-Xylenes	<RL	1.0
Bromoform	<RL	0.5
Styrene	<RL	0.5
1,1,2,2-Tetrachloroethane	<RL	0.5
o-Xylene	<RL	0.5
4-Ethyltoluene	<RL	0.5
1,3,5-Trimethylbenzene	<RL	0.5
1,2,4-Trimethylbenzene	<RL	0.5
Benzyl Chloride (a-Chlorotoluene)	<RL	0.5
1,3-Dichlorobenzene	<RL	0.5
1,4-Dichlorobenzene	<RL	0.5
1,2-Dichlorobenzene	<RL	0.5
1,2,4-Trichlorobenzene	<RL	0.5
Hexachlorobutadiene	<RL	0.5
System Monitoring Compounds		
BFB-Surrogate Std. % Recovery	95%	--

RL - Reporting Limit

Marcus Hueppe
Laboratory Director

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Quality Control/Quality Assurance Report

AAC ID	: 140465-70143	DATE ANALYZED	: 04/10/2014
MATRIX	: Air	DATE REPORTED	: 04/11/2014
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Chlorodifluoromethane	<SRL	<SRL	0.0
Propene	<SRL	<SRL	0.0
Dichlorodifluoromethane	<SRL	<SRL	0.0
Chloromethane	<SRL	<SRL	0.0
Dichlorotetrafluoroethane	<SRL	<SRL	0.0
Vinyl Chloride	<SRL	<SRL	0.0
Methanol	5400000	5200000	3.8
1,3-Butadiene	<SRL	<SRL	0.0
Bromomethane	<SRL	<SRL	0.0
Chloroethane	<SRL	<SRL	0.0
Dichlorofluoromethane	<SRL	<SRL	0.0
Ethanol	582000	599000	2.9
Vinyl Bromide	<SRL	<SRL	0.0
Acetone	827000	836000	1.1
Trichlorofluoromethane	<SRL	<SRL	0.0
2-Propanol (IPA)	<SRL	<SRL	0.0
Acrylonitrile	<SRL	<SRL	0.0
1,1-Dichloroethene	<SRL	<SRL	0.0
Methylene Chloride (DCM)	<SRL	<SRL	0.0
Allyl Chloride	<SRL	<SRL	0.0
Carbon Disulfide	<SRL	<SRL	0.0
Trichlorotrifluoroethane	<SRL	<SRL	0.0
trans-1,2-Dichloroethene	<SRL	<SRL	0.0
1,1-Dichloroethane	<SRL	<SRL	0.0
Methyl Tert Butyl Ether (MTBE)	<SRL	<SRL	0.0
Vinyl Acetate	<SRL	<SRL	0.0
2-Butanone (MEK)	457000	444000	2.9
cis-1,2-Dichloroethene	<SRL	<SRL	0.0
Hexane	<SRL	<SRL	0.0
Chloroform	<SRL	<SRL	0.0
Ethyl Acetate	<SRL	<SRL	0.0
Tetrahydrofuran	311000	300000	3.6
1,2-Dichloroethane	<SRL	<SRL	0.0
1,1,1-Trichloroethane	<SRL	<SRL	0.0
Benzene	341000	347000	1.7
Carbon Tetrachloride	<SRL	<SRL	0.0

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

AAC ID	**: 140465-70143**	**DATE ANALYZED**	**: 04/10/2014**
MATRIX	**: Air**	**DATE REPORTED**	**: 04/11/2014**
		UNITS	**: ppbv**

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Cyclohexane	<SRL	<SRL	0.0
1,2-Dichloropropane	<SRL	<SRL	0.0
Bromodichloromethane	<SRL	<SRL	0.0
1,4-Dioxane	<SRL	<SRL	0.0
Trichloroethene (TCE)	<SRL	<SRL	0.0
2,2,4-Trimethylpentane	<SRL	<SRL	0.0
Heptane	<SRL	<SRL	0.0
cis-1,3-Dichloropropene	<SRL	<SRL	0.0
4-Methyl-2-pentanone (MiBK)	<SRL	<SRL	0.0
trans-1,3-Dichloropropene	<SRL	<SRL	0.0
1,1,2-Trichloroethane	<SRL	<SRL	0.0
Toluene	<SRL	<SRL	0.0
2-Hexanone (MBK)	<SRL	<SRL	0.0
Dibromochloromethane	<SRL	<SRL	0.0
1,2-Dibromoethane	<SRL	<SRL	0.0
Tetrachloroethene (PCE)	<SRL	<SRL	0.0
Chlorobenzene	<SRL	<SRL	0.0
Ethylbenzene	<SRL	<SRL	0.0
m & p-Xylenes	<SRL	<SRL	0.0
Bromoform	<SRL	<SRL	0.0
Styrene	<SRL	<SRL	0.0
1,1,2,2-Tetrachloroethane	<SRL	<SRL	0.0
o-Xylene	<SRL	<SRL	0.0
4-Ethyltoluene	<SRL	<SRL	0.0
1,3,5-Trimethylbenzene	<SRL	<SRL	0.0
1,2,4-Trimethylbenzene	<SRL	<SRL	0.0
Benzyl Chloride (a-Chlorotoluene)	<SRL	<SRL	0.0
1,3-Dichlorobenzene	<SRL	<SRL	0.0
1,4-Dichlorobenzene	<SRL	<SRL	0.0
1,2-Dichlorobenzene	<SRL	<SRL	0.0
1,2,4-Trichlorobenzene	<SRL	<SRL	0.0
Hexachlorobutadiene	<SRL	<SRL	0.0
System Monitoring Compounds			
BFB-Surrogate Std. % Recovery	98%	99%	0.5

SRL - Sample Reporting Limit

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
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E-mail: info@aaclab.com

AAC Project No. 140465

Page 1 of 1

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: REPUBLIC SERVICES

Project Name: BRIDGETON LANDFILL

Project Mgr (Print Name): MIKE LAMBRICH

Project Number:

Sampler's Name (Print Name): MIKE LAMBRICH

Sampler's Signature: [signature]

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	3C/ASTM1945	ASTM D5504	TO-14A/15	TO-8		
70143	4/7/14	12:17	Gas	CT-14 GRAB SAMPLE	Summa 1	X	X	X	X		

Analysis Requested

Send report:

Attn:

Phone#:

Fax#

Send invoice to:

Attn:

P.O. #

Turnaround Time

24-Hr ____ 48-Hr ____

5 Day ____ Normal ____

Other (Specify) ____

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
[signature]	MIKE LAMBRICH	4/7/14 @ 12:48	F. Daniel Brennan	F. Daniel Brennan
F. Daniel Brennan	F. Daniel Brennan	4/9/14 0940	[signature]	John Zackman

FedEx

Atmospheric Analysis & Consulting, Inc.

CLIENT : SCS Tracer Environmental
PROJECT NAME : Republic Services
AAC PROJECT NO. : 140465
REPORT DATE : 4/10/2014

On April 9, 2014, Atmospheric Analysis & Consulting, Inc. received one (1) Six-Liter Summa Canister for ASTM D-1945 analysis and TRS analysis by ASTM D-5504. Upon receipt, the sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
CT-14 Grab Sample	140465-70143	600.4

ASTM D-1945 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/FID/TCD for analysis following ASTM D-1945 as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of this sample. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-ASTM D-1945 and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

This report consists of 7 pages.

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Tracer Environmental**
PROJECT NO. : **140465**
MATRIX : **Air**

SAMPLING DATE : **04/07/2014**
RECEIVING DATE : **04/09/2014**
ANALYSIS DATE : **04/09/2014**
REPORT DATE : **04/10/2014**

ASTM D-1945

Client ID	CT-14 Grab Sample
AAC ID	140465-70143
Can Dilution Factor	1.71
Analyte	Result
H_2	9.2 %
O_2	7.6 %
N_2	30.9 %
CO	< 0.2 %
CO_2	41.4 %
CH_4	10.2 %
C_2 (as Ethane)	110 ppmV
C_3 (as Propane)	123 ppmV
C_4 (as Butane)	805 ppmV
C_5 (as Pentane)	918 ppmV
C_6 (as Hexane)	879 ppmV
C_6+ (as Hexane)	2,218 ppmV

Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac (if applicable)

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT	**: SCS Tracer Environmental**	**SAMPLING DATE**	**: 04/07/2014**
PROJECT NO.	**: 140465**	**RECEIVING DATI**	**: 04/09/2014**
MATRIX	**: Air**	**ANALYSIS DATE**	**: 04/10/2014**
UNITS	**: ppmV**	**REPORT DATE**	**: 04/10/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**CT-14 Grab Sample**
AAC ID	**140465-70143**
Can Dilution Factor	**1.7**
Analyte	**Result**
Hydrogen Sulfide	**39.5 ppmv**
Carbonyl Sulfide	**0.600 ppmv**
Sulfur Dioxide	< 0.086 ppmv
Methyl Mercaptan	**263 ppmv**
Ethyl Mercaptan	**2.48 ppmv**
Dimethyl Sulfide	**1,048 ppmv**
Carbon Disulfide	**0.853 ppmv**
Isopropyl Mercaptan	**1.20 ppmv**
tert-Butyl Mercaptan	**0.223 ppmv**
n-Propyl Mercaptan	< 0.086 ppmv
Methylethylsulfide	**7.34 ppmv**
sec-Butyl Mercaptan	< 0.086 ppmv
Thiophene	< 0.086 ppmv
iso-Butyl Mercaptan	**15.4 ppmv**
Diethyl Sulfide	**0.954 ppmv**
n-Butyl Mercaptan	**2.35 ppmv**
Dimethyl Disulfide	**108 ppmv**
2-Methylthiophene	< 0.086 ppmv
3-Methylthiophene	< 0.086 ppmv
Tetrahydrothiophene	**15.560 ppmv**
Bromothiophene	< 0.086 ppmv
Thiophenol	< 0.086 ppmv
Diethyl disulfide	**1.065 ppmv**
Total Unidentified Sulfur	**17.7 ppmv**
Total Reduced Sulfurs as H_2S	**1,524 ppmv**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 04/09/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 04/13/2012
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	Result	10.5	10.7	21.9	10.0	9.8	10.2
	% Rec *	102.7	102.1	111.8	97.3	98.9	98.7

II - Method Blank - ASTM D-1945/1946

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	LCS Result	10.8	10.4	21.8	9.8	9.6	10.0
	LCSD Result	9.9	10.4	21.4	9.7	9.7	10.1
	LCS % Rec *	105.7	99.8	111.1	95.5	96.2	96.8
	LCSD % Rec *	96.4	99.9	109.3	95.0	97.3	97.9
	% RPD ***	9.2	0.0	1.7	0.5	1.1	1.2

IV - Sample & Sample Duplicate - ASTM D-1945/1946

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
140465-70143	Sample	5.0	4.0	16.3	21.9	5.3	0.0
	Sample Dup	5.1	4.3	17.6	23.6	5.9	0.0
	Mean	5.1	4.2	17.0	22.7	5.6	0.0
	% RPD ***	2.4	7.9	8.1	7.1	9.6	0.0

V - Matrix Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
140465-70143	Sample Conc	2.5	8.5	11.4	2.8	0.0
	Spike Conc	10.3	9.2	10.3	9.9	10.3
	MS Result	13.8	19.4	20.9	13.2	10.8
	MSD Result	14.3	19.3	20.5	13.3	11.0
	MS % Rec **	110.1	118.3	93.0	104.6	104.6
	MSD % Rec **	114.5	117.4	89.0	105.6	106.4
	% RPD ***	3.9	0.8	4.5	1.0	1.7

VI - Closing Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	Result	10.6	10.1	20.2	9.8	9.7	10.1
	% Rec *	103.1	96.2	102.9	95.5	97.4	98.1

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 04/09/2014
Analyst : DJ
Units : ppmv

Instrument ID : FID #3
Calb Date : 01/28/14
Reporting Limit : 0.5 ppmv

I - Opening Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
CCV	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	Result	110.5	105.7	106.1	106.6	107.5	104.4
	% Rec *	103.7	104.1	104.4	104.2	103.8	103.1

II - Method Blank - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	LCS Result	109.9	105.1	106.3	106.8	107.7	104.4
	LCSD Result	107.8	102.0	104.0	105.5	106.5	103.4
	LCS % Rec *	103.1	103.6	104.7	104.4	104.1	103.2
	LCSD % Rec *	101.1	100.5	102.4	103.2	102.9	102.1
	% RPD ***	2.0	3.0	2.2	1.2	1.1	1.0

IV - Sample & Sample Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
140465-70143	Sample	NA	30.2	16.2	17.5	2.2	13.0
	Sample Dup	NA	29.0	16.7	17.2	2.1	13.0
	Mean	NA	29.6	16.4	17.4	2.2	13.0
	% RPD ***	NA	3.9	3.0	1.8	3.3	0.0

V - Matrix Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
140465-70143	Sample Conc	NA	14.8	8.2	8.7	1.1	6.5
	Spike Conc	NA	50.7	50.8	51.2	51.8	50.6
	MS Result	NA	69.6	54.5	55.9	48.4	52.3
	MSD Result	NA	64.7	53.4	54.9	48.0	51.4
	MS % Rec **	NA	108.0	91.1	92.3	91.4	90.5
	MSD % Rec **	NA	98.3	89.1	90.3	90.6	88.7
	% RPD ***	NA	9.4	2.3	2.1	0.9	2.0

VI - Closing Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
CCV	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	Result	107.1	101.3	102.6	103.5	104.3	101.4
	% Rec *	100.5	99.8	101.0	101.2	100.8	100.2

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

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Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 4/10/2014
Analyst: ZG

Instrument ID: SCD#10
Calb. Date: 1/27/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppbV)	% Rec *	% RPD ****
Initial	14746	491	98.2	NA
Duplicate	14760	492	98.3	0.1
Triplicate	14837	494	98.9	0.6

Method Blank

Analyte	Result
H2S	ND

Matrix Spike & Duplicate Sample ID 140469-70152

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.0	250.0	245.7	242.2	98.3	96.9	1.4

Duplicate Analysis Sample ID 140469-70152

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.0	0.0	0.0	0.0

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result (ppbV)	% Rec **
H2S	500.0	460.6	92.1

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** Must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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AAC Project No. 140465

Page 1 of 1

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: REPUBLIC SERVICES

Project Name: BRIDGETON LANDFILL

Project Mgr (Print Name): MIKE LAMBRICH

Project Number:

Sampler's Name (Print Name): MIKE LAMBRICH

Sampler's Signature: [signature]

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	3C/ASTM1945	ASTM D5504	TO-14A/15	TO-8		
70143	4/7/14	12:17	Gas	CT-14 GRAB SAMPLE	Summa 1	X	X	X	X		

Analysis Requested

Send report:

Attn:

Phone#:

Fax#

Send invoice to:

Attn:

P.O. #

Turnaround Time

24-Hr ____ 48-Hr ____

5 Day ____ Normal ____

Other (Specify) ____

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
[signature]	MIKE LAMBRICH	4/7/14 @ 12:48	F. Daniel Brennan	F. Daniel Brennan
F. Daniel Brennan	F. Daniel Brennan	4/9/14 0840	[signature]	John Zachman

FedEx

Atmospheric Analysis & Consulting, Inc.

CLIENT : SCS Tracer Environmental
PROJECT NAME : Republic Services - Bridgeton LF
PROJECT NUMBER : 23211003.06 Task 2
AAC PROJECT NO. : 140762
REPORT DATE : 05/21/2014

On May 16, 2014, Atmospheric Analysis & Consulting, Inc. received six (6) Six-Liter Summa Canisters for Volatile Organic Compounds analysis by EPA method TO-15. Upon receipt each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab ID	Return Pressure (mmHga)
BLIN	140762-71044	652.6
ECSIN	140762-71045	661.5
GEW 27A	140762-71046	657.1
GEW 22R	140762-71047	647.8
GEW 90	140762-71048	644.6
SCD 9	140762-71049	644.4

An initial reading of each canister's vacuum was taken and recorded. Subsequently, each canister was brought to positive pressure using UHP-He and the final pressure was recorded.

TO-15 Analysis - Up to a 500 mL aliquot of sample is concentrated, put through a water and CO_2 management system, cryofocused and injected into the GC/MS (full scan mode) for analysis following EPA Method TO-15 as specified in the SOW.

No Phenols or Creosols were detected by TIC search results in any of these samples.

No problems were encountered during receiving, preparation and/ or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# TO.15.10.

I certify that this data is technically accurate, complete and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized the release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

This report consists of 15 pages.

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

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Atmospheric Analysis & Consulting, Inc.

CLIENT	: SCS Tracer Environmental
PROJECT NAME	: Bridgeton LF
PROJECT NO.	: 23211003.06 Task 2
AAC PROJECT NO.	: 140762
REPORT DATE	: 5/23/2014

On May 16, 2014, Atmospheric Analysis & Consulting, Inc. received six (6) Six-Liter Summa Canisters for TRS analysis by ASTM D-5504 and ASTM D-1945 analysis. Upon receipt, the samples were assigned unique Laboratory ID numbers as follows:

Client ID	Lab No.	Initial Pressure
BLIN	140762-71044	652.6
ECSIN	140762-71045	661.5
GEW 27A	140762-71046	657.1
GEW 22R	140762-71047	647.8
GEW 90	140762-71048	644.6
SCD 9	140762-71049	644.4

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

ASTM D-1945 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/FID/TCD for analysis following ASTM D-1945 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-ASTM D-5504 and ASTM D-1945.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Sucha S. Parmar,Ph.D.
Technical Director

This report consists of 8 pages.

