

Facility: North Country Environmental Services, Inc. Landfill

AFS #: 3300990255

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15. Annual NOx Statement/Report	<input type="checkbox"/>	<input type="checkbox"/>
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19. Ammonia Usage Report	<input type="checkbox"/>	<input type="checkbox"/>
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23. Tri-annual Landfill Gas Sulfur Content	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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25. Hydrogen Sulfide Ambient Air Monitoring	<input type="checkbox"/>	<input type="checkbox"/>
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Please submit reports to: NH DES Air Resources Division
 29 Hazen Drive
 P.O. Box 95
 Concord, NH 03302-0095
 Attention: Compliance Bureau



Mr. Mike O'Brien
N.H. Department of Environmental Services
Air Resources Division
29 Hazen Dr., P.O. Box 95
Concord, NH 03302-0095

October 6, 2023
File No. 2493.23

Re: Landfill Gas Sampling Results, August 21, 2023
North Country Environmental Services, Inc. Landfill
Bethlehem, New Hampshire

Dear Mike:

On behalf of North Country Environmental Services, Inc. (NCES), Sanborn, Head & Associates Inc. (Sanborn Head) prepared the enclosed August 21, 2023 Landfill Gas Sampling Results report to describe the methodologies and results of sampling landfill gas (LFG) at the NCES Landfill in Bethlehem, New Hampshire.

Please call Heather at 802-391-8506 with any questions.

Sincerely,
SANBORN, HEAD & ASSOCIATES, INC.

A handwritten signature in black ink that reads "Matthew E. Estabrooks".

Matthew E. Estabrooks, P.E.
Senior Project Manager

A handwritten signature in black ink that reads "Heather H. Little".

Heather H. Little, P.G.
Project Director

MEC/LET/MEE/HHL: mec

Encl. August 21, 2023 Landfill Gas Sampling Results

cc: Joe Gay (NCES)
Kevin Roy (NCES)

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August 21, 2023 Landfill Gas Sampling Results

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC. LANDFILL
Bethlehem, New Hampshire

Prepared for North Country Environmental Services, Inc.
File No. 2493.23
October 2023

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1.0 INTRODUCTION

On behalf of North Country Environmental Services, Inc. (NCES), Sanborn, Head & Associates, Inc. (Sanborn Head) prepared this report to present the results of landfill gas (LFG) sampling conducted at the NCES Landfill in Bethlehem, New Hampshire. The sampling was required by Title V Operating Permit, TV-0063, issued by the New Hampshire Department of Environmental Services (NHDES) to NCES on April 15, 2021, with a Minor Modification on December 10, 2021.

Section VIII, Table 6, Item 2 of TV-0063 requires triannual testing to measure the concentrations of fixed gases (i.e., methane, carbon dioxide, nitrogen, and oxygen), and total reduced sulfur (TRS) compounds. Section VIII, Table 8, Item 3 of TV-0063 requires the owner or operator to submit to the department all analytical test results obtained pursuant to periodic testing of LFG composition within thirty (30) days after the information becomes available.

LFG samples were collected from the NCES Landfill on August 21, 2023 (the second round of the 2023 triannual sampling) and analyzed for TRS content and additional parameters. Sanborn Head received the laboratory analytical report on September 7, 2023; therefore, the landfill gas sampling results report is due to NHDES by October 7, 2023.

2.0 FACILITY DESCRIPTION

The landfill is located on (+/-) 327 acres at 581 Trudeau Road in Bethlehem, New Hampshire. The site is bordered on the west by Trudeau Road, on the north by Muchmore Road and the Ammonoosuc River, and on the east and south by publicly owned forestlands, as shown on Figure 1, the Locus Plan. The current landfill units (six lined cells; Stages I, II, III, IV, V, and VI) occupy approximately 54 acres. Municipal solid waste (MSW) has been placed and landfill gas (LFG) infrastructure has been constructed in each of these landfill units. The Stage VI landfill expansion was approved by the NHDES' Solid Waste Management Bureau in October 2020. The air permit, TP-0258, associated with the Stage VI expansion was issued on April 22, 2020 and was wrapped into TV-0063 with the December 10, 2021 Minor Modification. NCES began waste placement in Stage VI around March 2021.

The facility also operates an active gas collection and control system (GCCS) consisting of a network of vertical extraction wells, horizontal gas collection trenches, and several leachate collection pipes. Centrifugal blowers are used to extract gas from the landfill through manifold piping and deliver the gas to two Parnel Biogas, Inc. open flare control devices. Figure 2 shows the location of the flares, GCCS components, and existing features of the landfill.

3.0 TRS SAMPLING

3.1 TRS Sampling Procedure

TRS sampling consists of collecting three LFG samples in general accordance with the South Coast Air Quality Management District (SCAQMD) Method 307-91. The use of this test method was requested in a letter entitled Alternative Total Reduced Sulfur (TRS) Analytical Method Request dated March 25, 2022 and approved by NHDES in an email dated April 8, 2022. It is recommended in section 2.7 of SCAQMD Method 307-91 that gas samples should be collected in Tedlar bags with inert fittings; however, non-reactive Summa canisters that are lined with an inert coating (e.g., Silonite™, Silcosteel™, Silco™) and backfilled with helium were approved as



an alternative sampling container to eliminate the need for dangerous goods shipping and to provide for a longer sample hold time. According to SCAQMD Method 307-91, analysis of TRS samples would need to be conducted within 24 hours of sample collection for samples collected in Tedlar bags. By performing the sample collection in lined Summa canisters, the hold time for these samples increases to seven (7) days from the time of sample collection, consistent with American Society of Testing and Materials (ASTM) Method D5504, Section 9.2.1.

TRS sampling at the NCES Landfill was conducted per the July 2023 Landfill Gas Sampling Protocol (Protocol) prepared by Sanborn Head and submitted to NHDES on July 26, 2023. Sanborn Head used Summa canisters lined with an inert coating (e.g., Silonite™, Silcosteel™, Silco™) for sample collection in lieu of the evacuated container sampling procedure which utilizes flexible (e.g., Tedlar) bags and is an alternative method approved by NHDES, as previously mentioned.

The sampling event consisted of collecting three LFG samples from a sampling port in the main header pipe at a point located approximately 10 feet upstream of the moisture separator. The approximate location of the TRS sampling port is shown on Figure 2. Samples were collected in 6-liter Summa canisters from a polytetrafluoroethylene (PTFE) tube installed near the center of a 14-inch diameter high-density polyethylene (HDPE) header pipe. During the sampling event, the three samples were collected at a flow rate of approximately 200 milliliters per minute. The samples were sent to AtmAA, Inc. (AtmAA) of Calabasas, California.

Sanborn Head personnel recorded parameters during the sampling event including barometric pressure, ambient temperature, sampling flow rate, and the gas flow rate measured immediately upstream of the flare using NCES' instrumentation. The field data sheet from the sampling event is included in Appendix A.

3.2 TRS Sampling Results

The TRS sampling results are presented in the following table.

Sampling Date	Average TRS Concentration (ppmv)	Average Heat Content (Btu/ft ³)	Corrected Average TRS Concentration, at 50% Methane (ppmv)
August 21, 2023	579	500	579

Note: The TRS and heat content are based on analyses according to SCAQMD Method 307-91 and ASTM D3588-98, respectively, as performed by AtmAA.

As summarized above, the average TRS concentration reported by AtmAA for samples collected during the reporting period was 579 ppm-v. The average heat content reported by the laboratory for the samples collected during the reporting period was 500 Btu/ft³.



The average TRS concentration at 50% methane (i.e., the corrected average TRS concentration) incorporates the value for heat content, as shown in the formula below. The corrected average TRS concentration for samples collected during the reporting period was 579 ppm-v.

$$\text{Corrected} \cdot \text{Average} \cdot \text{TRS} \cdot \text{concentration} = \text{Average} \cdot \text{TRS} \cdot \text{concentration} * \left(\frac{500 \frac{\text{Btu}}{\text{ft}^3}}{\text{Average} \cdot \text{Heat} \cdot \text{Content}} \right)$$

The results of individual samples are summarized in Tables 1 and 2 as well as the laboratory report included in Appendix B. As recommended, TRS analysis began within seven days for each Summa canister sample.