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT	**: SCS Tracer Environmental**	**SAMPLING DATE**	**: 05/15/2014**
PROJECT NO.	**: 140762**	**RECEIVING DATE**	**: 05/16/2014**
MATRIX	**: Air**	**ANALYSIS DATE**	**: 05/21-22/2014**
UNITS	**: ppmV**	**REPORT DATE**	**: 05/23/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**BLIN**	**ECSIN**	**GEW 27A**	**GEW 22R**	**GEW 90**	**SCD 9**
AAC ID	**140762-71044**	**140762-71045**	**140762-71046**	**140762-71047**	**140762-71048**	**140762-71049**
Canister Dil. Fac.	**1.6**	**1.5**	**1.6**	**1.6**	**1.6**	**1.6**
Analyte	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Hydrogen Sulfide	**11.5 ppmv**	**24.8 ppmv**	< 0.156 ppmv	**60.4 ppmv**	< 0.158 ppmv	< 0.158 ppmv
Carbonyl Sulfide	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Sulfur Dioxide	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Methyl Mercaptan	**0.668 ppmv**	**1.03 ppmv**	< 0.156 ppmv	**0.173 ppmv**	< 0.158 ppmv	< 0.158 ppmv
Ethyl Mercaptan	**187 ppmv**	**275 ppmv**	**63.4 ppmv**	**216 ppmv**	**216 ppmv**	**9.29 ppmv**
Dimethyl Sulfide	**1,095 ppmv**	**1,056 ppmv**	**1,487 ppmv**	**1,318 ppmv**	**627 ppmv**	**841 ppmv**
Carbon Disulfide	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Isopropyl Mercaptan	**8.31 ppmv**	**9.25 ppmv**	**9.05 ppmv**	**11.4 ppmv**	**5.90 ppmv**	**10.8 ppmv**
tert-Butyl Mercaptan	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
n-Propyl Mercaptan	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Methylethylsulfide	**15.6 ppmv**	**14.5 ppmv**	**11.7 ppmv**	**14.8 ppmv**	**11.0 ppmv**	**19.4 ppmv**
sec-Butyl Mercaptan	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Thiophene	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	**2.71 ppmv**	< 0.158 ppmv	< 0.158 ppmv
iso-Butyl Mercaptan	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Diethyl Sulfide	**139 ppmv**	**115 ppmv**	**36.6 ppmv**	**14.6 ppmv**	**215 ppmv**	**441 ppmv**
n-Butyl Mercaptan	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	**2.70 ppmv**	< 0.158 ppmv	< 0.158 ppmv
Dimethyl Disulfide	**20.3 ppmv**	**17.7 ppmv**	**12.0 ppmv**	**17.6 ppmv**	**19.2 ppmv**	**24.0 ppmv**
2-Methylthiophene	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
3-Methylthiophene	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Tetrahydrothiophene	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	**3.48 ppmv**	< 0.158 ppmv	< 0.158 ppmv
Bromothiophene	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Thiophenol	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Diethyl disulfide	< 0.157 ppmv	< 0.153 ppmv	< 0.156 ppmv	< 0.158 ppmv	< 0.158 ppmv	< 0.158 ppmv
Total Unidentified Sulfur	**31.1 ppmv**	**18.7 ppmv**	**8.92 ppmv**	**4.90 ppmv**	**24.8 ppmv**	**30.2 ppmv**
Total Reduced Sulfurs as H_2S	**1,509 ppmv**	**1,532 ppmv**	**1,628 ppmv**	**1,666 ppmv**	**1,119 ppmv**	**1,375 ppmv**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Sucha S. Parmar, Ph.D.
Technical Director

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO. : 140762
MATRIX : Air

SAMPLING DATE : 05/15/2014
RECEIVING DATE : 05/16/2014
ANALYSIS DATE : 05/20/2014
REPORT DATE : 05/23/2014

ASTM D-1945

Client ID	BLIN	ECSIN	GEW 27A
AAC ID	140762-71044	140762-71045	140762-71046
Can Dilution Factor	1.57	1.53	1.56
Analyte	Result	Result	Result
H_2	10.5 %	13.3 %	31.1 %
O_2	6.2 %	4.4 %	1.2 %
N_2	27.4 %	18.2 %	4.1 %
CO	0.1 %	0.2 %	0.5 %
CO_2	43.4 %	54.1 %	61.8 %
CH_4	11.9 %	9.1 %	0.4 %
C_2 (as Ethane)	113 ppmV	141 ppmV	265 ppmV
C_3 (as Propane)	116 ppmV	149 ppmV	251 ppmV
C_4 (as Butane)	824 ppmV	1,123 ppmV	1,858 ppmV
C_5 (as Pentane)	870 ppmV	1,184 ppmV	1,532 ppmV
C_6 (as Hexane)	787 ppmV	1,093 ppmV	1,408 ppmV
C_6+ (as Hexane)	2,348 ppmV	3,167 ppmV	2,574 ppmV

Client ID	GEW 22R	GEW 90	SCD 9
AAC ID	140762-71047	140762-71048	140762-71049
Can Dilution Factor	1.58	1.58	1.58
Analyte	Result	Result	Result
H_2	18.5 %	14.1 %	17.2 %
O_2	0.7 %	10.4 %	2.0 %
N_2	2.5 %	37.4 %	8.7 %
CO	0.4 %	0.2 %	0.2 %
CO_2	68.8 %	34.0 %	56.9 %
CH_4	7.9 %	2.8 %	14.4 %
C_2 (as Ethane)	167 ppmV	95.0 ppmV	146 ppmV
C_3 (as Propane)	151 ppmV	81.6 ppmV	149 ppmV
C_4 (as Butane)	1,425 ppmV	2,620 ppmV	936 ppmV
C_5 (as Pentane)	2,629 ppmV	1,298 ppmV	815 ppmV
C_6 (as Hexane)	2,181 ppmV	1,359 ppmV	1,045 ppmV
C_6+ (as Hexane)	6,215 ppmV	5,682 ppmV	3,814 ppmV

Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac (if applicable)

Sucha S. Parmar, Ph.D.
Technical Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 05/20/2014
Analyst : DJ
Units : ppmv

Instrument ID : FID #3
Calb Date : 01/28/14
Reporting Limit : 0.5 ppmv

I - Opening Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
CCV	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	Result	107.0	102.8	102.8	103.7	104.8	102.0
	% Rec *	100.4	101.3	101.2	101.4	101.3	100.8

II - Method Blank - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	LCS Result	105.4	101.2	101.2	102.5	103.4	100.2
	LCSD Result	103.6	99.0	99.2	100.9	102.2	100.4
	LCS % Rec *	98.9	99.7	99.6	100.2	99.9	99.0
	LCSD % Rec *	97.2	97.6	97.7	98.6	98.8	99.2
	% RPD ***	1.8	2.2	2.0	1.7	1.1	0.2

IV - Sample & Sample Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
140762-71049	Sample	N/A	237.1	23.7	26.9	4.5	11.1
	Sample Dup	N/A	214.5	23.5	28.4	3.8	10.3
	Mean	N/A	225.8	23.6	27.6	4.1	10.7
	% RPD ***	N/A	10.0	1.0	5.5	16.2	8.2

V - Matrix Spike & Duplicate - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
140762-71049	Sample Conc	N/A	112.9	11.8	13.8	2.1	5.3
	Spike Conc	N/A	50.7	50.8	51.2	51.8	50.6
	MS Result	N/A	154.0	59.6	59.5	48.7	50.3
	MSD Result	N/A	154.0	58.4	60.7	48.9	51.5
	MS % Rec **	N/A	80.9	94.2	89.3	90.0	88.9
	MSD % Rec **	N/A	80.9	91.8	91.6	90.5	91.2
	% RPD ***	N/A	0.0	2.5	2.5	0.5	2.6

VI - Closing Continuing Calibration Verification - ASTM D-1945/1946

AAC ID	Analyte	Methane	Ethane	Propane	Butane	Pentane	Hexane
CCV	Spike Conc	106.6	101.5	101.6	102.3	103.5	101.2
	Result	104.7	100.2	100.3	101.1	101.5	98.5
	% Rec *	98.2	98.7	98.7	98.8	98.1	97.4

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

Sucha S. Parmar, Ph.D.
Technical Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 05/20/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 04/13/2012
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	Result	10.6	10.8	20.4	11.0	11.0	11.5
	% Rec *	103.1	103.6	104.0	106.9	111.0	111.2

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	LCS Result	10.5	10.3	19.9	10.6	10.6	11.1
	LCSD Result	10.8	10.2	19.8	11.0	10.9	11.4
	LCS % Rec *	102.7	98.4	101.4	103.8	106.6	107.2
	LCSD % Rec *	105.0	97.7	100.8	106.8	110.1	110.6
	% RPD ***	2.2	0.7	0.6	2.9	3.3	3.1

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
140758-71031	Sample	0.0	14.4	79.7	6.2	0.0	0.0
	Sample Dup	0.0	14.7	80.7	6.2	0.0	0.0
	Mean	0.0	14.5	80.2	6.2	0.0	0.0
	% RPD ***	0.0	2.3	1.2	0.0	0.0	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
140758-71031	Sample Conc	0.0	40.1	3.1	0.0	0.0
	Spike Conc	10.3	9.2	10.3	9.9	10.3
	MS Result	10.8	49.0	13.6	11.1	11.5
	MSD Result	10.8	49.2	13.6	10.9	11.4
	MS % Rec **	105.5	96.6	102.2	111.3	111.3
	MSD % Rec **	105.4	99.2	102.2	109.8	110.0
	% RPD ***	0.1	2.6	0.0	1.4	1.2

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	10.3	10.5	19.6	10.3	9.9	10.3
	Result	11.2	10.5	20.4	11.3	11.3	11.7
	% Rec *	109.6	100.3	104.0	110.7	113.7	113.3

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 05/21/2014 **Instrument ID: GC BTU**
Analyst: ZG **Calb. Date:** 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	2977	0.50	99.8	NA
Duplicate	2991	0.50	100.3	0.5
Triplicate	3000	0.50	100.6	0.8

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis **Sample ID** 140791-71106 x1

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.0	0.0	0.0	0.0

Matrix Spike & Duplicate **Sample ID** 140791-71106 x1

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.00	0.25	0.25	0.24	100.3	96.0	4.3

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.50	0.54	107.2

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** must be < 5% RPD from Initial result.*

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 05/22/2014 **Instrument ID: GC BTU**
Analyst: ZG **Calb. Date:** 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	3039	0.51	101.9	NA
Duplicate	3082	0.52	103.3	1.4
Triplicate	3014	0.51	101.1	0.8

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis **Sample ID** 140762-71048 x100

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.0	0.0	0.0	0.0

Matrix Spike & Duplicate **Sample ID** 140762-71048 x100

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.00	0.25	0.26	0.24	104.2	96.4	7.7

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.50	0.53	105.8

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** must be < 5% RPD from Initial result.*

Sucha S. Parmar, Ph.D.
Technical Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
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Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. 1407EN

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Republic Services
Project Name: Bridgeton LF
Project Mgr (Print Name): Mike Lamprech
Project Number: 23211003.06 Task 2
Sampler's Name (Print Name):
Sampler's Signature:

Analysis Requested

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	3C/ASTM1945	ASTM D 5504	TO-14A/15	[illegible]		
764	5/15/14		Gas	BLIN 71044	Summa 1	X	X	X	[illegible]		
753	5/15/14		↓	ECSIN 71045	1	X	X	X	[illegible]		
791	5/15/14			GEW 27A 71046	1	X	X	X	[illegible]		
782	5/15/14			GEW 22R 71047	1	X	X	X	[illegible]		
763	5/15/14			GEW 90 71048	1	X	X	X	[illegible]		
794	5/15/14			SCD 9 71048	1	X	X	X	[illegible]		

Send report:
SCS Tracer Environmental
970 Los Vallecitos Blvd.
Suite 100
San Marcos, CA 92069
Attn: Paul Schafer
Phone#: 760-744-9611
Fax# 760-744-8616

Send invoice to:
Attn:
P.O. #

Turnaround Time
24-Hr ____ 48-Hr ____
5 Day X Normal ____
Other (Specify) ____

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
F. Daniel Brennan	F. Daniel Brennan	5/15/14 3pm		
Relinquished by (Signature):	Print Name:	Date/Time 5/16/14 1100	Received by (signature):	Print Name John Zachman

– Fed Ex

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140762
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 05/16/2014
DATE REPORTED : 05/21/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	BLIN			Sample Reporting Limit (SRL) (MRLxDF's)	ECSIN			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71044				140762-71045				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.57				1.53				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Chlorodifluoromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Propene	120000		10000	15660	155000		10000	15349	1.0
Dichlorodifluoromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Chloromethane	10000		1000	783	18300		1000	767	0.5
Dichlorotetrafluoroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Vinyl Chloride	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Methanol	4840000		100000	783022	6780000		200000	1534845	5.0
1,3-Butadiene	2220		1000	783	3100		1000	767	0.5
Bromomethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Chloroethane	2280		1000	783	4040		1000	767	0.5
Dichlorofluoromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Ethanol	677000		100000	313209	1070000		200000	613938	2.0
Vinyl Bromide	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Acetone	1040000		100000	313209	1270000		200000	613938	2.0
Trichlorofluoromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
2-Propanol (IPA)	180000		10000	31321	201000		10000	30697	2.0
Acrylonitrile	<SRL	U	1000	1566	<SRL	U	1000	1535	1.0
1,1-Dichloroethene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Methylene Chloride (DCM)	<SRL	U	1000	1566	<SRL	U	1000	1535	1.0
Allyl Chloride	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Carbon Disulfide	<SRL	U	1000	783	1140		1000	767	0.5
Trichlorotrifluoroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
trans-1,2-Dichloroethene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,1-Dichloroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Methyl Tert Butyl Ether (MTBE)	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Vinyl Acetate	<SRL	U	1000	1566	<SRL	U	1000	1535	1.0
2-Butanone (MEK)	506000		100000	156604	614000		200000	306969	1.0
cis-1,2-Dichloroethene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Hexane	2600		1000	783	3030		1000	767	0.5
Chloroform	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Ethyl Acetate	51700		10000	7830	70100		10000	7674	0.5
Tetrahydrofuran	307000		10000	7830	340000		10000	7674	0.5
1,2-Dichloroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,1,1-Trichloroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Tracer Environmental**
PROJECT NO : **140762**
MATRIX : **AIR**
UNITS : **PPB (v/v)**

DATE RECEIVED : **05/16/2014**
DATE REPORTED : **05/21/2014**

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	BLIN			Sample Reporting Limit (SRL) (MRLxDF's)	ECSIN			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71044				140762-71045				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.57				1.53				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Benzene	388000		100000	78302	510000		200000	153485	0.5
Carbon Tetrachloride	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Cyclohexane	892		1000	783	950		1000	767	0.5
1,2-Dichloropropane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Bromodichloromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,4-Dioxane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Trichloroethene (TCE)	<SRL	U	1000	783	<SRL	U	1000	767	0.5
2,2,4-Trimethylpentane	942		1000	783	1300		1000	767	0.5
Heptane	2250		1000	783	2670		1000	767	0.5
cis-1,3-Dichloropropene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
4-Methyl-2-pentanone (MiBK)	13700		1000	783	15100		1000	767	0.5
trans-1,3-Dichloropropene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,1,2-Trichloroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Toluene	55200		10000	7830	63500		10000	7674	0.5
2-Hexanone (MBK)	6400		1000	783	7050		1000	767	0.5
Dibromochloromethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,2-Dibromoethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Tetrachloroethene (PCE)	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Chlorobenzene	<SRL	U	1000	783	794		1000	767	0.5
Ethylbenzene	18000		10000	7830	19700		10000	7674	0.5
m & p-Xylenes	30300		10000	15660	33800		10000	15349	1.0
Bromoform	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Styrene	870		1000	783	976		1000	767	0.5
1,1,2,2-Tetrachloroethane	<SRL	U	1000	783	<SRL	U	1000	767	0.5
o-Xylene	11200		1000	783	12900		1000	767	0.5
4-Ethyltoluene	1660		1000	783	1960		1000	767	0.5
1,3,5-Trimethylbenzene	1930		1000	783	2230		1000	767	0.5
1,2,4-Trimethylbenzene	4990		1000	783	5780		1000	767	0.5
Benzyl Chloride (a-Chlorotoluene)	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,3-Dichlorobenzene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,4-Dichlorobenzene	1860		1000	783	2160		1000	767	0.5
1,2-Dichlorobenzene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
1,2,4-Trichlorobenzene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
Hexachlorobutadiene	<SRL	U	1000	783	<SRL	U	1000	767	0.5
BFB-Surrogate Std. % Recovery	101%				102%				70-130%

U - Compound was analyzed for, but was not detected at or above the SRL.

Marcus Hueppe
Laboratoy Director

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140762
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 05/16/2014
DATE REPORTED : 05/21/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	GEW 27A			Sample Reporting Limit (SRL) (MRLxDF's)	GEW 22R			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71046				140762-71047				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.56				1.58				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Chlorodifluoromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Propene	259000		10000	15634	174000		10000	15750	1.0
Dichlorodifluoromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Chloromethane	3730		1000	782	978		1000	788	0.5
Dichlorotetrafluoroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Vinyl Chloride	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Methanol	11400000		200000	1563385	9170000		200000	1575023	5.0
1,3-Butadiene	3340		1000	782	3470		1000	788	0.5
Bromomethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Chloroethane	858		1000	782	1590		1000	788	0.5
Dichlorofluoromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Ethanol	1670000		200000	625354	3210000		200000	630009	2.0
Vinyl Bromide	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Acetone	1690000		200000	625354	2420000		200000	630009	2.0
Trichlorofluoromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
2-Propanol (IPA)	289000		10000	31268	639000		10000	31501	2.0
Acrylonitrile	<SRL	U	1000	1563	<SRL	U	1000	1575	1.0
1,1-Dichloroethene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Methylene Chloride (DCM)	<SRL	U	1000	1563	<SRL	U	1000	1575	1.0
Allyl Chloride	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Carbon Disulfide	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Trichlorotrifluoroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
trans-1,2-Dichloroethene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,1-Dichloroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Methyl Tert Butyl Ether (MTBE)	1280		1000	782	<SRL	U	1000	788	0.5
Vinyl Acetate	<SRL	U	1000	1563	<SRL	U	1000	1575	1.0
2-Butanone (MEK)	774000		200000	312677	1120000		200000	315005	1.0
cis-1,2-Dichloroethene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Hexane	5150		1000	782	3540		1000	788	0.5
Chloroform	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Ethyl Acetate	79300		10000	7817	205000		10000	7875	0.5
Tetrahydrofuran	197000		10000	7817	707000		200000	157502	0.5
1,2-Dichloroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,1,1-Trichloroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140762
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 05/16/2014
DATE REPORTED : 05/21/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	GEW 27A			Sample Reporting Limit (SRL) (MRLxDF's)	GEW 22R			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71046				140762-71047				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.56				1.58				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Benzene	400000		200000	156339	703000		200000	157502	0.5
Carbon Tetrachloride	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Cyclohexane	1470		1000	782	1160		1000	788	0.5
1,2-Dichloropropane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Bromodichloromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,4-Dioxane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Trichloroethene (TCE)	<SRL	U	1000	782	<SRL	U	1000	788	0.5
2,2,4-Trimethylpentane	1600		1000	782	4150		1000	788	0.5
Heptane	4470		1000	782	3750		1000	788	0.5
cis-1,3-Dichloropropene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
4-Methyl-2-pentanone (MiBK)	15400		1000	782	32600		1000	788	0.5
trans-1,3-Dichloropropene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,1,2-Trichloroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Toluene	81500		10000	7817	121000		10000	7875	0.5
2-Hexanone (MBK)	4390		1000	782	9480		1000	788	0.5
Dibromochloromethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,2-Dibromoethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Tetrachloroethene (PCE)	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Chlorobenzene	833		1000	782	1380		1000	788	0.5
Ethylbenzene	21600		10000	7817	41100		10000	7875	0.5
m & p-Xylenes	38400		10000	15634	81000		10000	15750	1.0
Bromoform	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Styrene	1020		1000	782	3090		1000	788	0.5
1,1,2,2-Tetrachloroethane	<SRL	U	1000	782	<SRL	U	1000	788	0.5
o-Xylene	11600		1000	782	27800		10000	7875	0.5
4-Ethyltoluene	1490		1000	782	4060		1000	788	0.5
1,3,5-Trimethylbenzene	1580		1000	782	4620		1000	788	0.5
1,2,4-Trimethylbenzene	3410		1000	782	10200		1000	788	0.5
Benzyl Chloride (a-Chlorotoluene)	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,3-Dichlorobenzene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,4-Dichlorobenzene	1200		1000	782	5130		1000	788	0.5
1,2-Dichlorobenzene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
1,2,4-Trichlorobenzene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
Hexachlorobutadiene	<SRL	U	1000	782	<SRL	U	1000	788	0.5
BFB-Surrogate Std. % Recovery	102%				102%				70-130%

U - Compound was analyzed for, but was not detected at or above the SRL.