Since approximately 2005, TRS concentration at 50% methane has generally been trending downward based on monthly, quarterly, and tri-annual sampling results. Since early 2008, TRS concentration at 50% methane has generally ranged between approximately 600 and 1,200 ppm-v.

4.0 QUALITY CONTROL PROCEDURES

The controller for the flare system at the NCES landfill records operating parameters such as temperature, pressure, and flow rate. Based on field observations made during the sampling event, the flare was combusting gas at an average flow rate of approximately 2,797 standard cubic feet per minute (scfm) and the gas collection and control system appeared to operate normally during the sampling event.

Following the sampling event, Sanborn Head completed and signed the chain-of-custody (COC) forms and delivered the samples to AtmAA via United Parcel Service (UPS). AtmAA performed laboratory analysis. Heather H. Little, P.G., served as Sanborn Head's data reviewer for this project.

During the sampling event, Sanborn Head used a portable LFG monitor to measure the concentrations of methane, carbon dioxide, oxygen, and balance gas in the LFG at the sampling port. This field-measured data is included in Appendix A and was used as part of the quality control procedures.

We used quality control procedures based on specifications included in Section 9.0 of USEPA Method 25C to validate sampling results. The table below shows that the concentration of oxygen measured in the field was similar to the concentration of oxygen reported by the laboratory, which indicates that these LFG samples were not affected by air infiltration before the laboratory analysis. We, therefore, assumed that the LFG content was not diluted before laboratory analysis, and that the LFG constituent concentrations reported by the laboratory (summarized below) is representative of the constituent concentrations of LFG in the landfill.



Sample	O ₂ Concentration Measured with a Portable LFG Monitor (%)	O ₂ Concentration Reported by AtmAA (%)
2023-08-21-NCES-02	0.4	0.88
2023-08-21-NCES-03	0.4	0.52
2023-08-21-NCES-04	0.4	0.59

Note: Sanborn Head measured oxygen concentrations during the sampling event with a portable LFG monitor, and AtmAA measured oxygen concentrations in the laboratory according to ASTM D1946.

Neither audit samples nor sample blanks were required for the sampling program, and we did not include them as part of this project. The portable LFG monitor calibration log and calibration gas certificates are included in Appendix C. A Certification of Accuracy Statement is included in Appendix D.

5.0 ADDITIONAL LFG SAMPLING

Sanborn Head will schedule the third 2023 triannual testing event between October and December 2023. Sanborn Head will notify the NHDES of the anticipated sampling dates. Sanborn Head will prepare a sampling report for submittal to the NHDES within 30 days after the analytical results become available.

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Tables

Table 1
Summary of Analysis of Gas Samples for Sulfur Gases by SCAQMD Method 307-91

North Country Environmental Services, Inc. Landfill
Bethlehem, New Hampshire

August 21, 2023				
Compound	Sample 1 Concentration (ppmv)	Sample 2 Concentration (ppmv)	Sample 3 Concentration (ppmv)	Average Concentration (ppmv)
Hydrogen Sulfide	553	577	581	570
Carbonyl Sulfide	--	--	--	--
Methyl Mercaptan	1.22	1.27	1.40	1.30
Ethyl Mercaptan	--	--	--	--
Dimethyl Sulfide	0.88	0.91	0.99	0.93
Carbon Disulfide	--	--	--	--
Isopropyl Mercaptan	3.25	3.35	3.61	3.40
tert-Butyl Mercaptan	--	--	--	--
n-Propyl Mercaptan	--	--	--	--
s-Butyl Mercaptan	2.90	2.97	3.20	3.02
Isobutyl Mercaptan	--	--	--	--
Dimethyl Sulfide	--	--	--	--
Tetrahydrothiophene	--	--	--	--
Unidentified Sulfurs	--	--	--	--
Total Reduced Sulfur	561	586	590	579

Notes:

1. Analytical testing was performed by AtmAA of Calabasas, California.
2. Date indicates the day on which samples were collected.
3. The Total Reduced Sulfur (TRS) concentration is calculated by summing all peaks obtained during SCAQMD Method 307-91 and quantitating the area based on the response of Hydrogen Sulfide.
4. Unless otherwise noted, -- indicates that the compound was not detected.