Marcus Hueppe
Laboratoy Director

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140762
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 05/16/2014
DATE REPORTED : 05/21/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	GEW 90			Sample Reporting Limit (SRL) (MRLxDF's)	SCD 9			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71048				140762-71049				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.58				1.58				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Chlorodifluoromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Propene	81200		10000	15830	144000		10000	15830	1.0
Dichlorodifluoromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Chloromethane	27000		1000	792	8950		1000	792	0.5
Dichlorotetrafluoroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Vinyl Chloride	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Methanol	18200000		200000	1582997	5440000		200000	1583023	5.0
1,3-Butadiene	1660		1000	792	2570		1000	792	0.5
Bromomethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Chloroethane	2610		1000	792	2760		1000	792	0.5
Dichlorofluoromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Ethanol	1720000		200000	633199	302000		10000	31661	2.0
Vinyl Bromide	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Acetone	1500000		200000	633199	1080000		200000	633209	2.0
Trichlorofluoromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
2-Propanol (IPA)	259000		10000	31660	48900		10000	31661	2.0
Acrylonitrile	<SRL	U	1000	1583	<SRL	U	1000	1583	1.0
1,1-Dichloroethene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Methylene Chloride (DCM)	<SRL	U	1000	1583	<SRL	U	1000	1583	1.0
Allyl Chloride	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Carbon Disulfide	<SRL	U	1000	792	834		1000	792	0.5
Trichlorotrifluoroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
trans-1,2-Dichloroethene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,1-Dichloroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Methyl Tert Butyl Ether (MTBE)	<SRL	U	1000	792	834		1000	792	0.5
Vinyl Acetate	<SRL	U	1000	1583	<SRL	U	1000	1583	1.0
2-Butanone (MEK)	659000		200000	316599	555000		200000	316605	1.0
cis-1,2-Dichloroethene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Hexane	2030		1000	792	3800		1000	792	0.5
Chloroform	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Ethyl Acetate	74900		10000	7915	33600		10000	7915	0.5
Tetrahydrofuran	526000		200000	158300	301000		10000	7915	0.5
1,2-Dichloroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,1,1-Trichloroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : SCS Tracer Environmental
PROJECT NO : 140762
MATRIX : AIR
UNITS : PPB (v/v)

DATE RECEIVED : 05/16/2014
DATE REPORTED : 05/21/2014

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	GEW 90			Sample Reporting Limit (SRL) (MRLxDF's)	SCD 9			Sample Reporting Limit (SRL) (MRLxDF's)	Method Reporting Limit (MRL)
AAC ID	140762-71048				140762-71049				
Date Sampled	05/15/2014				05/15/2014				
Date Analyzed	05/20/2014				05/20/2014				
Can Dilution Factor	1.58				1.58				
	Result	Qualifier	Analysis DF		Result	Qualifier	Analysis DF		
Benzene	268000		10000	7915	478000		200000	158302	0.5
Carbon Tetrachloride	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Cyclohexane	<SRL	U	1000	792	1390		1000	792	0.5
1,2-Dichloropropane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Bromodichloromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,4-Dioxane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Trichloroethene (TCE)	<SRL	U	1000	792	<SRL	U	1000	792	0.5
2,2,4-Trimethylpentane	1120		1000	792	1160		1000	792	0.5
Heptane	1620		1000	792	3120		1000	792	0.5
cis-1,3-Dichloropropene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
4-Methyl-2-pentanone (MiBK)	26500		1000	792	17500		1000	792	0.5
trans-1,3-Dichloropropene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,1,2-Trichloroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Toluene	48300		10000	7915	56700		10000	7915	0.5
2-Hexanone (MBK)	15000		1000	792	8760		1000	792	0.5
Dibromochloromethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,2-Dibromoethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Tetrachloroethene (PCE)	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Chlorobenzene	911		1000	792	<SRL	U	1000	792	0.5
Ethylbenzene	24500		10000	7915	18900		10000	7915	0.5
m & p-Xylenes	47800		10000	15830	29800		10000	15830	1.0
Bromoform	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Styrene	2170		1000	792	957		1000	792	0.5
1,1,2,2-Tetrachloroethane	<SRL	U	1000	792	<SRL	U	1000	792	0.5
o-Xylene	21100		10000	7915	12200		1000	792	0.5
4-Ethyltoluene	4410		1000	792	2120		1000	792	0.5
1,3,5-Trimethylbenzene	5460		1000	792	2640		1000	792	0.5
1,2,4-Trimethylbenzene	14800		1000	792	7970		1000	792	0.5
Benzyl Chloride (a-Chlorotoluene)	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,3-Dichlorobenzene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,4-Dichlorobenzene	9020		1000	792	4980		1000	792	0.5
1,2-Dichlorobenzene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
1,2,4-Trichlorobenzene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
Hexachlorobutadiene	<SRL	U	1000	792	<SRL	U	1000	792	0.5
BFB-Surrogate Std. % Recovery	101%				101%				70-130%

U - Compound was analyzed for, but was not detected at or above the SRL.

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Laboratoy Director

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Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 05/20/2014 **INSTRUMENT ID : GC/MS-02**
ANALYST : JJG/DH **CALIBRATION STD ID : PS031714-01**

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15
Continuing Calibration Verification of the 04/22/2014 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC**
4-BFB (surrogate standard)	10.00	9.96	100
Chlorodifluoromethane	10.40	11.05	106
Propene	10.50	11.54	110
Dichlorodifluoromethane	10.10	10.74	106
Chloromethane	10.10	10.73	106
Dichlorotetrafluoroethane	10.30	10.41	101
Vinyl Chloride	10.30	11.14	108
Methanol	20.10	18.96	94
1,3-Butadiene	10.20	11.02	108
Bromomethane	10.00	10.76	108
Chloroethane	10.00	10.96	110
Dichlorofluoromethane	10.50	11.16	106
Ethanol	10.80	11.02	102
Vinyl Bromide	10.10	10.65	105
Acetone	10.40	10.02	96
Trichlorofluoromethane	10.50	11.52	110
2-Propanol (IPA)	11.00	11.57	105
Acrylonitrile	11.90	12.73	107
1,1-Dichloroethene	10.20	10.55	103
Methylene Chloride (DCM)	10.10	9.02	89
Allyl Chloride	10.50	11.38	108
Carbon Disulfide	10.20	10.72	105
Trichlorotrifluoroethane	9.90	10.24	103
trans-1,2-Dichloroethene	9.90	10.25	104
1,1-Dichloroethane	10.10	10.97	109
Methyl Tert Butyl Ether (MTBE)	10.20	10.79	106
Vinyl Acetate	11.00	12.59	114
2-Butanone (MEK)	10.30	11.68	113
cis-1,2-Dichloroethene	10.40	10.76	103
Hexane	10.20	11.08	109
Chloroform	9.90	10.66	108
Ethyl Acetate	9.90	11.13	112
Tetrahydrofuran	10.20	10.66	105
1,2-Dichloroethane	10.30	10.78	105
1,1,1-Trichloroethane	10.20	10.38	102

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Atmospheric Analysis & Consulting, Inc.

ANALYSIS DATE : 05/20/2014 **INSTRUMENT ID : GC/MS-02**
ANALYST : JJG/DH **CALIBRATION STD ID : PS031714-01**

VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15
Continuing Calibration Verification of the 04/22/2014 Calibration

Compounds	*Conc*	*Daily Conc*	*%REC**
Benzene	10.40	11.11	107
Carbon Tetrachloride	10.30	10.27	100
Cyclohexane	10.30	10.88	106
1,2-Dichloropropane	10.40	11.31	109
Bromodichloromethane	10.30	11.04	107
1,4-Dioxane	10.30	10.31	100
Trichloroethene (TCE)	10.30	10.18	99
2,2,4-Trimethylpentane	10.40	11.30	109
Heptane	10.40	11.12	107
cis-1,3-Dichloropropene	10.90	12.07	111
4-Methyl-2-pentanone (MiBK)	10.10	11.18	111
trans-1,3-Dichloropropene	10.90	12.09	111
1,1,2-Trichloroethane	10.40	10.78	104
Toluene	10.60	11.01	104
2-Hexanone (MBK)	10.70	11.96	112
Dibromochloromethane	10.60	10.53	99
1,2-Dibromoethane	10.50	10.79	103
Tetrachloroethene (PCE)	10.20	10.20	100
Chlorobenzene	10.70	10.52	98
Ethylbenzene	10.60	11.02	104
m & p-Xylenes	20.60	20.81	101
Bromoform	10.30	10.54	102
Styrene	10.70	10.92	102
1,1,2,2-Tetrachloroethane	10.70	11.67	109
o-Xylene	10.70	11.14	104
4-Ethyltoluene	10.40	10.93	105
1,3,5-Trimethylbenzene	10.50	10.85	103
1,2,4-Trimethylbenzene	10.50	10.80	103
Benzyl Chloride (a-Chlorotoluene)	10.70	10.81	101
1,3-Dichlorobenzene	10.70	10.75	100
1,4-Dichlorobenzene	10.40	10.43	100
1,2-Dichlorobenzene	10.50	10.37	99
1,2,4-Trichlorobenzene	10.40	9.97	96
Hexachlorobutadiene	10.30	9.84	96

* - %REC should be 70-130%

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

CLIENT ID	: Laboratory Control Spike	DATE ANALYZED	: 05/20/2014
AAC ID	: LCS/LCSD	DATE REPORTED	: 05/20/2014
MEDIA	: Air	UNITS	: ppbv

TO-15 Laboratory Control Spike Recovery

Compound	Sample Conc.	Spike Added	Spike Res	Dup Spike Res	Spike % Rec *	Spike Dup % Rec *	RPD** %
1,1-Dichloroethene	0.0	10.20	10.55	10.65	103	104	0.9
Methylene Chloride (DCM)	0.0	10.10	9.02	9.94	89	98	9.7
Benzene	0.0	10.40	11.11	11.04	107	106	0.6
Trichloroethene (TCE)	0.0	10.30	10.18	9.98	99	97	2.0
Toluene	0.0	10.60	11.01	11.07	104	104	0.5
Tetrachloroethene (PCE)	0.0	10.20	10.20	10.05	100	99	1.5
Chlorobenzene	0.0	10.70	10.52	10.72	98	100	1.9
Ethylbenzene	0.0	10.60	11.02	11.12	104	105	0.9
m & p-Xylenes	0.0	20.60	20.81	21.13	101	103	1.5
o-Xylene	0.0	10.70	11.14	11.18	104	104	0.4

* Must be 70-130%

** Must be < 25%

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Method Blank Analysis Report

MATRIX	**: AIR**	**ANALYSIS DATE**	**: 05/20/2014**
UNITS	**: ppbv**	**REPORT DATE**	**: 05/20/2014**

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID	Method Blank	RL
AAC ID	MB 052014	
Chlorodifluoromethane	<RL	0.5
Propene	<RL	1.0
Dichlorodifluoromethane	<RL	0.5
Chloromethane	<RL	0.5
Dichlorotetrafluoroethane	<RL	0.5
Vinyl Chloride	<RL	0.5
Methanol	<RL	5.0
1,3-Butadiene	<RL	0.5
Bromomethane	<RL	0.5
Chloroethane	<RL	0.5
Dichlorofluoromethane	<RL	0.5
Ethanol	<RL	2.0
Vinyl Bromide	<RL	0.5
Acetone	<RL	2.0
Trichlorofluoromethane	<RL	0.5
2-Propanol (IPA)	<RL	2.0
Acrylonitrile	<RL	1.0
1,1-Dichloroethene	<RL	0.5
Methylene Chloride (DCM)	<RL	1.0
Allyl Chloride	<RL	0.5
Carbon Disulfide	<RL	0.5
Trichlorotrifluoroethane	<RL	0.5
trans-1,2-Dichloroethene	<RL	0.5
1,1-Dichloroethane	<RL	0.5
Methyl Tert Butyl Ether (MTBE)	<RL	0.5
Vinyl Acetate	<RL	1.0
2-Butanone (MEK)	<RL	1.0
cis-1,2-Dichloroethene	<RL	0.5
Hexane	<RL	0.5
Chloroform	<RL	0.5
Ethyl Acetate	<RL	0.5
Tetrahydrofuran	<RL	0.5
1,2-Dichloroethane	<RL	0.5
1,1,1-Trichloroethane	<RL	0.5
Benzene	<RL	0.5
Carbon Tetrachloride	<RL	0.5
Cyclohexane	<RL	0.5
1,2-Dichloropropane	<RL	0.5
Bromodichloromethane	<RL	0.5
1,4-Dioxane	<RL	0.5
Trichloroethene (TCE)	<RL	0.5
2,2,4-Trimethylpentane	<RL	0.5
Heptane	<RL	0.5

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Method Blank Analysis Report

MATRIX	**: AIR**	**ANALYSIS DATE**	**: 05/20/2014**
UNITS	**: ppbv**	**REPORT DATE**	**: 05/20/2014**

VOLATILE ORGANIC COMPOUNDS BY EPA TO-15

Client ID / *AAC ID*	Method Blank / MB 052014	RL
cis-1,3-Dichloropropene	<RL	0.5
4-Methyl-2-pentanone (MiBK)	<RL	0.5
trans-1,3-Dichloropropene	<RL	0.5
1,1,2-Trichloroethane	<RL	0.5
Toluene	<RL	0.5
2-Hexanone (MBK)	<RL	0.5
Dibromochloromethane	<RL	0.5
1,2-Dibromoethane	<RL	0.5
Tetrachloroethene (PCE)	<RL	0.5
Chlorobenzene	<RL	0.5
Ethylbenzene	<RL	0.5
m & p-Xylenes	<RL	1.0
Bromoform	<RL	0.5
Styrene	<RL	0.5
1,1,2,2-Tetrachloroethane	<RL	0.5
o-Xylene	<RL	0.5
4-Ethyltoluene	<RL	0.5
1,3,5-Trimethylbenzene	<RL	0.5
1,2,4-Trimethylbenzene	<RL	0.5
Benzyl Chloride (a-Chlorotoluene)	<RL	0.5
1,3-Dichlorobenzene	<RL	0.5
1,4-Dichlorobenzene	<RL	0.5
1,2-Dichlorobenzene	<RL	0.5
1,2,4-Trichlorobenzene	<RL	0.5
Hexachlorobutadiene	<RL	0.5
System Monitoring Compounds		
BFB-Surrogate Std. % Recovery	96%	--

RL - Reporting Limit

Marcus Hueppe
Laboratory Director

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Quality Control/Quality Assurance Report

AAC ID	: 140762-71044	DATE ANALYZED	: 05/20/2014
MATRIX	: Air	DATE REPORTED	: 05/20/2014
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Chlorodifluoromethane	<SRL	<SRL	0.0
Propene	<SRL	<SRL	0.0
Dichlorodifluoromethane	<SRL	<SRL	0.0
Chloromethane	<SRL	<SRL	0.0
Dichlorotetrafluoroethane	<SRL	<SRL	0.0
Vinyl Chloride	<SRL	<SRL	0.0
Methanol	4840000	4890000	1.0
1,3-Butadiene	<SRL	<SRL	0.0
Bromomethane	<SRL	<SRL	0.0
Chloroethane	<SRL	<SRL	0.0
Dichlorofluoromethane	<SRL	<SRL	0.0
Ethanol	677000	669000	1.2
Vinyl Bromide	<SRL	<SRL	0.0
Acetone	1040000	1020000	1.9
Trichlorofluoromethane	<SRL	<SRL	0.0
2-Propanol (IPA)	<SRL	<SRL	0.0
Acrylonitrile	<SRL	<SRL	0.0
1,1-Dichloroethene	<SRL	<SRL	0.0
Methylene Chloride (DCM)	<SRL	<SRL	0.0
Allyl Chloride	<SRL	<SRL	0.0
Carbon Disulfide	<SRL	<SRL	0.0
Trichlorotrifluoroethane	<SRL	<SRL	0.0
trans-1,2-Dichloroethene	<SRL	<SRL	0.0
1,1-Dichloroethane	<SRL	<SRL	0.0
Methyl Tert Butyl Ether (MTBE)	<SRL	<SRL	0.0
Vinyl Acetate	<SRL	<SRL	0.0
2-Butanone (MEK)	506000	517000	2.2
cis-1,2-Dichloroethene	<SRL	<SRL	0.0
Hexane	<SRL	<SRL	0.0
Chloroform	<SRL	<SRL	0.0
Ethyl Acetate	<SRL	<SRL	0.0
Tetrahydrofuran	<SRL	<SRL	0.0
1,2-Dichloroethane	<SRL	<SRL	0.0
1,1,1-Trichloroethane	<SRL	<SRL	0.0
Benzene	388000	389000	0.3
Carbon Tetrachloride	<SRL	<SRL	0.0

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Quality Control/Quality Assurance Report

AAC ID	: 140762-71044	DATE ANALYZED	: 05/20/2014
MATRIX	: Air	DATE REPORTED	: 05/20/2014
		UNITS	: ppbv

TO-15 Duplicate Analysis

Compound	Sample Conc	Duplicate Conc	% RPD
Cyclohexane	<SRL	<SRL	0.0
1,2-Dichloropropane	<SRL	<SRL	0.0
Bromodichloromethane	<SRL	<SRL	0.0
1,4-Dioxane	<SRL	<SRL	0.0
Trichloroethene (TCE)	<SRL	<SRL	0.0
2,2,4-Trimethylpentane	<SRL	<SRL	0.0
Heptane	<SRL	<SRL	0.0
cis-1,3-Dichloropropene	<SRL	<SRL	0.0
4-Methyl-2-pentanone (MiBK)	<SRL	<SRL	0.0
trans-1,3-Dichloropropene	<SRL	<SRL	0.0
1,1,2-Trichloroethane	<SRL	<SRL	0.0
Toluene	<SRL	<SRL	0.0
2-Hexanone (MBK)	<SRL	<SRL	0.0
Dibromochloromethane	<SRL	<SRL	0.0
1,2-Dibromoethane	<SRL	<SRL	0.0
Tetrachloroethene (PCE)	<SRL	<SRL	0.0
Chlorobenzene	<SRL	<SRL	0.0
Ethylbenzene	<SRL	<SRL	0.0
m & p-Xylenes	<SRL	<SRL	0.0
Bromoform	<SRL	<SRL	0.0
Styrene	<SRL	<SRL	0.0
1,1,2,2-Tetrachloroethane	<SRL	<SRL	0.0
o-Xylene	<SRL	<SRL	0.0
4-Ethyltoluene	<SRL	<SRL	0.0
1,3,5-Trimethylbenzene	<SRL	<SRL	0.0
1,2,4-Trimethylbenzene	<SRL	<SRL	0.0
Benzyl Chloride (a-Chlorotoluene)	<SRL	<SRL	0.0
1,3-Dichlorobenzene	<SRL	<SRL	0.0
1,4-Dichlorobenzene	<SRL	<SRL	0.0
1,2-Dichlorobenzene	<SRL	<SRL	0.0
1,2,4-Trichlorobenzene	<SRL	<SRL	0.0
Hexachlorobutadiene	<SRL	<SRL	0.0
System Monitoring Compounds			
BFB-Surrogate Std. % Recovery	97%	96%	0.8

SRL - Sample Reporting Limit

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
1534 Eastman Avenue, Suite A
Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. 1407EV

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Republic Services
Project Name: Bridgeton LF
Project Mgr (Print Name): Mike Lamborch
Project Number: 23211003.06 Task 2
Sampler's Name (Print Name):
Sampler's Signature:

Send report:
SCS Tracer Environmental
970 Los Vallecitos Blvd.
Suite 100
San Marcos, CA 92069
Attn: Paul Schafer
Phone#: 760-744-9611
Fax# 760-744-8616

Send invoice to:
Attn:
P.O. #

Turnaround Time
24-Hr ____ 48-Hr ____
5 Day X Normal ____
Other (Specify) ____

Special Instructions/remarks:

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	3C/ASTM1945	ASTM D5504	TO-14A/15	[redacted]		
764	5/15/14		Gas	BLIN 71044	Summa 1	X	X	X	[redacted]		
753	5/15/14		↓	ECSIN 71045	1	X	X	X	[redacted]		
791	5/15/14			GEW 27A 71046	1	X	X	X	[redacted]		
782	5/15/14			GEW 22R 71047	1	X	X	X	[redacted]		
763	5/15/14			GEW 90 71048	1	X	X	X	[redacted]		
794	5/15/14			SCD 9 71049	1	X	X	X	[redacted]		

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
F. Daniel Brennan	F. Daniel Brennan	5/15/14 3pm		
Relinquished by (Signature):	Print Name:	Date/Time 1100 5/16/14	Received by (signature):	Print Name John Zachman

— Fed Ex

Atmospheric Analysis & Consulting, Inc.

CLIENT	: SCS Engineers
PROJECT NAME	: Pilot Study
PROJECT NUMBER	: 23211003.17
AAC PROJECT NO.	: 141277
REPORT DATE	: 8/8/2014

On August 6, 2014, Atmospheric Analysis & Consulting, Inc. received six (6) Six-Liter Summa Canisters for Fixed Gases analysis by EPA 3C and Total Reduced Sulfur analysis by ASTM D-5504. Upon receipt, each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
Inlet Round 1	141277-73019	596.1
Middle Round 1	141277-73018	606.0
Outlet Round 1	141277-73017	613.4
Inlet Round 2	141277-73022	655.8
Middle Round 2	141277-73021	641.6
Outlet Round 2	141277-73020	636.9

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-EPA 3C and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

This report consists of 7 pages.

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Engineers**
PROJECT NO. : **141277**
MATRIX : **AIR**

SAMPLING DATE : **08/05/2014**
RECEIVING DATE : **08/06/2014**
ANALYSIS DATE : **08/06/2014**
REPORT DATE : **08/08/2014**

EPA 3C

Client ID	Inlet Round 1	Middle Round 1	Outlet Round 1
AAC ID	141277-73019	141277-73018	141277-73017
Can Dilution Factor	1.78	1.74	1.79
Analyte	Result	Result	Result
H_2	11.3 %	11.9 %	11.2 %
O_2	6.2 %	6.3 %	6.2 %
N_2	27.3 %	27.4 %	27.3 %
CO	< 0.2 %	< 0.2 %	< 0.2 %
CO_2	44.6 %	44.0 %	44.7 %
CH_4	10.4 %	10.3 %	10.4 %

Client ID	Inlet Round 2	Middle Round 2	Outlet Round 2
AAC ID	141277-73022	141277-73021	141277-73020
Can Dilution Factor	1.61	1.64	1.65
Analyte	Result	Result	Result
H_2	12.1 %	12.5 %	11.6 %
O_2	5.7 %	5.5 %	5.5 %
N_2	24.8 %	24.1 %	24.2 %
CO	< 0.2 %	< 0.2 %	< 0.2 %
CO_2	46.2 %	46.7 %	47.7 %
CH_4	11.1 %	11.0 %	10.9 %

All fixed gases have been normalized to 100% on a dry weight basis
Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT : **SCS Engineers**
PROJECT NO. : **141277**
MATRIX : **AIR**
UNITS : **ppmV**

SAMPLING DATE : **08/05/2014**
RECEIVING DAT] : **08/06/2014**
ANALYSIS DATE : **08/06-07/2014**
REPORT DATE : **08/08/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	Inlet Round 1	Middle Round 1	Outlet Round 1	Inlet Round 2	Middle Round 2	Outlet Round 2
AAC ID	141277-73019	141277-73018	141277-73017	141277-73022	141277-73021	141277-73020
Canister Dil. Fac.	1.8	1.7	1.8	1.6	1.6	1.7
Analyte	Result	Result	Result	Result	Result	Result
Hydrogen Sulfide	32.6	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Carbonyl Sulfide	< 0.888	< 0.870	0.264	< 0.805	< 0.822	< 0.827
Sulfur Dioxide	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Methyl Mercaptan	199	< 0.870	0.333	< 0.805	1.64	< 0.827
Ethyl Mercaptan	1.96	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Dimethyl Sulfide	736	731	864	735	811	895
Carbon Disulfide	< 0.888	< 0.870	0.811	0.858	1.01	1.17
Isopropyl Mercaptan	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
tert-Butyl Mercaptan	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
n-Propyl Mercaptan	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Methylethylsulfide	4.76	4.45	5.38	4.58	5.79	6.33
sec-Butyl Mercaptan	7.94	7.33	9.42	7.11	9.94	12.1
Thiophene	< 0.888	< 0.870	0.524	< 0.805	< 0.822	< 0.827
iso-Butyl Mercaptan	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Diethyl Sulfide	< 0.888	< 0.870	0.626	< 0.805	< 0.822	< 0.827
n-Butyl Mercaptan	1.04	0.900	1.15	< 0.805	1.22	1.57
Dimethyl Disulfide	40.9	62.8	105	229	96.2	169
2-Methylthiophene	4.20	4.07	6.21	3.38	6.54	11.1
3-Methylthiophene	< 0.888	< 0.870	0.583	< 0.805	< 0.822	1.17
Tetrahydrothiophene	< 0.888	< 0.870	0.559	< 0.805	< 0.822	1.32
Bromothiophene	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Thiophenol	< 0.888	< 0.870	< 0.090	< 0.805	< 0.822	< 0.827
Diethyl disulfide	< 0.888	< 0.870	< 0.090	1.72	< 0.822	< 0.827
Total Unidentified Sulfur	4.35	2.66	3.49	7.61	3.79	6.98
Total Reduced Sulfurs as H_2S	1,033	813	998	989	937	1,105

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 08/06/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 08/05/2012
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	10.1	10.4	21.3	11.0	10.7	10.8
	% Rec *	106.2	103.2	105.5	108.0	106.0	105.7

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	LCS Result	9.6	10.0	20.3	10.5	10.0	10.2
	LCSD Result	9.6	10.3	21.0	10.8	10.4	10.5
	LCS % Rec *	101.0	99.0	100.3	102.6	99.3	99.5
	LCSD % Rec *	101.4	102.6	103.8	106.1	102.7	103.0
	% RPD ***	0.4	3.6	3.5	3.3	3.4	3.4

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
141277-73017	Sample	5.6	3.2	14.0	22.7	5.3	0.0
	Sample Dup	5.8	3.2	14.1	23.2	5.4	0.0
	Mean	5.7	3.2	14.0	23.0	5.4	0.0
	% RPD ***	3.0	0.3	0.6	2.2	1.5	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
141277-73017	Sample Conc	2.9	7.0	11.5	2.7	0.0
	Spike Conc	9.5	9.2	10.2	10.1	10.2
	MS Result	13.0	18.0	22.2	13.3	10.7
	MSD Result	12.7	17.3	21.2	12.6	10.1
	MS % Rec **	107.1	119.3	105.2	105.6	104.4
	MSD % Rec **	103.7	111.8	95.3	98.2	99.1
	% RPD ***	3.2	6.5	9.9	7.3	5.2

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.7	10.4	20.9	10.6	10.3	10.4
	% Rec *	101.7	103.4	103.4	103.6	101.8	101.9

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 8/6/2014
Analyst: ZG

Instrument ID: SCD#10
Calb. Date: 1/27/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppbV)	% Rec *	% RPD ****
Initial	15504	516	103.3	NA
Duplicate	15534	517	103.5	0.2
Triplicate	15461	515	103.0	0.3

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis Sample ID 141271-73002 x1

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	2.6	2.4	2.5	4.7

Matrix Spike & Duplicate Sample ID 141271-73002 x1

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	1.2	250.0	247.6	244.3	98.5	97.2	1.3

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result (ppbV)	% Rec **
H2S	500.0	480.4	96.1

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** Must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 8/7/2014
Analyst: ZG

Instrument ID: SCD#10
Calb. Date: 1/27/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppbV)	% Rec *	% RPD ****
Initial	14912	497	99.4	NA
Duplicate	14809	493	98.7	0.7
Triplicate	14881	496	99.1	0.2

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis Sample ID 141277-73018 x500

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.0	0.0	0.0	0.0

Matrix Spike & Duplicate Sample ID 141277-73018 x500

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.0	250.0	251.5	231.5	100.6	92.6	8.3

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result (ppbV)	% Rec **
H2S	500.0	510.5	102.1

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** Must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
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AAC Project No. 141277

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

dbrennan@scsengineers.com

Client Name: Bridgeton LF
Project Name: Pilot Study
Project Mgr (Print Name): Dan Brennan
Project Number: 23211003.17
Sampler's Name (Print Name): Dan Brennan
Sampler's Signature: Daniel Brennan

Analysis Requested: ASTM D5504; EPA 3C CH4, CO2, CO, N2, H2, O2

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	ASTM D5504	EPA 3C CH4, CO2, CO, N2, H2, O2				
626	8/5/14	9:45		Inlet Round 1		X	X	73019			
302	8/5/14	9:53		Middle Round 1		X	X	73018			
675	8/5/14	10:01		Outlet Round 1		X	X	73017			
368	8/5/14	1:22pm		Inlet Round 2		X	X	73022			
625	8/5/14	1:30pm		Middle Round 2		X	X	73021			
677	8/5/14	1:40pm		Outlet Round 2		X	X	73020			

Send report:
Attn:
Phone#:
Fax#

Send invoice to:
SCS Engineers
2060 Reading Road
Suite 200
Cincinnati, Ohio 45202
Attn: Dan Brennan
P.O. #

Turnaround Time
24 - 48 Hr X 72 Hr
5 Day Normal
Other (Specify)

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
F. Daniel Brennan	F. Daniel Brennan	8/5/14		
Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
		8/6/14 1000 Fedex		Josh

Atmospheric Analysis & Consulting, Inc.

CLIENT : SCS Engineers
PROJECT NAME : Bridgeton LF Pilot Study
PROJECT NUMBER : 23211003.17
AAC PROJECT NO. : 141336
REPORT DATE : 8/18/2014

On August 15, 2014, Atmospheric Analysis & Consulting, Inc. received three (3) 1.4-Liter Summa Canisters for Fixed Gases analysis by EPA 3C and Total Reduced Sulfur analysis by ASTM D-5504. Upon receipt, each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
Inlet Round 3	141336-73333	638.0
Middle Round 3	141336-73334	648.2
Outlet Round 3	141336-73335	653.3

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-EPA 3C and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

This report consists of 6 pages.

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Engineers**
PROJECT NO. : **141336**
MATRIX : **AIR**

SAMPLING DATE : **08/14/2014**
RECEIVING DATE : **08/15/2014**
ANALYSIS DATE : **08/15/2014**
REPORT DATE : **08/18/2014**

EPA 3C

Client ID	Inlet Round 3	Middle Round 3	Outlet Round 3
AAC ID	141336-73333	141336-73334	141336-73335
Can Dilution Factor	1.43	1.41	1.40
Analyte	Result	Result	Result
H_2	11.7 %	12.2 %	13.2 %
O_2	5.0 %	5.0 %	5.0 %
N_2	22.8 %	22.5 %	23.3 %
CO	< 0.1 %	< 0.1 %	< 0.1 %
CO_2	48.6 %	48.6 %	46.4 %
CH_4	11.8 %	11.5 %	11.9 %

All fixed gases have been normalized to 100% on a dry weight basis
Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT : **SCS Engineers**
PROJECT NO. : **141336**
MATRIX : **AIR**
UNITS : **ppmV**

SAMPLING DATE : **08/14/2014**
RECEIVING DAT] : **08/15/2014**
ANALYSIS DATE : **08/15/2014**
REPORT DATE : **08/18/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**Inlet Round 3**	**Middle Round 3**	**Outlet Round 3**
AAC ID	**141336-73333**	**141336-73334**	**141336-73335**
Canister Dil. Fac.	**1.4**	**1.4**	**1.4**
Analyte	**Result**	**Result**	**Result**
Hydrogen Sulfide	**19.0**	< 0.071	< 0.070
Carbonyl Sulfide	**0.437**	**0.425**	**0.429**
Sulfur Dioxide	< 0.072	< 0.071	< 0.070
Methyl Mercaptan	**250**	**2.21**	**0.190**
Ethyl Mercaptan	**1.58**	< 0.071	< 0.070
Dimethyl Sulfide	**1,079**	**1,279**	**1,191**
Carbon Disulfide	**1.09**	**1.10**	**1.30**
Isopropyl Mercaptan	**0.674**	< 0.071	< 0.070
tert-Butyl Mercaptan	< 0.072	< 0.071	< 0.070
n-Propyl Mercaptan	**5.69**	**5.78**	**7.27**
Methylethylsulfide	< 0.072	< 0.071	< 0.070
sec-Butyl Mercaptan	< 0.072	< 0.071	< 0.070
Thiophene	< 0.072	< 0.071	< 0.070
iso-Butyl Mercaptan	< 0.072	< 0.071	< 0.070
Diethyl Sulfide	< 0.072	< 0.071	< 0.070
n-Butyl Mercaptan	**0.650**	**0.907**	**1.20**
Dimethyl Disulfide	**87.0**	**154**	**258**
2-Methylthiophene	**0.151**	**1.28**	**1.79**
3-Methylthiophene	< 0.072	< 0.071	< 0.070
Tetrahydrothiophene	**5.59**	**8.86**	**16.0**
Bromothiophene	< 0.072	< 0.071	< 0.070
Thiophenol	< 0.072	< 0.071	< 0.070
Diethyl disulfide	**10.1**	**1.70**	**3.06**
Total Unidentified Sulfur	**11.1**	**12.9**	**19.2**
Total Reduced Sulfurs as H_2S	**1,472**	**1,467**	**1,499**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Marcus Hueppe
Laboratory Director

1534 Eastman Ave., Ste. A • Ventura, • CA 93003 www.aaclab.com • (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 08/15/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 08/05/2014
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	10.4	9.8	20.2	10.5	9.9	10.1
	% Rec *	109.3	97.8	99.7	102.6	98.2	98.4

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	LCS Result	10.8	10.0	20.5	10.2	9.5	9.6
	LCSD Result	10.6	9.7	19.6	10.2	9.6	9.7
	LCS % Rec *	113.6	99.7	101.5	99.5	94.1	94.3
	LCSD % Rec *	111.2	96.2	96.8	99.7	95.2	95.0
	% RPD ***	2.2	3.5	4.7	0.2	1.1	0.8

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
141329-73316	Sample	0.0	0.7	8.1	22.9	33.4	0.0
	Sample Dup	0.0	0.7	8.0	23.0	33.4	0.0
	Mean	0.0	0.7	8.0	22.9	33.4	0.0
	% RPD ***	0.0	3.8	0.8	0.2	0.0	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
141329-73316	Sample Conc	0.0	4.0	11.5	16.7	0.0
	Spike Conc	9.5	9.2	10.2	10.1	10.2
	MS Result	10.4	14.3	21.6	29.0	10.4
	MSD Result	9.1	13.6	20.4	26.8	9.6
	MS % Rec **	109.1	111.6	99.0	121.2	102.1
	MSD % Rec **	95.7	104.1	87.3	100.2	93.9
	% RPD ***	13.1	7.0	12.6	19.0	8.4

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.6	9.9	20.1	10.3	9.9	10.0
	% Rec *	100.9	98.7	99.5	100.9	98.2	98.0

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 08/15/2014
Analyst: ZG

Instrument ID: GC BTU
Calb. Date: 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	2901	0.486	97.3	NA
Duplicate	2920	0.490	97.9	0.7
Triplicate	2901	0.486	97.3	0.0

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis Sample ID 141328-73314

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	877.890	831.760	854.825	5.4

Matrix Spike & Duplicate Sample ID 141328-73314 x4k

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.214	0.250	0.433	0.443	93.4	95.5	2.3

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.500	0.512	102.3

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** must be < 5% RPD from Initial result.*

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
1534 Eastman Avenue, Suite A
Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. 141336

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Bridgeton LF
Project Name: Pilot Study
Project Mgr (Print Name): Dan Brennan
Project Number: 23211003.17
Sampler's Name (Print Name): Zach Brammeier
Sampler's Signature: [signature]

Analysis Requested: ASTM D5504; EPA 3C CH4, CO2, CO, N2, H2, O2

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	ASTM D5504	EPA 3C CH4, CO2, CO, N2, H2, O2				
301	8/14/14	3:28 pm	73333	Inlet Round 3		X	X				
680	8/14/14	3:38 pm	73334	Middle Round 3		X	X				
678	8/14/14	3:48 pm	73335	Outlet Round 3		X	X				

Send report:
Attn:
Phone#:
Fax#

Send invoice to:
SCS Engineers
2060 Reading Road
Suite 200
Cincinnati, Ohio 45202
Attn: Dan Brennan
P.O. #

Turnaround Time
24 - 48 Hr X 72 Hr
5 Day Normal
Other (Specify)

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
[signature]	Zachary Brammeier	8/14/14		
Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
		8/15/14 0915	[signature]	John Zachman - Fed Ex

Atmospheric Analysis & Consulting, Inc.

CLIENT : SCS Engineers
PROJECT NAME : Bridgeton LF Pilot Study
PROJECT NUMBER : 23211003.17
AAC PROJECT NO. : 141409
REPORT DATE : 08/29/2014

On August 29, 2014, Atmospheric Analysis & Consulting, Inc. received three (3) 1.4-Liter Summa Canisters for Fixed Gases analysis by EPA 3C and Total Reduced Sulfur analysis by ASTM D-5504. Upon receipt, each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
Inlet 4	141409-73774	602.8
Middle 4	141409-73775	595.1
Outlet 4	141409-73776	603.5

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-EPA 3C and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

This report consists of 6 pages.