Table 2
Summary of Permanent Gases by ASTM D1946 and Heat Content by ASTM D3588-98

North Country Environmental Services, Inc. Landfill
Bethlehem, New Hampshire

August 21, 2023				
Compound	Sample 1 Concentration (%)	Sample 2 Concentration (%)	Sample 3 Concentration (%)	Average Concentration (%)
Oxygen	0.87	0.51	0.59	0.66
Nitrogen	11.31	10.16	10.38	10.62
Carbon Dioxide	38.87	39.72	39.49	39.36
Methane	48.82	49.49	49.42	49.24
Total Btu/ft ³	495.5	502.2	501.4	499.7

Notes:

1. Analytical testing was performed by AtmAA of Calabasas, California.
2. Date indicates the day on which samples were collected.
3. Unless otherwise noted, -- indicates that the compound was not detected.

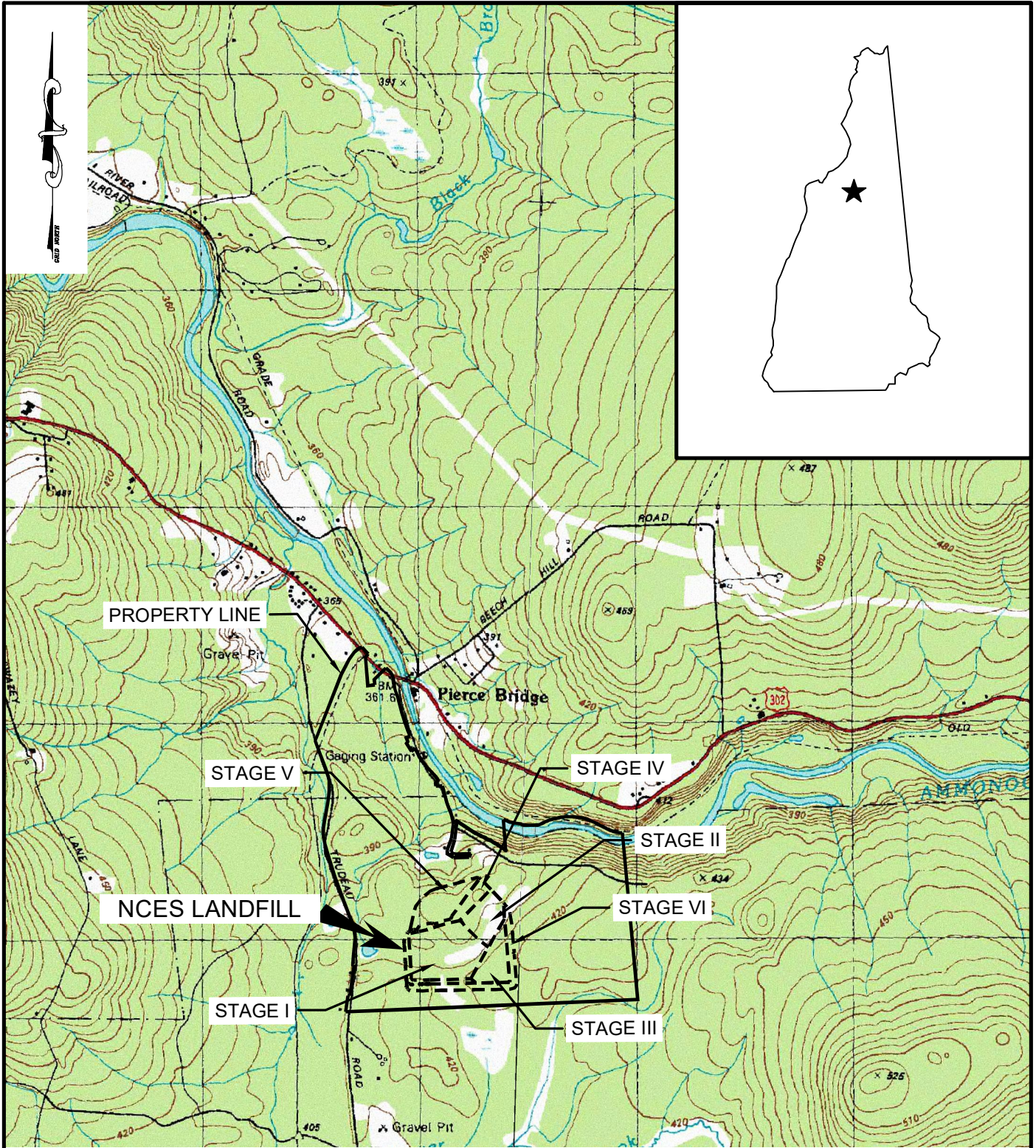
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FILE: P:\2400s\2493.23\Graphics Files\CAD\IFG Testing\Figure 1\NCESLOC.dwg
 LAYOUT: LOCUS
 CTB FILE: SHA STANDARD.CTB
 PLOT DATE: 9-25-23



NOTES:

BASE MAP TAKEN FROM 7.5 MINUTE
 USGS QUADRANGLE MAP: BETHLEHEM
 NEW HAMPSHIRE 1982

NORTH COUNTRY ENVIRONMENTAL SERVICES, INC.
 BETHLEHEM, NEW HAMPSHIRE

LOCUS PLAN



SCALE: 1:25,000

DRAWN BY: LET

FILE NO. 2493.23

DATE: SEP 2023

CHECKED BY: HHL

FIGURE NO. 1

Appendix A

Field Data Forms

Plant North Country Environmental Services, Inc. Landfill Date 8/21/2023
 Site Bethlehem, New Hampshire

	Sample_1	Sample_2	Sample_3
Source Temperature (F)	80	80	80
Barometric pressure (in Hg)	30.03	30.03	30.03
Ambient temperature (F)	69	69	71
Header vacuum ("H ₂ O)	38.1	39	39.6
Flare Temperature (°F)	1,032	1,282	1,230
Landfill gas flow rate (scfm)	2,815	2,811	2,764
Sample flow rate (appr.) (l/min)	0.2	0.2	0.2
Sample number	2023_08_21_NCES_02	2023_08_21_NCES_03	2023_08_21_NCES_04
Start time	11:10	11:50	12:29
Finish time	11:40	12:22	15:59

Notes:

Source temperature shown above is the temperature of the landfill gas at time of sampling.

Summary of LFG Field Measurements

North Country Environmental Services Landfill Bethlehem, New Hampshire

Sample	Time	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Balance (%)	Drager Tube Readings (ppm)
1	8/21/23 11:10 AM	49.7	41.1	0.4	8.8	70
2	8/21/23 11:50 AM	49.4	40.7	0.4	9.5	35
3	8/21/23 12:29 PM	48.9	40.7	0.4	10.0	500

Note:

1. Fixed gas measurements are based on readings from NCES's Elkins Earthworks Envision instrument.
2. Drager tube readings are based on reagent colorimetric glass vials for hydrogen sulfide.
3. Drager tube readings for Sample 1 and Sample 2 are not representative field measurements for the landfill gas hydrogen sulfide concentration. The Tedlar bag used for these field measurements was perforated. Sample 3 indicates a hydrogen sulfide field measurement that is representative of the landfill gas concentration. Field measurements are taken as a backup quality control and assurance procedure and are not required for compliance with the facility's air permit.