1534 Eastman Ave., Ste. A • Ventura, • CA 93003 www.aaclab.com • (805) 650-1642 • FAX (805) 650-1644

Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Engineers**
PROJECT NO. : **141409**
MATRIX : **AIR**

SAMPLING DATE : **08/27/2014**
RECEIVING DATE : **08/29/2014**
ANALYSIS DATE : **08/29/2014**
REPORT DATE : **08/29/2014**

EPA 3C

Client ID	Inlet 4	Middle 4	Outlet 4
AAC ID	141409-73774	141409-73775	141409-73776
Can Dilution Factor	1.61	1.62	1.63
Analyte	Result	Result	Result
H_2	10.0 %	9.8 %	10.1 %
O_2	6.0 %	6.0 %	6.0 %
N_2	26.1 %	26.1 %	26.0 %
CO	< 0.2 %	< 0.2 %	< 0.2 %
CO_2	46.3 %	46.6 %	46.4 %
CH_4	11.4 %	11.5 %	11.5 %

All fixed gases have been normalized to 100% on a dry weight basis
Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT	**: SCS Engineers**	**SAMPLING DATE**	**: 08/27/2014**
PROJECT NO.	**: 141409**	**RECEIVING DATI**	**: 08/29/2014**
MATRIX	**: AIR**	**ANALYSIS DATE**	**: 08/29/2014**
UNITS	**: ppmV**	**REPORT DATE**	**: 08/29/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**Inlet 4**	**Middle 4**	**Outlet 4**
AAC ID	**141409-73774**	**141409-73775**	**141409-73776**
Canister Dil. Fac.	**1.6**	**1.6**	**1.6**
Analyte	**Result**	**Result**	**Result**
Hydrogen Sulfide	**4.29**	< 0.810	< 0.813
Carbonyl Sulfide	< 0.805	< 0.810	< 0.813
Sulfur Dioxide	< 0.805	< 0.810	< 0.813
Methyl Mercaptan	**101**	< 0.810	< 0.813
Ethyl Mercaptan	< 0.805	< 0.810	< 0.813
Dimethyl Sulfide	**979**	**938**	**977**
Carbon Disulfide	**2.05**	**1.88**	**1.66**
Isopropyl Mercaptan	< 0.805	< 0.810	< 0.813
tert-Butyl Mercaptan	< 0.805	< 0.810	< 0.813
n-Propyl Mercaptan	**5.93**	**6.05**	**6.40**
Methylethylsulfide	< 0.805	< 0.810	< 0.813
sec-Butyl Mercaptan	< 0.805	< 0.810	< 0.813
Thiophene	< 0.805	< 0.810	< 0.813
iso-Butyl Mercaptan	< 0.805	< 0.810	< 0.813
Diethyl Sulfide	< 0.805	< 0.810	< 0.813
n-Butyl Mercaptan	< 0.805	**0.934**	**1.39**
Dimethyl Disulfide	**128**	**135**	**192**
2-Methylthiophene	**0.943**	**1.39**	**1.79**
3-Methylthiophene	< 0.805	< 0.810	< 0.813
Tetrahydrothiophene	**7.01**	**9.47**	**13.1**
Bromothiophene	< 0.805	< 0.810	< 0.813
Thiophenol	< 0.805	< 0.810	< 0.813
Diethyl disulfide	**44.8**	**3.46**	**3.65**
Total Unidentified Sulfur	**12.8**	**10.8**	**13.1**
Total Reduced Sulfurs as H_2S	**1,285**	**1,107**	**1,211**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

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Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 08/29/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 08/05/2014
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.5	8.9	21.0	11.7	11.4	11.8
	% Rec *	100.3	88.4	103.7	114.3	113.1	114.9

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	LCS Result	9.5	9.7	19.8	10.3	9.8	9.7
	LCSD Result	9.7	9.8	20.6	11.0	10.5	10.5
	LCS % Rec *	99.7	96.1	98.0	101.2	97.0	95.3
	LCSD % Rec *	102.0	97.1	102.0	107.3	104.0	102.6
	% RPD ***	2.3	1.0	4.0	5.9	6.9	7.4

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
141405-73745	Sample	0.0	9.5	46.8	3.3	0.0	0.0
	Sample Dup	0.0	10.4	51.7	3.5	0.0	0.0
	Mean	0.0	9.9	49.3	3.4	0.0	0.0
	% RPD ***	0.0	8.9	9.9	6.7	0.0	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
141405-73745	Sample Conc	0.0	24.6	1.7	0.0	0.0
	Spike Conc	9.5	9.2	10.2	10.1	10.2
	MS Result	8.2	32.6	11.8	9.9	10.0
	MSD Result	8.5	33.0	11.9	10.0	10.1
	MS % Rec **	86.7	86.9	99.1	98.5	97.9
	MSD % Rec **	89.4	90.3	99.6	99.2	98.3
	% RPD ***	3.1	3.9	0.6	0.7	0.4

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.3	9.0	18.6	9.9	9.3	9.3
	% Rec *	97.6	89.6	91.9	96.6	91.9	91.1

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 08/29/2014
Analyst: ZG

Instrument ID: GC BTU
Calb. Date: 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	3044	0.510	102.1	NA
Duplicate	3119	0.523	104.6	2.4
Triplicate	3129	0.525	104.9	2.8

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis Sample ID 141408-73767 x10

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.140	0.140	0.140	0.2

Matrix Spike & Duplicate Sample ID 141408-73767 x10

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.014	0.250	0.268	0.251	101.5	95.1	6.5

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.500	0.539	107.8

** Must be 95-105%*
*** Must be 90-110%*
**** Must be < 10%*
***** must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
1534 Eastman Avenue, Suite A
Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. 141409

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Bridgeton LF
Project Name: Pilot Study
Project Mgr (Print Name): Dan Brennan
Project Number: 23211003.17
Sampler's Name (Print Name): Zach Brammeier
Sampler's Signature: Zachary Brammeier

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	ASTM D5504	EPA 3C CH4, CO2, CO, N2, H2, O2				
682	8/27/14	3:33 pm	73774	Inlet 4		X	X				
295	8/27/14	3:42 pm	73775	Middle 4		X	X				
293	8/27/14	3:50 pm	73776	Outlet 4		X	X				

Analysis Requested

Send report:
Attn:
Phone#:
Fax#

Send invoice to:
SCS Engineers
2060 Reading Road
Suite 200
Cincinnati, Ohio 45202
Attn: Dan Brennan
P.O. #

Turnaround Time
24-Hr X 48-Hr
5 Day Normal
Other (Specify)

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
Zachary Brammeier	Zach Brammeier	8/28/14		
Relinquished by (Signature):	Print Name:	Date/Time 1020 8/29/14	Received by (signature):	Print Name John Zachman

Fed Ex

Atmospheric Analysis & Consulting, Inc.

CLIENT	: SCS Engineers
PROJECT NAME	: Bridgeton LF Pilot Study
PROJECT NUMBER	: 23211003.17
AAC PROJECT NO.	: 141490
REPORT DATE	: 09/15/2014

On September 12, 2014, Atmospheric Analysis & Consulting, Inc. received three (3) 1.4-Liter Summa Canisters for Fixed Gases analysis by EPA 3C and Total Reduced Sulfur analysis by ASTM D-5504. Upon receipt, each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
Inlet 5	141490-74233	673.6
Middle 5	141490-74234	676.2
Outlet 5	141490-74235	678.7

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-EPA 3C and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac Certificate #E87837

This report consists of 6 pages.

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Engineers**
PROJECT NO. : **141490**
MATRIX : **AIR**

SAMPLING DATE : **09/11/2014**
RECEIVING DATE : **09/12/2014**
ANALYSIS DATE : **09/15/2014**
REPORT DATE : **09/15/2014**

EPA 3C

Client ID	Inlet 5	Middle 5	Outlet 5
AAC ID	141490-74233	141490-74234	141490-74235
Can Dilution Factor	1.34	1.34	1.33
Analyte	Result	Result	Result
H_2	11.9 %	10.9 %	10.9 %
O_2	6.8 %	7.0 %	6.9 %
N_2	29.7 %	30.0 %	29.7 %
CO	0.1 %	< 0.1 %	< 0.1 %
CO_2	40.9 %	41.4 %	41.8 %
CH_4	10.5 %	10.5 %	10.6 %

All fixed gases have been normalized to 100% on a dry weight basis

Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT	**: SCS Engineers**	**SAMPLING DATE**	**: 09/11/2014**
PROJECT NO.	**: 141490**	**RECEIVING DATE**	**: 09/12/2014**
MATRIX	**: AIR**	**ANALYSIS DATE**	**: 09/15/2014**
UNITS	**: ppmV**	**REPORT DATE**	**: 09/15/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**Inlet 5**	**Middle 5**	**Outlet 5**
AAC ID	**141490-74233**	**141490-74234**	**141490-74235**
Canister Dil. Fac.	**1.3**	**1.3**	**1.3**
Analyte	**Result**	**Result**	**Result**
Hydrogen Sulfide	**29.6**	< 0.134	< 0.133
Carbonyl Sulfide	**0.423**	**0.481**	**0.449**
Sulfur Dioxide	< 0.134	< 0.134	< 0.133
Methyl Mercaptan	**221**	**0.185**	**0.327**
Ethyl Mercaptan	**1.44**	< 0.134	< 0.133
Dimethyl Sulfide	**902**	**755**	**630**
Carbon Disulfide	**0.788**	**0.755**	**0.793**
Isopropyl Mercaptan	**0.758**	< 0.134	< 0.133
tert-Butyl Mercaptan	< 0.134	< 0.134	< 0.133
n-Propyl Mercaptan	**3.37**	**3.67**	**3.91**
Methylethylsulfide	< 0.134	< 0.134	< 0.133
sec-Butyl Mercaptan	< 0.134	< 0.134	< 0.133
Thiophene	< 0.134	< 0.134	< 0.133
iso-Butyl Mercaptan	< 0.134	< 0.134	< 0.133
Diethyl Sulfide	< 0.134	< 0.134	< 0.133
n-Butyl Mercaptan	< 0.134	**0.284**	**0.255**
Dimethyl Disulfide	**15.1**	**34.7**	**43.6**
2-Methylthiophene	**0.212**	**0.434**	**0.541**
3-Methylthiophene	< 0.134	< 0.134	< 0.133
Tetrahydrothiophene	**0.731**	**1.55**	**1.93**
Bromothiophene	< 0.134	< 0.134	< 0.133
Thiophenol	< 0.134	< 0.134	< 0.133
Diethyl disulfide	**5.63**	**1.46**	< 0.133
Total Unidentified Sulfur	**3.23**	**5.40**	**5.64**
Total Reduced Sulfurs as H_2S	**1,184**	**804**	**687**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Marcus Hueppe
Laboratory Director

Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 09/15/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 08/05/2014
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.9	10.5	21.7	10.4	9.6	9.6
	% Rec *	104.0	104.4	107.4	101.4	94.9	94.2

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	LCS Result	9.7	10.1	21.2	10.5	9.6	9.5
	LCSD Result	9.4	10.1	21.1	10.4	9.7	9.8
	LCS % Rec *	102.6	99.9	105.1	102.2	94.6	93.3
	LCSD % Rec *	99.0	100.7	104.5	101.7	96.4	95.3
	% RPD ***	3.5	0.8	0.6	0.5	1.9	2.1

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
141477-74160	Sample	0.0	0.3	44.9	6.8	0.0	0.0
	Sample Dup	0.0	0.3	43.2	6.7	0.0	0.0
	Mean	0.0	0.3	44.1	6.7	0.0	0.0
	% RPD ***	0.0	5.8	3.9	0.8	0.0	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
141477-74160	Sample Conc	0.0	22.0	3.4	0.0	0.0
	Spike Conc	9.5	9.2	10.2	10.1	10.2
	MS Result	9.5	32.1	13.3	9.7	9.7
	MSD Result	9.6	32.4	13.3	9.6	9.7
	MS % Rec **	99.7	109.2	97.1	95.8	94.6
	MSD % Rec **	100.7	112.2	97.0	94.8	94.8
	% RPD ***	1.0	2.7	0.1	1.0	0.1

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	10.3	10.2	21.1	11.2	10.6	10.7
	% Rec *	108.8	101.2	104.6	109.2	104.6	104.3

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 09/15/2014 **Instrument ID: GC BTU**
Analyst: ZG **Calb. Date:** 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	2973	0.498	99.7	NA
Duplicate	2935	0.492	98.4	1.3
Triplicate	2937	0.492	98.5	1.2

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis **Sample ID** 141496-74281 x1

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	0.057	0.056	0.056	1.8

Matrix Spike & Duplicate **Sample ID** 141496-74281 x1

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.028	0.250	0.261	0.260	93.9	93.4	0.5

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.500	0.480	96.0

** Must be 95-105%*

*** Must be 90-110%*

**** Must be < 10%*

***** must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
1534 Eastman Avenue, Suite A
Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. _____ Page ____ of ____

141490

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Bridgefan LF
Project Name: Pilot Study
Project Mgr (Print Name): Dan Brennan
Project Number: 23211003.17
Sampler's Name (Print Name): Zach Brammeier
Sampler's Signature: Zachary Brammeier

Analysis Requested: ASTM D5504; EPA 3C CH4, CO2, CO, N2, H2, O2

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	ASTM D5504	EPA 3C CH4, CO2, CO, N2, H2, O2				
294	9/11/14	1214pm		Inlet 5		X	X	74233			
676	9/11/14	1224pm		Middle 5		X	X	74234			
363	9/11/14	1234pm		Outlet 5		X	X	74235			

Send report:
Attn: _____
Phone#: _____
Fax# _____

Send invoice to:
SCS Engineers
2060 Reading Road
Suite 200
Cincinnati, Ohio 45202
Attn: _____
P.O. # _____

Turnaround Time
24-Hr X 48-Hr ____
5 Day ____ Normal ____
Other (Specify) _____

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
Zachary Brammeier	Zachary Brammeier	9/11/14		
Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
		9/12/14 1400	[signature]	Tony DiCeglie

Drop off

Atmospheric Analysis & Consulting, Inc.

CLIENT	: SCS Engineers
PROJECT NAME	: Bridgeton LF Pilot Study
PROJECT NUMBER	: 23211003.17
AAC PROJECT NO.	: 141562
REPORT DATE	: 09/29/2014

On September 26, 2014, Atmospheric Analysis & Consulting, Inc. received three (3) 1.4-Liter Summa Canisters for Fixed Gases analysis by EPA 3C and Total Reduced Sulfur analysis by ASTM D-5504. Upon receipt, each sample was assigned a unique Laboratory ID number as follows:

Client ID	Lab No.	Initial Pressure (mmHg)
Inlet 6	141562-74631	701.6
Middle 6	141562-74632	610.1
Outlet 6	141562-74633	633.0

EPA 3C Analysis - An aliquot of the gaseous sample is injected into the GC/TCD for analysis following EPA 3C as specified in the SOW.

ASTM D-5504 Analysis - Up to a 1 mL aliquot of sample is injected into the GC/SCD for analysis following ASTM D-5504 as specified in the SOW.

No problems were encountered during receiving, preparation, and/or analysis of these samples. The test results included in this report meet all requirements of the NELAC Standards and/or AAC SOP# AACI-EPA 3C and ASTM D-5504.

I certify that this data is technically accurate, complete, and in compliance with the terms and conditions of the contract. The Laboratory Director or his designee, as verified by the following signature, has authorized release of the data contained in this hardcopy data package.

If you have any questions or require further explanation of data results, please contact the undersigned.

Marcus Hueppe
Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac
Certificate #E87837

This report consists of 7 pages.

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Atmospheric Analysis & Consulting, Inc.

Laboratory Analysis Report

CLIENT : **SCS Engineers**
PROJECT NO. : **141562**
MATRIX : **AIR**

SAMPLING DATE : **09/25/2014**
RECEIVING DATE : **09/26/2014**
ANALYSIS DATE : **09/26/2014**
REPORT DATE : **09/29/2014**

EPA 3C

Client ID	Inlet 6	Middle 6	Outlet 6
AAC ID	141562-74631	141562-74632	141562-74633
Can Dilution Factor	1.47	1.70	1.63
Analyte	Result	Result	Result
H_2	10.3 %	10.4 %	10.2 %
O_2	8.1 %	7.8 %	8.1 %
N_2	34.8 %	33.9 %	34.7 %
CO	< 0.1 %	< 0.2 %	< 0.2 %
CO_2	37.1 %	37.9 %	37.2 %
CH_4	9.7 %	9.8 %	9.6 %

All fixed gases have been normalized to 100% on a dry weight basis
Sample Reporting Limit (SRL) is equal to Reporting Limit x Analysis Dil. Fac x Canister Dil. Fac

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

LABORATORY ANALYSIS REPORT

CLIENT	**: SCS Engineers**	**SAMPLING DATE**	**: 09/25/2014**
PROJECT NO.	**: 141562**	**RECEIVING DATE**	**: 09/26/2014**
MATRIX	**: AIR**	**ANALYSIS DATE**	**: 09/15/2014**
UNITS	**: ppmV**	**REPORT DATE**	**: 09/29/2014**

Total Reduced Sulfur Compounds Analysis by ASTM D-5504

Client ID	**Inlet 6**	**Middle 6**	**Outlet 6**
AAC ID	**141562-74631**	**141562-74632**	**141562-74633**
Canister Dil. Fac.	**1.5**	**1.7**	**1.6**
Analyte	**Result**	**Result**	**Result**
Hydrogen Sulfide	**18.9**	< 0.085	< 0.082
Carbonyl Sulfide	**0.491**	**0.482**	**0.511**
Sulfur Dioxide	< 0.073	< 0.085	< 0.082
Methyl Mercaptan	**170**	**1.49**	< 0.082
Ethyl Mercaptan	**1.14**	< 0.085	< 0.082
Dimethyl Sulfide	**1,050**	**955**	**911**
Carbon Disulfide	**1.13**	**1.03**	**1.19**
Isopropyl Mercaptan	**0.529**	< 0.085	< 0.082
tert-Butyl Mercaptan	**6.27**	**6.93**	**8.92**
n-Propyl Mercaptan	**4.34**	**4.22**	**5.24**
Methylethylsulfide	< 0.073	< 0.085	< 0.082
sec-Butyl Mercaptan	< 0.073	< 0.085	< 0.082
Thiophene	< 0.073	< 0.085	< 0.082
iso-Butyl Mercaptan	< 0.073	< 0.085	< 0.082
Diethyl Sulfide	< 0.073	< 0.085	< 0.082
n-Butyl Mercaptan	**0.436**	< 0.085	< 0.082
Dimethyl Disulfide	**42.4**	**69.8**	**105.7**
2-Methylthiophene	**0.642**	**0.685**	**0.924**
3-Methylthiophene	< 0.073	< 0.085	< 0.082
Tetrahydrothiophene	**3.27**	**3.89**	**5.50**
Bromothiophene	< 0.073	< 0.085	< 0.082
Thiophenol	< 0.073	< 0.085	< 0.082
Diethyl disulfide	< 0.073	< 0.085	< 0.082
Total Unidentified Sulfur	< 0.073	< 0.085	< 0.082
Total Reduced Sulfurs as H_2S	**1,299**	**1,043**	**1,038**

All compound's concentrations expressed in terms of H_2S (TRS does not include COS and SO_2)
Sample Reporting Limit (SRL) is equal to Reporting Limit x Canister Dil. Fac. x Analysis Dil. Fac.

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report

Date Analyzed : 09/26/2014
Analyst : ZG
Units : %

Instrument ID : TCD#1
Calb Date : 08/05/2014
Reporting Limit : 0.1%

I - Opening Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.5	9.8	20.4	9.7	8.9	8.9
	% Rec *	100.3	97.7	100.8	94.7	88.1	87.4

II - Method Blank - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
MB	Concentration	ND	ND	ND	ND	ND	ND

III - Laboratory Control Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
Lab Control Standards	Sample Conc	0.0	0.0	0.0	0.0	0.0	0.0
	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	LCS Result	9.8	10.6	22.0	10.5	9.9	10.1
	LCSD Result	9.6	10.5	21.9	10.4	9.9	10.0
	LCS % Rec *	103.1	105.3	109.0	102.9	98.3	98.3
	LCSD % Rec *	100.6	104.2	108.3	102.1	97.9	97.8
	% RPD ***	2.4	1.1	0.7	0.7	0.4	0.5

IV - Sample & Sample Duplicate - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
141560-74626	Sample	0.0	0.1	53.2	8.1	0.0	0.0
	Sample Dup	0.0	0.1	53.5	8.1	0.0	0.0
	Mean	0.0	0.1	53.4	8.1	0.0	0.0
	% RPD ***	0.0	0.9	0.5	0.1	0.0	0.0

V - Matrix Spike & Duplicate - EPA 3C

AAC ID	Analyte	H_2	N_2	CO_2	CH_4	CO
141560-74626	Sample Conc	0.0	26.7	4.1	0.0	0.0
	Spike Conc	9.5	9.2	10.2	10.1	10.2
	MS Result	9.8	37.0	14.4	10.4	10.5
	MSD Result	9.5	36.9	14.2	10.1	10.2
	MS % Rec **	102.7	112.1	100.7	103.2	102.4
	MSD % Rec **	100.1	110.6	99.3	100.1	99.5
	% RPD ***	2.6	1.3	1.4	3.1	2.9

VI - Closing Continuing Calibration Verification - EPA 3C

AAC ID	Analyte	H_2	O_2	N_2	CO_2	CH_4	CO
CCV	Spike Conc	9.5	10.1	20.2	10.2	10.1	10.2
	Result	9.6	10.4	21.4	11.2	10.8	10.8
	% Rec *	101.2	103.4	105.9	109.8	106.5	105.6

** Must be 85-115%*
*** Must be 75-125%*
**** Must be < 25%*
ND = Not Detected
<RL = less than Reporting Limit

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 09/26/2014 **Instrument ID: GC BTU**
Analyst: ZG **Calb. Date:** 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	3018	0.506	101.2	NA
Duplicate	3056	0.512	102.5	1.3
Triplicate	3043	0.510	102.0	0.8

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis **Sample ID** 141561-74630

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	275.230	272.710	273.970	0.9

Matrix Spike & Duplicate **Sample ID** 141561-74630 x1000

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.274	0.250	0.487	0.478	92.9	91.2	1.9

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.500	0.521	104.2

** Must be 95-105%*

*** Must be 90-110%*

**** Must be < 10%*

***** must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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Atmospheric Analysis & Consulting, Inc.