Appendix B

Analytical Results



LABORATORY ANALYSIS REPORT

Permanent Gases Analysis in Silco Canister Sample by Method ASTM D1946

Report Date: September 5, 2023
Client: Sanborn Head
Project Name: NCES Landfill
Project Location: Bethlehem, NH
Project No.: 2493.23
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

ANALYSIS DESCRIPTION

Permanent gases were measured by thermal conductivity detection/gas chromatography (TCD/GC), ASTM D1946.

AtmAA Lab No.:	22353-21	22353-22	22353-23
Sample I.D.:	2023-08-21-NCES-02	2023-08-21-NCES-03	2023-08-21-NCES-04

Components	(Concentration in %,v)		
Nitrogen	11.00	9.85	10.04
Oxygen	0.88	0.52	0.59
Methane	47.48	47.96	47.80
Carbon dioxide	37.80	38.49	38.20

The reported oxygen concentration includes any argon present in the sample. Calibration is based on a standard atmosphere containing 20.95% oxygen and 0.93% argon. The accuracy of permanent gas analysis by TCD/GC is +/- 2%, actual results are reported. Actual analysis results are reported on a "wet" basis.

Brian W. Fung
Laboratory Director

QUALITY ASSURANCE SUMMARY
(Repeat Analyses)

Project Name: NCES Landfill
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

Components	Sample ID	Repeat Analysis		Mean Conc.	% RPD
		Run #1	Run #2		
		<i>(Concentration in %,v)</i>			
Nitrogen	2023-08-21-NCES-02	10.88	11.11	11.00	2.1
Oxygen	2023-08-21-NCES-02	0.84	0.92	0.88	9.1
Methane	2023-08-21-NCES-02	47.44	47.51	47.48	0.15
Carbon dioxide	2023-08-21-NCES-02	37.74	37.86	37.80	0.32

Three Silco canister samples, laboratory numbers 22353-(20-23), were analyzed for permanent gases. Agreement between repeat analyses is a measure of precision and is shown above in the column "% RPD". The average % RPD for 4 repeat measurements from three Silco canister samples is 2.9%.





LABORATORY ANALYSIS REPORT

Speciated Hydrocarbons Analysis in Silco Canister Sample

Report Date: September 5, 2023
Client: Sanborn Head
Project Location: NCES Landfill
Project No.: 2493.23
Date Received: August 23, 2023
Date Analyzed: August 24, 2023
Laboratory Temp: 76.5 °F
Barometric Pressure: 29.90 inHg

ANALYSIS DESCRIPTION

Hydrocarbon speciation analysis was performed by flame ionization detection/gas chromatography (FID/GC), modified EPA-18.

AtmAA Lab No.:	22353-21	22353-22	22353-23
Sample ID:	2023-08-21-NCES-02	2023-08-21-NCES-03	2023-08-21-NCES-04
Pressure (i) mmHg:	458	429	445
Pressure (f) mmHg:	823	822	826
Component	(Concentration in ppmv, component)		
Methane	474750	479600	478000
Ethene	<0.27	<0.27	<0.27
Acetylene	<0.27	<0.27	<0.27
Ethane	0.91	0.96	1.05
Non-methane hydrocarbons analysis by carbon number grouping			
C3	48.1	47.6	47.5
C4	23.5	22.3	22.7
C5	34.8	30.5	30.5
C6	35.2	32.1	31.8
C7	28.4	28.1	27.1
C8	36.1	36.5	35.0
C9	54.3	54.3	54.1
C10	65.0	63.1	63.2
C11	20.3	17.8	17.5
C12	6.12	5.11	4.44
C13	1.10	1.05	0.86
C14	0.20	0.24	0.18

	(Concentration in ppmvC)		
TNMHC	2566	2461	2427

TNMHC - total non-methane hydrocarbons as ppmvC.
Actual analysis results are reported on a "wet" basis.

Brian W. Fung
Laboratory Director

QUALITY ASSURANCE SUMMARY
(Repeat Analyses)

Project Location: NCES Landfill
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

Component	Sample ID	Repeat Analysis		Mean Conc.	% RPD
		Run #1	Run #2		
		<i>(Conc. in ppmv, component)</i>			
Methane	2023-08-21-NCES-02	474400	475100	474750	0.15
Ethene	2023-08-21-NCES-02	<0.27	<0.27	<0.27	---
Acetylene	2023-08-21-NCES-02	<0.27	<0.27	<0.27	---
Ethane	2023-08-21-NCES-02	0.87	0.95	0.91	9.6
<u>non-methane hydrocarbons analysis by carbon number grouping</u>					
C3	2023-08-21-NCES-02	47.7	48.5	48.1	1.7
C4	2023-08-21-NCES-02	24.1	22.9	23.5	5.1
C5	2023-08-21-NCES-02	34.7	34.9	34.8	0.66
C6	2023-08-21-NCES-02	34.9	35.6	35.2	2.0
C7	2023-08-21-NCES-02	27.4	29.4	28.4	7.1
C8	2023-08-21-NCES-02	36.3	35.9	36.1	1.0
C9	2023-08-21-NCES-02	54.8	53.9	54.3	1.7
C10	2023-08-21-NCES-02	65.5	64.5	65.0	1.5
C11	2023-08-21-NCES-02	20.0	20.5	20.3	2.4
C12	2023-08-21-NCES-02	6.09	6.15	6.12	1.0
C13	2023-08-21-NCES-02	1.08	1.13	1.10	3.8
C14	2023-08-21-NCES-02	0.22	0.19	0.20	17
		<i>(Concentration in ppmvC)</i>			
TNMHC	2023-08-21-NCES-02	2564	2567	2566	0.10

Three Silco canister samples, laboratory numbers 22353-(21-23), were analyzed for hydrocarbon speciation, EPA Method 18. Agreement between repeat analyses is a measure of precision and is shown above in the column "% RPD". The average % RPD for 15 repeat measurements from three Silco canister samples is 3.6%.



Calculated values for Specific Volume, BTU, and F (factor)

Report Date: September 5, 2023
 Client: Sanborn Head
 Project Location: NCES Landfill
 Date Received: August 23, 2023
 Date Analyzed: August 24, 2023
 AtmAA Lab #: 22353-21
 Sample ID: 2023-08-21-NCES-02

Specific volume, BTU, and F-factor are calculated using normalized laboratory analysis results for methane, carbon dioxide, nitrogen, oxygen, TNMHC, and sulfur compounds in equations that include gross/net heating and specific gas volume values taken from the GPA-2145 Midstream Standard. Heating value factor is a calculated according to ASTM 3588-98 (14.696 psia and 60°F). The F-factor is calculated according to the equation in EPA Method 19.

Component	Mole %	Wt %	C,H,O,N,S, Wt. %	
Methane	48.82	27.48	Carbon	37.12
Carbon dioxide	38.87	60.16	Hydrogen	6.89
Nitrogen	11.31	11.14	Oxygen	44.73
Oxygen	0.87	0.98	Nitrogen	11.14
Argon	0.04	0.05	Argon	0.05
Hydrogen (CH ₂) _n	0.00 0.036	0.00 0.13	Sulfur	0.06
Specific Volume		13.326		
BTU/ft ³ (Dry @60F, 14.696 psia)		495.5	(HHV)	446.2 (LHV)
BTU/ft ³ (Water Saturated @ 0.25636 psia)		486.9	(HHV)	438.5 (LHV)
BTU/lb (Dry @60F, 14.696 psia)		6603	(HHV)	5946 (LHV)
F _d (factor)		9528		
F _w (factor)		11543		
F _c (factor)		1805		
Compressibility Factor (@60F, 14.696 psia)		0.9971		
Wobbe Index		500.1		
Specific Gravity		0.9819		

Component	Specific volume reference values *
Methane	23.7 (ft ³ /lb)
Carbon dioxide	8.62
Nitrogen	13.5
Oxygen	11.9
Argon	9.52
Hydrogen	188.2

* reference, Rev. 2016, GPA-2145 Midstream Standard, Selected Hydrocarbons 60°F



Calculated values for Specific Volume, BTU, and F (factor)