Quality Control/Quality Assurance Report
ASTM D-5504

Date Analyzed: 09/29/2014
Analyst: ZG

Instrument ID: GC BTU
Calb. Date: 5/13/2014

Opening Calibration Verification Standard

	Resp. (area)	Result (ppmV)	% Rec *	% RPD ****
Initial	3058	0.513	102.5	NA
Duplicate	3099	0.520	103.9	1.3
Triplicate	3094	0.519	103.7	1.2

Method Blank

Analyte	Result
H2S	ND

Duplicate Analysis Sample ID 141562-74631

Analyte	Sample Result	Duplicate Result	Mean	% RPD ***
H2S	13.080	12.670	12.875	3.2

Matrix Spike & Duplicate Sample ID 141562-74631 x50

Analyte	Sample Conc.	Spike Added	MS Result	MSD Result	MS % Rec **	MSD % Rec **	% RPD ***
H2S	0.258	0.250	0.487	0.489	96.0	96.4	0.4

Closing Calibration Verification Standard

Analyte	Std. Conc.	Result	%Recovery **
H2S	0.500	0.493	98.6

** Must be 95-105%*

*** Must be 90-110%*

**** Must be < 10%*

***** must be < 5% RPD from Initial result.*

Marcus Hueppe
Laboratory Director

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ATMOSPHERIC ANALYSIS & CONSULTING, INC.
1534 Eastman Avenue, Suite A
Ventura, California 93003
Phone (805) 650-1642 Fax (805) 650-1644
E-mail: info@aaclab.com

AAC Project No. 141562

CHAIN OF CUSTODY/ ANALYSIS REQUEST FORM

Client Name: Bridgeton LF
Project Name: Pilot Study
Project Mgr (Print Name): Dan Brennan
Project Number: 23211003.17
Sampler's Name (Print Name): Zach Brammeier
Sampler's Signature: Zachary Brammeier

Analysis Requested: ASTM D5504; EPA 3C CH4, CO2, O2, N2, H2, O2

AAC Sample No.	Date Sampled	Time Sampled	Sample Type	Client Sample ID/Description	Type/No. of Containers	ASTM D5504	EPA 3C CH4, CO2, O2, N2, H2, O2				
722	9/25/14	1305		Inlet Round 6		X	X		746	31	
627	9/25/14	1318		Middle Round 6		X	X		746	32	
295	9/25/14	1327		Outlet Round 6		X	X		746	33	

Send report:

Attn: _____

Phone#: _____
Fax# _____

Send invoice to:
SCS Engineers
2060 Reading Road
Suite 200
Cincinnati, Ohio 45202
Attn: Dan Brennan

P.O. # _____

Turnaround Time

24 - 48 Hr X 72 Hr ____

5 Day ____ Normal ____
Other (Specify) _____

Special Instructions/remarks:

Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
Zachary Brammeier	Zachary Brammeier	9/25/14		
Relinquished by (Signature):	Print Name:	Date/Time	Received by (signature):	Print Name
		9/26/14	[signature]	Tony DiCeglie

Fed Ex 0945

3x 1.4L Cans

APPENDIX C

Daily Field Check Log

Date	Liquid in Inlet Line?	System Gas Flow Rate	Vessel 1 Pressure	Vessel 2 Pressure	Comments	Last Updated By	Last Updated Time
8/6/2014 8:30	FALSE	10	10	9.5		Dan Brennan	8/7/2014 8:30
8/7/2014 5:04	FALSE	9	10	9.5	adjusted flow back to 10 scfm	Dan Brennan	8/7/2014 17:04
8/11/2014 8:19	FALSE	9	15	10		Ryan Daniels	8/11/2014 8:19
8/11/2014 13:28	FALSE	12	15	10	vessel 1 surging 15-20 " liquid in barrels	Ryan Daniels	8/11/2014 13:28
8/12/2014 8:34	FALSE	10	16	10	drained liquid out of line	Ryan Daniels	8/12/2014 8:34
8/13/2014 8:29	FALSE	17	14	8	drained liquid from line	Ryan Daniels	8/13/2014 8:29
8/13/2014 16:52	TRUE	5	15	10	Drained the barrels, and Vessel 1 pressure is bouncing from 12 to 17	Dan Brennan	8/13/2014 16:51
8/14/2014 7:52	FALSE	11	15	10	vessel 1 press. surging 15-18". drained liquid from line through bypass	Ryan Daniels	8/14/2014 7:52
8/14/2014 16:00	TRUE	5	15	9	Third round of sampling. Vessel one pressure bouncing from 12 to 17	Dan Brennan	8/14/2014 16:18
8/15/2014 11:24	FALSE	5	15	9	drained liquid in line	Ryan Daniels	8/15/2014 11:24
8/18/2014 7:34	FALSE	5	15	9	drained liquid in line	Ryan Daniels	8/18/2014 7:34
8/19/2014 8:32	TRUE	5	16	9	drained liquid	Ryan Daniels	8/19/2014 8:32
8/19/2014 17:40	TRUE	5	11	10	Put the additives into both vessels	Dan Brennan	8/19/2014 17:51
8/20/2014 7:34	TRUE	5	15	10	drained liquid	Ryan Daniels	8/20/2014 7:34
8/21/2014 8:04	TRUE	5	15	10	drained liquid	Ryan Daniels	8/21/2014 8:04
8/22/2014 14:30	TRUE	5	15	10	drained liquid	Ryan Daniels	8/22/2014 14:30
8/25/2014 7:55	TRUE	5	15	10	drained liquid	Ryan Daniels	8/25/2014 7:55
8/25/2014 3:40	FALSE	3	15	11	adjusted flow to 5scfm	Dan Brennan	8/25/2014 15:40
8/26/2014 7:40	TRUE	5	15	10	drained liquid	Ryan Daniels	8/26/2014 7:40
8/27/2014 7:57	TRUE	5	15	9	drained liquid	Ryan Daniels	8/27/2014 15:57
8/27/2014 16:40	TRUE	5	17	12	Pulled fourth set of samples	Dan Brennan	8/27/2014 17:07
8/28/2014 8:23	TRUE	5	17	10.5	drained liquid	Ryan Daniels	8/28/2014 8:23
9/2/2014 7:37	TRUE	5	17	11	drained liquid	Ryan Daniels	9/2/2014 7:37
9/3/2014 11:19	TRUE	6	18	10	drained liquid	Ryan Daniels	9/3/2014 11:19
9/8/2014 11:13	TRUE	5	20	10	drained liquid	Ryan Daniels	9/8/2014 11:13
9/9/2014 8:45	TRUE	5	18	10	drained liquid	Ryan Daniels	9/9/2014 8:45
9/11/2014 11:10	TRUE	5	19	11	drained liquid	Ryan Daniels	9/11/2014 11:10
9/22/2014 8:23	TRUE	5	20	10	drained liquid	Ryan Daniels	9/22/2014 8:23
9/24/2014 10:10	TRUE	5	22	12	drained liquid	Ryan Daniels	9/26/2014 8:09
9/25/2014 11:00	TRUE	5	25	18	drained liquid	Ryan Daniels	9/26/2014 8:09
9/26/2014 8:10	TRUE	5	25	17	drained liquid	Ryan Daniels	9/26/2014 8:10
9/30/2014 15:55	TRUE	3	22	12	drained liquid	Ryan Daniels	9/30/2014 15:55
10/1/2014 7:50	TRUE	7	25	12	drained liquid	Ryan Daniels	10/1/2014 7:50
10/2/2014 13:59	TRUE	5	23	11	drained liquid	Ryan Daniels	10/2/2014 13:59

APPENDIX D

Field Gas Sampling Forms

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	8/5/2014	Clear, cool	SCS: Dan Brennan	Zachary Brammeier

SUMMA CANNISTER ID	626	302	675		
SAMPLE NO.	Inlet #1	Middle #1	Outlet #1		
TOTAL CANISTER VACUUM (in. Hg)	27.0	27.0	27.5		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	19.3	19.3	19.6		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	9:41 AM	9:50 AM	9:58 AM		
PURGE RATE (ml/min)	500	500	500		
TIME: END PURGE	9:43 AM	9:52 AM	10:00 AM		
PURGE VOLUME (L)	1.00	1.50	2.00		
GEM: % METHANE	11.8	11.8	11.8		
GEM: % CO2	46.2	46.3	46.3		
GEM: % O2	6.1	6.2	6.2		
GEM: % NITROGEN (calc)	35.9	35.7	35.7		
CANISTER VAC: INITIAL (in. of Hg)	27.0	27.0	27.5		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	9:45 AM	9:53 AM	10:01 AM		
SAMPLE FILL RATE (ml/min)	570.0	380.0	287.5		
TIME: END FILL	9:47 AM	9:56 AM	10:05 AM		
SAMPLE VOLUME (L)	1.14	1.14	1.15		
SAMPLE DEPTH (FT)					

GEM Serial #

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	8/5/2014	Sunny	SCS: Dan Brennan	Zachary Brammeier

SUMMA CANNISTER ID	368	625	677		
SAMPLE NO.	Inlet #2	Middle #2	Outlet #2		
TOTAL CANISTER VACUUM (in. Hg)	29.5	29.5	30.0		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	21.1	21.1	21.4		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	1:15 PM	1:26 PM	1:36 PM		
PURGE RATE (ml/min)	350	350	350		
TIME: END PURGE	1:18 PM	1:29 PM	1:39 PM		
PURGE VOLUME (L)	1.05	1.05	1.05		
GEM: % METHANE	11.8	11.8	11.8		
GEM: % CO2	46.2	46.3	46.3		
GEM: % O2	6.1	6.2	6.2		
GEM: % NITROGEN (calc)	35.9	35.7	35.7		
CANISTER VAC: INITIAL (in. of Hg)	29.5	29.5	30.0		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	1:22 PM	1:30 PM	1:40 PM		
SAMPLE FILL RATE (ml/min)	580.0	386.7	390.0		
TIME: END FILL	1:24 PM	1:33 PM	1:43 PM		
SAMPLE VOLUME (L)	1.16	1.16	1.17		
SAMPLE DEPTH (FT)					

GEM Serial #

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	8/14/2014	Clear	SCS: Zachary Brammeier	

SUMMA CANNISTER ID	626	302	675		
SAMPLE NO.	Inlet #3	Middle #3	Outlet #3		
TOTAL CANISTER VACUUM (in. Hg)	29.5	30.0	30.0		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	21.1	21.4	21.4		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	3:25 PM	3:35 PM	3:44 PM		
PURGE RATE (ml/min)	350	400	400		
TIME: END PURGE	3:28 PM	3:38 PM	3:47 PM		
PURGE VOLUME (L)	1.05	1.20	1.20		
GEM: % METHANE	13.7	13.9	14.0		
GEM: % CO2	51.4	51.8	51.8		
GEM: % O2	4.5	4.3	4.3		
GEM: % NITROGEN (calc)	30.4	30.0	29.9		
CANISTER VAC: INITIAL (in. of Hg)	29.5	30.0	30.0		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	3:28 PM	3:38 PM	3:48 PM		
SAMPLE FILL RATE (ml/min)	386.7	390	390		
TIME: END FILL	3:31 PM	3:41 PM	3:51 PM		
SAMPLE VOLUME (L)	1.16	1.17	1.17		
SAMPLE DEPTH (FT)					

GEM Serial #

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	8/27/2014	Sunny	SCS: Zachary Brammeier	

SUMMA CANNISTER ID	682	295	293		
SAMPLE NO.	Inlet #4	Middle #4	Outlet #4		
TOTAL CANISTER VACUUM (in. Hg)	28.0	28.5	28.5		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	20.0	20.4	20.4		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	3:25 PM	3:38 PM	3:46 PM		
PURGE RATE (ml/min)	350	400	350		
TIME: END PURGE	3:28 PM	3:41 PM	3:49 PM		
PURGE VOLUME (L)	1.05	1.20	1.05		
GEM: % METHANE	15.8	14.3	12.1		
GEM: % CO2	48.7	47.6	46.0		
GEM: % O2	2.8	5.3	5.1		
GEM: % NITROGEN (calc)	32.7	32.8	36.8		
CANISTER VAC: INITIAL (in. of Hg)	28.0	28.5	28.5		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	3:33 PM	3:42 PM	3:50 PM		
SAMPLE FILL RATE (ml/min)	383.3	383.3	383.3		
TIME: END FILL	3:36 PM	3:45 PM	3:53 PM		
SAMPLE VOLUME (L)	1.15	1.15	1.15		
SAMPLE DEPTH (FT)					

GEM Serial #

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	9/11/2014	Sunny	SCS: Zachary Brammeier	

SUMMA CANNISTER ID	294	676	363		
SAMPLE NO.	Inlet #5	Middle #5	Outlet #5		
TOTAL CANISTER VACUUM (in. Hg)	28.5	29.0	29.5		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	20.4	20.7	21.1		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	12:10 PM	12:20 PM	12:30 PM		
PURGE RATE (ml/min)	350	350	350		
TIME: END PURGE	12:13 PM	12:23 PM	12:33 PM		
PURGE VOLUME (L)	1.05	1.05	1.05		
GEM: % METHANE	11.1	11.3	11.3		
GEM: % CO2	43.2	44.0	43.4		
GEM: % O2	7.1	3.7	6.8		
GEM: % NITROGEN (calc)	38.6	41.0	38.5		
CANISTER VAC: INITIAL (in. of Hg)	28.5	29.0	29.5		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	12:14 PM	12:24 PM	12:34 PM		
SAMPLE FILL RATE (ml/min)	383.3	386.7	290.0		
TIME: END FILL	12:17 PM	12:27 PM	12:38 PM		
SAMPLE VOLUME (L)	1.15	1.16	1.16		
SAMPLE DEPTH (FT)					

GEM Serial #

PROJECT/CLIENT	PROJECT LOCATION	DATE	WEATHER	PERSONNEL	
Bridgeton Landfill LLC	Bridgeton LF Pilot Scale Study	9/25/2014	Sunny	SCS: Zachary Brammeier	

SUMMA CANNISTER ID	722	627	295		
SAMPLE NO.	Inlet #6	Middle #6	Outlet #6		
TOTAL CANISTER VACUUM (in. Hg)	30.0	26.0	29.0		
CANISTER VOLUME (L)	1.4	1.4	1.4		
CANISTER VACUUM/VOL (in. Hg/L)	21.4	18.6	20.7		
AMBIENT TEMPERATURE					
BAROMETRIC PRESSURE					
TIME: BEGIN PURGE	1:00 PM	1:14 PM	1:23 PM		
PURGE RATE (ml/min)	400	350	350		
TIME: END PURGE	1:03 PM	1:17 PM	1:26 PM		
PURGE VOLUME (L)	1.20	1.05	1.05		
GEM: % METHANE	11.0	10.8	10.6		
GEM: % CO2	39.5	40.3	40.7		
GEM: % O2	7.8	7.3	7.2		
GEM: % NITROGEN (calc)	41.7	41.6	41.5		
CANISTER VAC: INITIAL (in. of Hg)	30.0	26.0	29.0		
CANISTER VAC: FINAL (in. of Hg)	5.0	5.0	5.0		
TIME: BEGIN FILL	1:05 PM	1:18 PM	1:27 PM		
SAMPLE FILL RATE (ml/min)	292.5	376.7	290.0		
TIME: END FILL	1:09 PM	1:21 PM	1:31 PM		
SAMPLE VOLUME (L)	1.17	1.13	1.16		
SAMPLE DEPTH (FT)					

GEM Serial #

APPENDIX E

MDNR Approval Documentation

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

AUG - 1 2014

Mr. Brian Power
Area Environmental Manager
Republic Services, Inc.
13570 St. Charles Rock Road
Bridgeton, MO 63044

RE: Odor Evaluation Pilot Project Study, Odor Compound Removal Assessment for Bridgeton Landfill, Permit Number 0118912, St. Louis County

Dear Mr. Power:

This letter is in response to a submittal titled "Odor Evaluation Pilot Project Study", dated July 24, 2014, hand-delivered to the Missouri Department of Natural Resources' Solid Waste Management Program (SWMP) on July 24, 2014, and information on the filter media system found at the following Internet link: http://www.mvseer.com/index.php/solutions/odor-filter/index.html provided by Bridgeton Landfill staff. The pilot project is intended to determine the effectiveness of using MV Technologies (MVT) OdorFilter™ system and filter media for removal of total reduced sulfurs (TRS) from the landfill gas stream at Bridgeton Landfill. The planned test unit will use only a small amount of collected landfill gas, 3 to 25 scfm of landfill gas, to test the removal capabilities of the filter media.

We understand this pilot project is a single component of a more in-depth contract between SCS Engineers and Bridgeton Landfill. This SWMP response is limited to the Odor Evaluation Pilot Project Study. Prior to implementation of any future projects or studies under the overall contract, Bridgeton Landfill will need to submit project work plans for review and approval of those projects by the SWMP.

The SWMP has reviewed the submittal for compliance with the Solid Waste Management Law and regulations and approves the "Odor Evaluation Pilot Project Study" using filter media in the removal of odor causing compounds in the gas at Bridgeton Landfill with the following conditions. Compliance with these conditions shall, in part, determine compliance with Permit Number 0118912.

CONDITIONS:

1. In the event that odors from the facility increase during the pilot project and are attributable to the flare system as determined by the department, immediate action will be

required of Bridgeton Landfill to mitigate the situation to the satisfaction of the department.

2. Any major change to the "Odor Evaluation Pilot Project Study", such as altering the equipment used, shall be approved by the SWMP in advance of implementing any such change. Minor changes, such as modification or changing of the filter media shall be updated in the final report due no later than 45 days from completion of the pilot project.

3. If the four week time frame for this pilot project is determined to be insufficient to allow for conclusions to be drawn, a formal request for extension of the pilot project shall be made prior to expiration of the original four week period. The original four week period is planned to begin on August 4, 2014. Should the pilot project not begin on August 4, 2014, Bridgeton Landfill shall immediately e-mail the SWMP's Engineering Section Chief notifying her of the new start date for this pilot project.

4. The final report on the pilot project will need to include the findings and lab results from the preliminary sampling and sampling conducted during pilot project implementation. Additionally, the final report will need to include an evaluation of the effectiveness of the TRS removal as well as include the individual MVT summary reports provided to Bridgeton Landfill. The final report is required to have an authorized signature from Bridgeton Landfill conveying the report to the SWMP on behalf of the permitted facility. If our understanding of the pilot project or final report is not correct, please provide clarification.

5. The final pilot project report must contain not only summary data and laboratory analysis related to the final report's findings, but also the pre-pilot sampling data and laboratory analysis used to develop the submitted work plan. All laboratory data and analysis obtained from samplings related to this pilot project must be included in the final report. The narrative of the final report must clearly identify and define evaluation criteria used in determining success or failure of the pilot project.

6. If the pilot project proves successful and should a decision be made to implement a full scale system, Bridgeton Landfill will need to develop and submit for approval a plan for installation of the full scale system prior to beginning installation of such system.

7. SWMP's personnel shall be provided reasonable access to the site to view the pilot project or conduct inspections or investigations, as applicable.

This pilot project approval is not to be construed as compliance with any existing federal or state environmental laws other than the Missouri Solid Waste Management Law; nor should this be construed as a waiver for any other regulatory requirements. This pilot project approval is not to

be construed as compliance with any existing local permitting or zoning ordinances; nor does it supersede any local permitting and/or zoning requirements.

The department reserves the right to revoke, suspend, or modify this pilot project approval after due notice for failure to maintain compliance with the Missouri Solid Waste Management Law and regulations, or the terms and conditions of this pilot project approval.

The following document is hereby incorporated into Permit Number 0118912:

DOCUMENT:

A submittal titled "Odor Evaluation Pilot Project Study" prepared by SCS Engineers dated July 24, 2014, and hand carried to the SWMP on July 24, 2014. This submittal was not signed and sealed by a P.E. licensed in the state of Missouri.

If you have any questions or comments, please contact Mr. J. P. Boessen at (573) 526-3940 or at P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S. Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:jbl

c: Mr. Jim Getting, Bridgeton Landfill
Ms. Laura Yates, St Louis County Department of Health
Mr. Larry Lehman, Chief, Compliance/Enforcement Section, SWMP
Mr. Joe Trunko, St. Louis Regional Office via Electronic Shared File

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AUG 29 2014

Mr. Brian Power
Area Environmental Manager
Republic Services, Inc.
13570 St. Charles Rock Road
Bridgeton, MO 63044

RE: Odor Evaluation Pilot Project Study, Preliminary Notice of Extension of Pilot Study
Bridgeton Landfill, Permit Number 0118912, St. Louis County

Dear Mr. Power:

This letter is in response to a submittal titled "Preliminary Notice of Extension of Pilot Study", dated and received on August 28, 2014, by the Missouri Department of Natural Resources' Solid Waste Management Program (SWMP). The pilot project was approved on August 1, 2014, for a four (4) week period to allow for evaluation of the use of a filter media for removal of odor causing compounds from landfill gas generated by the Bridgeton Landfill.

The current extension request asks for an additional two (2) week period to sample and further assess the effectiveness of the media after addition of a proprietary microbiological material and to determine any adjustments that might increase the effectiveness of the system for sulfur capture. The requested two (2) week extension will allow the facility to gather additional data points needed to analyze the effectiveness of the system.

The SWMP has reviewed the extension request for compliance with the Solid Waste Management Law and regulations and approves the request for a two (2) week extension. Compliance with the conditions listed in the August 1, 2014, letter remains in effect.

As mentioned in this submittal, should the facility determine a need to extend the pilot study, such extension needs to be requested prior to the current pilot study end date of September 15, 2014. We will continue to monitor this project closely and look forward to having an opportunity to review the summary report and data upon completion of the study.

If you have any questions or comments, please contact me at (573) 526-3940 or at P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S. Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:ld

c: Mr. James Getting, Environmental Manager
Ms. Laura Yates, St Louis County Department of Health
Mr. Larry Lehman, Compliance/Enforcement Section, SWMP
Ms. Brenda Ardrey, Operations Section Chief, SWMP
Mr. Joe Trunko, St. Louis Regional Office

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SEP 19 2014

Mr. Brian Power
Area Environmental Manager
Republic Services, Inc.
13570 St. Charles Rock Road
Bridgeton, MO 63044

RE: Odor Evaluation Pilot Project Study, Request for Extension of Pilot Study, Bridgeton Landfill, Permit Number 0118912, St. Louis County

Dear Mr. Power:

This letter is in response to an e-mail submittal titled "Request for Extension of Pilot Study", dated and received September 17, 2014, by the Missouri Department of Natural Resources' Solid Waste Management Program (SWMP). The pilot project was approved on August 1, 2014, for a four (4) week period along with a 2 week extension (August 29, 2014) to allow for evaluation of the use of a filter media for removal of odor causing compounds from landfill gas generated by the Bridgeton Landfill.

The September 15, 2014, request for extension of the pilot study states that "this latest sampling event has indicated positive results of the media bed removing odorous sulfur compounds; however the current overall data set is inconclusive." Therefore, Bridgeton Landfill is requesting an additional four (4) week extension period to further evaluate the system.

The SWMP has reviewed the extension request for compliance with the Solid Waste Management Law and regulations and approves the request for a four (4) week extension of the pilot study to run through October 17, 2014. Compliance with the conditions listed in the August 1, 2014, letter remains in effect.

As mentioned in this submittal, should the facility determine a need to extend the pilot study, such extension should be requested prior to the expiration of the current extension of the pilot study, which terminates on October 17, 2014. We recommend any extension request be submitted for review no later than October 10, 2014. We will continue to monitor this project closely and look forward to having an opportunity to review the summary report and data upon completion of the study.

Recycled Paper

The approval of this pilot study extension should not be construed as compliance with any existing federal or state laws other than the Missouri Solid Waste Management Law, nor should this be construed as a waiver of any other regulatory requirements. This approval is not to be construed as compliance with any existing local permitting or zoning ordinances, nor does it supersede any local permitting and/or zoning requirements.

If you have any questions or comments, please contact me or J. P. Boessen, of my staff at (573) 526-3940 or at P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S. Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:jbl

c: Mr. James Getting, Environmental Manager
Ms. Laura Yates, St Louis County Department of Health
Mr. Larry Lehman, Compliance/Enforcement Section, SWMP
Ms. Brenda Ardrey, Operations Section Chief, SWMP
Mr. Joe Trunko, St. Louis Regional Office via Electronic Shared File

APPENDIX F

AP-42, Section 2.4

2.4 MUNICIPAL SOLID WASTE LANDFILLS

2.4.1 General[1-4]

A municipal solid waste (MSW) landfill unit is a discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile. An MSW landfill unit may also receive other types of wastes, such as commercial solid waste, nonhazardous sludge, and industrial solid waste. The municipal solid waste types potentially accepted by MSW landfills include (most landfills accept only a few of the following categories):

- MSW,
- Household hazardous waste,
- Municipal sludge,
- Municipal waste combustion ash,
- Infectious waste,
- Waste tires,
- Industrial non-hazardous waste,
- Conditionally exempt small quantity generator (CESQG) hazardous waste,
- Construction and demolition waste,
- Agricultural wastes,
- Oil and gas wastes, and
- Mining wastes.

In the United States, approximately 57 percent of solid waste is landfilled, 16 percent is incinerated, and 27 percent is recycled or composted. There were an estimated 2,500 active MSW landfills in the United States in 1995. These landfills were estimated to receive 189 million megagrams (Mg) (208 million tons) of waste annually, with 55 to 60 percent reported as household waste, and 35 to 45 percent reported as commercial waste.

2.4.2 Process Description[2,5]

There are three major designs for municipal landfills. These are the area, trench, and ramp methods. All of these methods utilize a three step process, which includes spreading the waste, compacting the waste, and covering the waste with soil. The trench and ramp methods are not commonly used, and are not the preferred methods when liners and leachate collection systems are utilized or required by law. The area fill method involves placing waste on the ground surface or landfill liner, spreading it in layers, and compacting with heavy equipment. A daily soil cover is spread over the compacted waste. The trench method entails excavating trenches designed to receive a day's worth of waste. The soil from the excavation is often used for cover material and wind breaks. The ramp method is typically employed on sloping land, where waste is spread and compacted similar to the area method, however, the cover material obtained is generally from the front of the working face of the filling operation.

Modern landfill design often incorporates liners constructed of soil (i.e., recompacted clay), or synthetics (i.e., high density polyethylene), or both to provide an impermeable barrier to leachate (i.e., water that has passed through the landfill) and gas migration from the landfill.

2.4.3 Control Technology[1,2,6]

The Resource Conservation and Recovery Act (RCRA) Subtitle D regulations promulgated on October 9, 1991 require that the concentration of methane generated by MSW landfills not exceed 25 percent of the lower explosive limit (LEL) in on-site structures, such as scale houses, or the LEL at the facility property boundary.

The New Source Performance Standards (NSPS) and Emission Guidelines for air emissions from MSW landfills for certain new and existing landfills were published in the Federal Register on March 1, 1996. The regulation requires that Best Demonstrated Technology (BDT) be used to reduce MSW landfill emissions from affected new and existing MSW landfills emitting greater than or equal to 50 Mg/yr (55 tons/yr) of non-methane organic compounds (NMOCs). The MSW landfills that are affected by the NSPS/Emission Guidelines are each new MSW landfill, and each existing MSW landfill that has accepted waste since November 8, 1987, or that has capacity available for future use. The NSPS/Emission Guidelines affect landfills with a design capacity of 2.5 million Mg (2.75 million tons) or more. Control systems require: (1) a well-designed and well-operated gas collection system, and (2) a control device capable of reducing NMOCs in the collected gas by 98 weight-percent.

Landfill gas (LFG) collection systems are either active or passive systems. Active collection systems provide a pressure gradient in order to extract LFG by use of mechanical blowers or compressors. Passive systems allow the natural pressure gradient created by the increase in pressure created by LFG generation within the landfill to mobilize the gas for collection.

LFG control and treatment options include (1) combustion of the LFG, and (2) purification of the LFG. Combustion techniques include techniques that do not recover energy (i.e., flares and thermal incinerators), and techniques that recover energy (i.e., gas turbines and internal combustion engines) and generate electricity from the combustion of the LFG. Boilers can also be employed to recover energy from LFG in the form of steam. Flares involve an open combustion process that requires oxygen for combustion, and can be open or enclosed. Thermal incinerators heat an organic chemical to a high enough temperature in the presence of sufficient oxygen to oxidize the chemical to carbon dioxide (CO_2) and water. Purification techniques can also be used to process raw landfill gas to pipeline quality natural gas by using adsorption, absorption, and membranes.

2.4.4 Emissions[2,7]

Methane (CH_4) and CO_2 are the primary constituents of landfill gas, and are produced by microorganisms within the landfill under anaerobic conditions. Transformations of CH_4 and CO_2 are mediated by microbial populations that are adapted to the cycling of materials in anaerobic environments. Landfill gas generation, including rate and composition, proceeds through four phases. The first phase is aerobic [i.e., with oxygen (O_2) available] and the primary gas produced is CO_2. The second phase is characterized by O_2 depletion, resulting in an anaerobic environment, where large amounts of CO_2 and some hydrogen (H_2) are produced. In the third phase, CH_4 production begins, with an accompanying reduction in the amount of CO_2 produced. Nitrogen (N_2) content is initially high in landfill gas in the first phase, and declines sharply as the landfill proceeds through the second and third phases. In the fourth phase, gas production of CH_4, CO_2, and N_2 becomes fairly steady. The total time and phase duration of gas generation varies with landfill conditions (i.e., waste composition, design management, and anaerobic state).

Typically, LFG also contains a small amount of non-methane organic compounds (NMOC). This NMOC fraction often contains various organic hazardous air pollutants (HAP), greenhouse gases (GHG), and compounds associated with stratospheric ozone depletion. The NMOC fraction also contains volatile

organic compounds (VOC). The weight fraction of VOC can be determined by subtracting the weight fractions of individual compounds that are non-photochemically reactive (i.e., negligibly-reactive organic compounds as defined in 40 CFR 51.100).

Other emissions associated with MSW landfills include combustion products from LFG control and utilization equipment (i.e., flares, engines, turbines, and boilers). These include carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), hydrogen chloride (HCl), particulate matter (PM) and other combustion products (including HAPs). PM emissions can also be generated in the form of fugitive dust created by mobile sources (i.e., garbage trucks) traveling along paved and unpaved surfaces. The reader should consult AP-42 Volume I Sections 13.2.1 and 13.2.2 for information on estimating fugitive dust emissions from paved and unpaved roads.

The rate of emissions from a landfill is governed by gas production and transport mechanisms. Production mechanisms involve the production of the emission constituent in its vapor phase through vaporization, biological decomposition, or chemical reaction. Transport mechanisms involve the transportation of a volatile constituent in its vapor phase to the surface of the landfill, through the air boundary layer above the landfill, and into the atmosphere. The three major transport mechanisms that enable transport of a volatile constituent in its vapor phase are diffusion, convection, and displacement.

2.4.4.1 Uncontrolled Emissions — To estimate uncontrolled emissions of the various compounds present in landfill gas, total landfill gas emissions must first be estimated. Uncontrolled CH_4 emissions may be estimated for individual landfills by using a theoretical first-order kinetic model of methane production developed by the EPA.[8] This model is known as the Landfill Air Emissions Estimation model, and can be accessed from the Office of Air Quality Planning and Standards Technology Transfer Network Website (OAQPS TTN Web) in the Clearinghouse for Inventories and Emission Factors (CHIEF) technical area (URL http://www.epa.gov/ttn/chief). The Landfill Air Emissions Estimation model equation is as follows:

$$Q_{CH_4} = L_o R (e^{-kc} - e^{-kt}) \quad (1)$$

where:

Q_{CH_4}	=	Methane generation rate at time t, m^3/yr;
L_o	=	Methane generation potential, m^3 CH_4/Mg refuse;
R	=	Average annual refuse acceptance rate during active life, Mg/yr;
e	=	Base log, unitless;
k	=	Methane generation rate constant, yr^{-1};
c	=	Time since landfill closure, yrs (c = 0 for active landfills); and
t	=	Time since the initial refuse placement, yrs.

It should be noted that the model above was designed to estimate LFG generation and not LFG emissions to the atmosphere. Other fates may exist for the gas generated in a landfill, including capture and subsequent microbial degradation within the landfill's surface layer. Currently, there are no data that adequately address this fate. It is generally accepted that the bulk of the gas generated will be emitted through cracks or other openings in the landfill surface.

Site-specific landfill information is generally available for variables R, c, and t. When refuse acceptance rate information is scant or unknown, R can be determined by dividing the refuse in place by the age of the landfill. If a facility has documentation that a certain segment (cell) of a landfill received *only* nondegradable refuse, then the waste from this segment of the landfill can be excluded from the calculation of R. Nondegradable refuse includes concrete, brick, stone, glass, plaster, wallboard, piping, plastics, and metal

objects. The average annual acceptance rate should only be estimated by this method when there is inadequate information available on the actual average acceptance rate. The time variable, t, includes the total number of years that the refuse has been in place (including the number of years that the landfill has accepted waste and, if applicable, has been closed).

Values for variables L_o and k must be estimated. Estimation of the potential CH_4 generation capacity of refuse (L_o) is generally treated as a function of the moisture and organic content of the refuse. Estimation of the CH_4 generation constant (k) is a function of a variety of factors, including moisture, pH, temperature, and other environmental factors, and landfill operating conditions. Specific CH_4 generation constants can be computed by the use of EPA Method 2E (40 CFR Part 60 Appendix A).

The Landfill Air Emission Estimation model includes both regulatory default values and recommended AP-42 default values for L_o and k. The regulatory defaults were developed for compliance purposes (NSPS/Emission Guideline). As a result, the model contains conservative L_o and k default values in order to protect human health, to encompass a wide range of landfills, and to encourage the use of site-specific data. Therefore, different L_o and k values may be appropriate in estimating landfill emissions for particular landfills and for use in an emissions inventory.

Recommended AP-42 defaults include a k value of 0.04/yr for areas recieving 25 inches or more of rain per year. A default k of 0.02/yr should be used in drier areas (<25 inches/yr). An L_o value of 100 m^3/Mg (3,530 ft^3/ton) refuse is appropriate for most landfills. Although the recommended default k and L_o are based upon the best fit to 21 different landfills, the predicted methane emissions ranged from 38 to 492% of actual, and had a relative standard deviation of 0.85. It should be emphasized that in order to comply with the NSPS/Emission Guideline, the regulatory defaults for k and L_o must be applied as specified in the final rule.

When gas generation reaches steady state conditions, LFG consists of approximately 40 percent by volume CO_2, 55 percent CH_4, 5 percent N_2 (and other gases), and trace amounts of NMOCs. Therefore, the estimate derived for CH_4 generation using the Landfill Air Emissions Estimation model can also be used to represent CO_2 generation. Addition of the CH_4 and CO_2 emissions will yield an estimate of total landfill gas emissions. If site-specific information is available to suggest that the CH_4 content of landfill gas is not 55 percent, then the site-specific information should be used, and the CO_2 emission estimate should be adjusted accordingly.

Most of the NMOC emissions result from the volatilization of organic compounds contained in the landfilled waste. Small amounts may be created by biological processes and chemical reactions within the landfill. The current version of the Landfill Air Emissions Estimation model contains a proposed regulatory default value for total NMOC of 4,000 ppmv, expressed as hexane. However, available data show that there is a range of over 4,400 ppmv for total NMOC values from landfills. The proposed regulatory default value for NMOC concentration was developed for regulatory compliance purposes and to provide the most cost-effective default values on a national basis. For emissions inventory purposes, site-specific information should be taken into account when determining the total NMOC concentration. In the absence of site-specific information, a value of 2,420 ppmv as hexane is suggested for landfills known to have co-disposal of MSW and non-residential waste. If the landfill is known to contain only MSW or have very little organic commercial/industrial wastes, then a total NMOC value of 595 ppmv as hexane should be used. In addition, as with the landfill model defaults, the regulatory default value for NMOC content must be used in order to comply with the NSPS/Emission Guideline.

If a site-specific total pollutant concentration is available (i.e., as measured by EPA Reference Method 25C), it must be corrected for air infiltration which can occur by two different mechanisms: LFG sample dilution, and air intrusion into the landfill. These corrections require site-specific data for the LFG CH_4,

CO_2, nitrogen (N_2), and oxygen (O_2) content. If the ratio of N_2 to O_2 is less than or equal to 4.0 (as found in ambient air), then the total pollutant concentration is adjusted for sample dilution by assuming that CO_2 and CH_4 are the primary (100 percent) constituents of landfill gas, and the following equation is used:

$$C_P \text{ (ppmv) (corrected for air infiltration)} = \frac{C_P \text{ (ppmv) } (1 \times 10^6)}{C_{CO_2} \text{ (ppmv)} + C_{CH_4} \text{ (ppmv)}} \qquad (2)$$

where:

C_P	=	Concentration of pollutant P in landfill gas (i.e., NMOC as hexane), ppmv;
C_{CO_2}	=	CO_2 concentration in landfill gas, ppmv;
C_{CH_4}	=	CH_4 Concentration in landfill gas, ppmv; and
1×10^6	=	Constant used to correct concentration of P to units of ppmv.

If the ratio of N_2 to O_2 concentrations (i.e., C_{N_2}, C_{O_2}) is greater than 4.0, then the total pollutant concentration should be adjusted for air intrusion into the landfill by using equation 2 and adding the concentration of N_2 (i.e., C_{N_2}) to the denominator. Values for C_{CO_2}, C_{CH_4}, C_{N_2}, C_{O_2}, can usually be found in the source test report for the particular landfill along with the total pollutant concentration data.

To estimate emissions of NMOC or other landfill gas constituents, the following equation should be used:

$$Q_P = 1.82 \; Q_{CH_4} * \frac{C_P}{(1 \times 10^6)} \qquad (3)$$

where:

Q_P	=	Emission rate of pollutant P (i.e. NMOC), m^3/yr;
Q_{CH_4}	=	CH_4 generation rate, m^3/yr (from the Landfill Air Emissions Estimation model);
C_P	=	Concentration of P in landfill gas, ppmv; and
1.82	=	Multiplication factor (assumes that approximately 55 percent of landfill gas is CH_4 and 45 percent is CO_2, N_2, and other constituents).

Uncontrolled mass emissions per year of total NMOC (as hexane), CO_2, CH_4, and speciated organic and inorganic compounds can be estimated by the following equation:

$$UM_P = Q_P * \left[\frac{MW_P * 1 \text{ atm}}{(8.205 \times 10^{-5} \text{ m}^3\text{-atm/gmol-}^\circ\text{K})(1000\text{g/kg})(273 + T\,^\circ\text{K})} \right] \qquad (4)$$

where:

UM_P	=	Uncontrolled mass emissions of pollutant P (i.e., NMOC), kg/yr;
MW_P	=	Molecular weight of P, g/gmol (i.e., 86.18 for NMOC as hexane);
Q_P	=	NMOC emission rate of P, m^3/yr; and
T	=	Temperature of landfill gas, ^oC.

This equation assumes that the operating pressure of the system is approximately 1 atmosphere. If the temperature of the landfill gas is not known, a temperature of 25^oC (77^oF) is recommended.

Uncontrolled default concentrations of speciated organics along with some inorganic compounds are presented in Table 2.4-1. These default concentrations have already been corrected for air infiltration and can be used as input parameters to equation 3 or the Landfill Air Emission Estimation model for estimating speciated emissions from landfills when site-specific data are not available. An analysis of the data, based on the co-disposal history (with non-residential wastes) of the individual landfills from which the concentration data were derived, indicates that for benzene, NMOC, and toluene, there is a difference in the uncontrolled concentrations. Table 2.4-2 presents the corrected concentrations for benzene, NMOC, and toluene to use based on the site's co-disposal history.

It is important to note that the compounds listed in Tables 2.4-1 and 2.4-2 are not the only compounds likely to be present in LFG. The listed compounds are those that were identified through a review of the available literature. The reader should be aware that additional compounds are likely present, such as those associated with consumer or industrial products. Given this information, extreme caution should be exercised in the use of the default VOC weight fractions and concentrations given at the bottom of Table 2.4-2. These default VOC values are heavily influenced by the ethane content of the LFG. Available data have shown that there is a range of over 1,500 ppmv in LFG ethane content among landfills.

2.4.4.2 Controlled Emissions — Emissions from landfills are typically controlled by installing a gas collection system, and combusting the collected gas through the use of internal combustion engines, flares, or turbines. Gas collection systems are not 100 percent efficient in collecting landfill gas, so emissions of CH_4 and NMOC at a landfill with a gas recovery system still occur. To estimate controlled emissions of CH_4, NMOC, and other constituents in landfill gas, the collection efficiency of the system must first be estimated. Reported collection efficiencies typically range from 60 to 85 percent, with an average of 75 percent most commonly assumed. Higher collection efficiencies may be achieved at some sites (i.e., those engineered to control gas emissions). If site-specific collection efficiencies are available (i.e., through a comprehensive surface sampling program), then they should be used instead of the 75 percent average.

Controlled emission estimates also need to take into account the control efficiency of the control device. Control efficiencies based on test data for the combustion of CH_4, NMOC, and some speciated organics with differing control devices are presented in Table 2.4-3. Emissions from the control devices need to be added to the uncollected emissions to estimate total controlled emissions.

Controlled CH_4, NMOC, and speciated emissions can be calculated with equation 5. It is assumed that the landfill gas collection and control system operates 100 percent of the time. Minor durations of system downtime associated with routine maintenance and repair (i.e., 5 to 7 percent) will not appreciably effect emission estimates. The first term in equation 5 accounts for emissions from uncollected landfill gas, while the second term accounts for emissions of the pollutant that were collected but not combusted in the control or utilization device:

$$CM_P = \left[UM_P * \left(1 - \frac{\eta_{col}}{100}\right)\right] + \left[UM_P * \frac{\eta_{col}}{100} * \left(1 - \frac{\eta_{cnt}}{100}\right)\right] \quad (5)$$

where:

CM_P	=	Controlled mass emissions of pollutant P, kg/yr;
UM_P	=	Uncontrolled mass emissions of P, kg/yr (from equation 4 or the Landfill Air Emissions Estimation Model);
η_{col}	=	Collection efficiency of the landfill gas collection system, percent; and
η_{cnt}	=	Control efficiency of the landfill gas control or utilization device, percent.

Emission factors for the secondary compounds, CO and NO_x, exiting the control device are presented in Tables 2.4-4 and 2.4-5. These emission factors should be used when equipment vendor guarantees are not available.

Controlled emissions of CO_2 and sulfur dioxide (SO_2) are best estimated using site-specific landfill gas constituent concentrations and mass balance methods.[68] If site-specific data are not available, the data in tables 2.4-1 through 2.4-3 can be used with the mass balance methods that follow.

Controlled CO_2 emissions include emissions from the CO_2 component of landfill gas (equivalent to uncontrolled emissions) and additional CO_2 formed during the combustion of landfill gas. The bulk of the CO_2 formed during landfill gas combustion comes from the combustion of the CH_4 fraction. Small quantities will be formed during the combustion of the NMOC fraction, however, this typically amounts to less than 1 percent of total CO_2 emissions by weight. Also, the formation of CO through incomplete combustion of landfill gas will result in small quantities of CO_2 not being formed. This contribution to the overall mass balance picture is also very small and does not have a significant impact on overall CO_2 emissions.[68]

The following equation which assumes a 100 percent combustion efficiency for CH_4 can be used to estimate CO_2 emissions from controlled landfills:

$$CM_{CO_2} = UM_{CO_2} + \left[UM_{CH_4} * \frac{\eta_{col}}{100} * 2.75 \right] \quad (6)$$

where:

CM_{CO_2}	=	Controlled mass emissions of CO_2, kg/yr;
UM_{CO_2}	=	Uncontrolled mass emissions of CO_2, kg/yr (from equation 4 or the Landfill Air Emission Estimation Model);
UM_{CH_4}	=	Uncontrolled mass emissions of CH_4, kg/yr (from equation 4 on the Landfill Air Emission Estimation Model);
η_{col}	=	Efficiency of the landfill gas collection system, percent; and
2.75	=	Ratio of the molecular weight of CO_2 to the molecular weight of CH_4.

To prepare estimates of SO_2 emissions, data on the concentration of reduced sulfur compounds within the landfill gas are needed. The best way to prepare this estimate is with site-specific information on the total reduced sulfur content of the landfill gas. Often these data are expressed in ppmv as sulfur (S). Equations 3 and 4 should be used first to determine the uncontrolled mass emission rate of reduced sulfur compounds as sulfur. Then, the following equation can be used to estimate SO_2 emissions:

$$CM_{SO_2} = UM_S * \frac{\eta_{col}}{100} * 2.0 \quad (7)$$

where:

CM_{SO_2}	=	Controlled mass emissions of SO_2, kg/yr;
UM_S	=	Uncontrolled mass emissions of reduced sulfur compounds as sulfur, kg/yr (from equations 3 and 4);
η_{col}	=	Efficiency of the landfill gas collection system, percent; and
2.0	=	Ratio of the molecular weight of SO_2 to the molecular weight of S.

The next best method to estimate SO_2 concentrations, if site-specific data for total reduced sulfur compounds as sulfur are not available, is to use site-specific data for speciated reduced sulfur compound concentrations. These data can be converted to ppmv as S with equation 8. After the total reduced sulfur as S has been obtained from equation 8, then equations 3, 4, and 7 can be used to derive SO_2 emissions.

$$C_S = \sum_{i=1}^{n} C_P * S_P \quad (8)$$

where:

C_S	=	Concentration of total reduced sulfur compounds, ppmv as S (for use in equation 3);
C_P	=	Concentration of each reduced sulfur compound, ppmv;
S_P	=	Number of moles of S produced from the combustion of each reduced sulfur compound (i.e., 1 for sulfides, 2 for disulfides); and
n	=	Number of reduced sulfur compounds available for summation.

If no site-specific data are available, a value of 46.9 ppmv can be assumed for C_S (for use in equation 3). This value was obtained by using the default concentrations presented in Table 2.4-1 for reduced sulfur compounds and equation 8.

Hydrochloric acid [Hydrogen Chloride (HCl)] emissions are formed when chlorinated compounds in LFG are combusted in control equipment. The best methods to estimate emissions are mass balance methods that are analogous to those presented above for estimating SO_2 emissions. Hence, the best source of data to estimate HCl emissions is site-specific LFG data on total chloride [expressed in ppmv as the chloride ion (Cl^-)]. If these data are not available, then total chloride can be estimated from data on individual chlorinated species using equation 9 below. However, emission estimates may be underestimated, since not every chlorinated compound in the LFG will be represented in the laboratory report (i.e., only those that the analytical method specifies).

$$C_{Cl} = \sum_{i=1}^{n} C_P * Cl_P \quad (9)$$

where:

C_{Cl}	=	Concentration of total chloride, ppmv as Cl^- (for use in equation 3);
C_P	=	Concentration of each chlorinated compound, ppmv;
Cl_P	=	Number of moles of Cl^- produced from the combustion of each chlorinated compound (i.e., 3 for 1,1,1-trichloroethane); and
n	=	Number of chlorinated compounds available for summation.

After the total chloride concentration (C_{Cl}) has been estimated, equations 3 and 4 should be used to determine the total uncontrolled mass emission rate of chlorinated compounds as chloride ion (UM_{Cl}). This value is then used in equation 10 below to derive HCl emission estimates:

$$CM_{HCl} = UM_{Cl} * \frac{\eta_{col}}{100} * 1.03 * \left(\frac{\eta_{cnt}}{100}\right) \quad (10)$$

where:

CM_{HCl}	=	Controlled mass emissions of HCl, kg/yr;
UM_{Cl}	=	Uncontrolled mass emissions of chlorinated compounds as chloride, kg/yr (from equations 3 and 4);
η_{col}	=	Efficiency of the landfill gas collection system, percent;
1.03	=	Ratio of the molecular weight of HCl to the molecular weight of Cl^-; and
η_{cnt}	=	Control efficiency of the landfill gas control or utilization device, percent.

In estimating HCl emissions, it is assumed that all of the chloride ion from the combustion of chlorinated LFG constituents is converted to HCl. If an estimate of the control efficiency, η_{cnt}, is not available, then the high end of the control efficiency range for the equipment listed in Table 9 should be used. This assumption is recommended to assume that HCl emissions are not under-estimated.

If site-specific data on total chloride or speciated chlorinated compounds are not available, then a default value of 42.0 ppmv can be used for C_{Cl}. This value was derived from the default LFG constituent concentrations presented in Table 2.4-1. As mentioned above, use of this default may produce underestimates of HCl emissions since it is based only on those compounds for which analyses have been performed. The constituents listed in Table 2.4-1are likely not all of the chlorinated compounds present in LFG.

The reader is referred to Sections 11.2-1 (Unpaved Roads, SCC 50100401), and 11-2.4 (Heavy Construction Operations) of Volume I, and Section II-7 (Construction Equipment) of Volume II, of the AP-42 document for determination of associated fugitive dust and exhaust emissions from these emission sources at MSW landfills.

2.4.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Supplemnt D (8/98) is a major revision of the text and recommended emission factors conained in the section. The most significant revisions to this section since publication in the Fifth Edition are summarized below.

- The equations to calculate the CH_4, CO_2 and other constituents were simplified.
- The default L_0 and k were revised based upon an expanded base of gas generation data.
- The default ratio of CO_2 to CH_4 was revised based upon averages observed in available source test reports.
- The default concentrations of LFG constituents were revised based upon additional data.
- Additional control efficiencies were included and existing efficiencies were revised based upon additional emission test data.
- Revised and expanded the recommended emission factors for secondary compounds emitted from typical control devices.

Supplement E (11/98) includes correction in equation 10 and a very minor change in the molecular weights for 1,1,1-Trichloroethane (methyl chloroform), 1,1-Dichloroethane, 1,2-Dichloropropane and Trichloroethylene (trichloroethene) presented in Table 2.4-1 to agree with values presented in Perry's Handbook.

Table 2.4-1. DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS[a]

(SCC 50100402, 50300603)

Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
1,1,1-Trichloroethane (methyl chloroform)[a]	133.41	0.48	B
1,1,2,2-Tetrachloroethane[a]	167.85	1.11	C
1,1-Dichloroethane (ethylidene dichloride)[a]	98.97	2.35	B
1,1-Dichloroethene (vinylidene chloride)[a]	96.94	0.20	B
1,2-Dichloroethane (ethylene dichloride)[a]	98.96	0.41	B
1,2-Dichloropropane (propylene dichloride)[a]	112.99	0.18	D
2-Propanol (isopropyl alcohol)	60.11	50.1	E
Acetone	58.08	7.01	B
Acrylonitrile[a]	53.06	6.33	D
Bromodichloromethane	163.83	3.13	C
Butane	58.12	5.03	C
Carbon disulfide[a]	76.13	0.58	C
Carbon monoxide[b]	28.01	141	E
Carbon tetrachloride[a]	153.84	0.004	B
Carbonyl sulfide[a]	60.07	0.49	D
Chlorobenzene[a]	112.56	0.25	C
Chlorodifluoromethane	86.47	1.30	C
Chloroethane (ethyl chloride)[a]	64.52	1.25	B
Chloroform[a]	119.39	0.03	B
Chloromethane	50.49	1.21	B
Dichlorobenzene[c]	147	0.21	E
Dichlorodifluoromethane	120.91	15.7	A
Dichlorofluoromethane	102.92	2.62	D
Dichloromethane (methylene chloride)[a]	84.94	14.3	A
Dimethyl sulfide (methyl sulfide)	62.13	7.82	C
Ethane	30.07	889	C
Ethanol	46.08	27.2	E
Ethyl mercaptan (ethanethiol)	62.13	2.28	D
Ethylbenzene[a]	106.16	4.61	B
Ethylene dibromide	187.88	0.001	E
Fluorotrichloromethane	137.38	0.76	B
Hexane[a]	86.18	6.57	B
Hydrogen sulfide	34.08	35.5	B
Mercury (total)[a,d]	200.61	2.92×10^{-4}	E

Table 2.4-1. (Concluded)

Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
Methyl ethyl ketone[a]	72.11	7.09	A
Methyl isobutyl ketone[a]	100.16	1.87	B
Methyl mercaptan	48.11	2.49	C
Pentane	72.15	3.29	C
Perchloroethylene (tetrachloroethylene)[a]	165.83	3.73	B
Propane	44.09	11.1	B
t-1,2-dichloroethene	96.94	2.84	B
Trichloroethylene (trichloroethene)[a]	131.40	2.82	B
Vinyl chloride[a]	62.50	7.34	B
Xylenes[a]	106.16	12.1	B

NOTE: This is not an all-inclusive list of potential LFG constituents, only those for which test data were available at multiple sites. References 10-67. Source Classification Codes in parentheses.

[a] Hazardous Air Pollutants listed in Title III of the 1990 Clean Air Act Amendments.

[b] Carbon monoxide is not a typical constituent of LFG, but does exist in instances involving landfill (underground) combustion. Therefore, this default value should be used with caution. Of 18 sites where CO was measured, only 2 showed detectable levels of CO.

[c] Source tests did not indicate whether this compound was the para- or ortho- isomer. The para isomer is a Title III-listed HAP.

[d] No data were available to speciate total Hg into the elemental and organic forms.

Table 2.4-2. DEFAULT CONCENTRATIONS OF BENZENE, NMOC, AND TOLUENE BASED ON WASTE DISPOSAL HISTORY[a]

(SCC 50100402, 50300603)

Pollutant	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
Benzene[b]	78.11		
Co-disposal		11.1	D
No or Unknown co-disposal		1.91	B
NMOC (as hexane)[c]	86.18		
Co-disposal		2420	D
No or Unknown co-disposal		595	B
Toluene[b]	92.13		
Co-disposal		165	D
No or Unknown co-disposal		39.3	A

[a] References 10-54. Source Classification Codes in parentheses.
[b] Hazardous Air Pollutants listed in Title III of the 1990 Clean Air Act Amendments.
[c] For NSPS/Emission Guideline compliance purposes, the default concentration for NMOC as specified in the final rule must be used. For purposes not associated with NSPS/Emission Guideline compliance, the default VOC content at co-disposal sites = 85 percent by weight (2,060 ppmv as hexane); at No or Unknown sites = 39 percent by weight 235 ppmv as hexane).

Table 2.4-3. CONTROL EFFICIENCIES FOR LFG CONSTITUENTS[a]

Control Device	Constituent[b]	Control Efficiency (%)		
		Typical	Range	Rating
Boiler/Steam Turbine (50100423)	NMOC	98.0	96-99+	D
	Halogenated Species	99.6	87-99+	D
	Non-Halogenated Species	99.8	67-99+	D
Flare[c] (50100410) (50300601)	NMOC	99.2	90-99+	B
	Halogenated Species	98.0	91-99+	C
	Non-Halogenated Species	99.7	38-99+	C
Gas Turbine (50100420)	NMOC	94.4	90-99+	E
	Halogenated Species	99.7	98-99+	E
	Non-Halogenated Species	98.2	97-99+	E
IC Engine (50100421)	NMOC	97.2	94-99+	E
	Halogenated Species	93.0	90-99+	E
	Non-Halogenated Species	86.1	25-99+	E

[a] References 10-67. Source Classification Codes in parentheses.
[b] Halogenated species are those containing atoms of chlorine, bromine, fluorine, or iodine. For any equipment, the control efficiency for mercury should be assumed to be 0. See section 2.4.4.2 for methods to estimate emissions of SO_2, CO_2, and HCl.
[c] Where information on equipment was given in the reference, test data were taken from enclosed flares. Control efficiencies are assumed to be equally representative of open flares.

Table 2.4-4. (Metric Units) EMISSION FACTORS FOR SECONDARY COMPOUNDS EXITING CONTROL DEVICES[a]

Control Device	Pollutant[b]	kg/10^6 dscm Methane	Emission Factor Rating
Flare[c]	Nitrogen dioxide	650	C
(50100410)	Carbon monoxide	12,000	C
(50300601)	Particulate matter	270	D
IC Engine	Nitrogen dioxide	4,000	D
(50100421)	Carbon monoxide	7,500	C
	Particulate matter	770	E
Boiler/Steam Turbine[d]	Nitrogen dioxide	530	D
(50100423)	Carbon monoxide	90	E
	Particulate matter	130	D
Gas Turbine	Nitrogen dioxide	1,400	D
(50100420)	Carbon monoxide	3,600	E
	Particulate matter	350	E

[a] Source Classification Codes in parentheses. Divide kg/10^6 dscm by 16,700 to obtain kg/hr/dscmm.
[b] No data on PM size distributions were available, however for other gas-fired combustion sources, most of the particulate matter is less than 2.5 microns in diameter. Hence, this emission factor can be used to provide estimates of PM-10 or PM-2.5 emissions. See section 2.4.4.2 for methods to estimate CO_2, SO_2, and HCl.
[c] Where information on equipment was given in the reference, test data were taken from enclosed flares. Control efficiencies are assumed to be equally representative of open flares.
[d] All source tests were conducted on boilers, however emission factors should also be representative of steam turbines. Emission factors are representative of boilers equipped with low-NO_x burners and flue gas recirculation. No data were available for uncontrolled NO_x emissions.

Table 2.4-5. (English Units) EMISSION RATES FOR SECONDARY COMPOUNDS EXITING CONTROL DEVICES[a]

Control Device	Pollutant[b]	lb/10^6 dscf Methane	Emission Factor Rating
Flare[c]	Nitrogen dioxide	40	C
(50100410)	Carbon monoxide	750	C
(50300601)	Particulate matter	17	D
IC Engine	Nitrogen dioxide	250	D
(50100421)	Carbon monoxide	470	C
	Particulate matter	48	E
Boiler/Steam Turbine[d]	Nitrogen dioxide	33	E
(50100423)	Carbon monoxide	5.7	E
	Particulate matter	8.2	E
Gas Turbine	Nitrogen dioxide	87	D
(50100420)	Carbon monoxide	230	D
	Particulate matter	22	E

[a] Source Classification Codes in parentheses. Divide lb/10^6 dscf by 16,700 to obtain lb/hr/dscfm.
[b] Based on data for other combustion sources, most of the particulate matter will be less than 2.5 microns in diameter. Hence, this emission rate can be used to provide estimates of PM-10 or PM-2.5 emissions. See section 2.4.4.2 for methods to estimate CO_2, SO_2, and HCl.
[c] Where information on equipment was given in the reference, test data were taken from enclosed flares. Control efficiencies are assumed to be equally representative of open flares.
[d] All source tests were conducted on boilers, however emission factors should also be representative of steam turbines. Emission factors are representative of boilers equipped with low-NO_x burners and flue gas recirculation. No data were available for uncontrolled NO_x emissions.

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2. *Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Guidelines*, Office of Air Quality Planning and Standards, EPA-450/3-90-011a, Chapters 3 and 4, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1991.

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5. *Suggested Control Measures for Landfill Gas Emissions*, State of California Air Resources Board, Stationary Source Division, Sacramento, CA, August 1990.

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