Report Date: September 5, 2023
 Client: Sanborn Head
 Project Location: NCES Landfill
 Date Received: August 23, 2023
 Date Analyzed: August 24, 2023
 AtmAA Lab #: 22353-22
 Sample ID: 2023-08-21-NCES-03

Specific volume, BTU, and F-factor are calculated using normalized laboratory analysis results for methane, carbon dioxide, nitrogen, oxygen, TNMHC, and sulfur compounds in equations that include gross/net heating and specific gas volume values taken from the GPA-2145 Midstream Standard. Heating value factor is a calculated according to ASTM 3588-98 (14.696 psia and 60°F). The F-factor is calculated according to the equation in EPA Method 19.

Component	Mole %	Wt %	C,H,O,N,S, Wt. %	
Methane	49.49	27.81	Carbon	37.71
Carbon dioxide	39.72	61.39	Hydrogen	6.98
Nitrogen	10.16	9.99	Oxygen	45.22
Oxygen	0.51	0.57	Nitrogen	9.99
Argon	0.02	0.03	Argon	0.03
Hydrogen	0.00	0.00	Sulfur	0.07
(CH ₂) _n	0.035	0.13		
Specific Volume		13.307		
BTU/ft ³ (Dry @60F, 14.696 psia)		502.2	(HHV)	452.2 (LHV)
BTU/ft ³ (Water Saturated @ 0.25636 psia)		493.4	(HHV)	444.4 (LHV)
BTU/lb (Dry @60F, 14.696 psia)		6683	(HHV)	6018 (LHV)
F _d (factor)		9536		
F _w (factor)		11551		
F _c (factor)		1811		
Compressibility Factor (@60F, 14.696 psia)		0.9971		
Wobbe Index		506.4		
Specific Gravity		0.9835		

Component	Specific volume reference values *
Methane	23.7 (ft ³ /lb)
Carbon dioxide	8.62
Nitrogen	13.5
Oxygen	11.9
Argon	9.52
Hydrogen	188.2

* reference, Rev. 2016, GPA-2145 Midstream Standard, Selected Hydrocarbons 60°F



Calculated values for Specific Volume, BTU, and F (factor)

Report Date: September 5, 2023
 Client: Sanborn Head
 Project Location: NCES Landfill
 Date Received: August 23, 2023
 Date Analyzed: August 24, 2023
 AtmAA Lab #: 22353-23
 Sample ID: 2023-08-21-NCES-04

Specific volume, BTU, and F-factor are calculated using normalized laboratory analysis results for methane, carbon dioxide, nitrogen, oxygen, TNMHC, and sulfur compounds in equations that include gross/net heating and specific gas volume values taken from the GPA-2145 Midstream Standard. Heating value factor is a calculated according to ASTM 3588-98 (14.696 psia and 60°F). The F-factor is calculated according to the equation in EPA Method 19.

Component	Mole %	Wt %	C,H,O,N,S, Wt.%	
Methane	49.42	27.80	Carbon	37.61
Carbon dioxide	39.49	61.09	Hydrogen	6.97
Nitrogen	10.38	10.22	Oxygen	45.09
Oxygen	0.59	0.66	Nitrogen	10.22
Argon	0.03	0.04	Argon	0.04
Hydrogen	0.00	0.00	Sulfur	0.07
(CH ₂) _n	0.035	0.13		
Specific Volume		13.319		
BTU/ft ³ (Dry @60F, 14.696 psia)		501.4	(HHV)	451.6 (LHV)
BTU/ft ³ (Water Saturated @ 0.25636 psia)		492.7	(HHV)	443.7 (LHV)
BTU/lb (Dry @60F, 14.696 psia)		6679	(HHV)	6014 (LHV)
F _d (factor)		9531		
F _w (factor)		11547		
F _c (factor)		1808		
Compressibility Factor (@60F, 14.696 psia)		0.9971		
Wobbe Index		505.9		
Specific Gravity		0.9826		

Component	Specific volume reference values *
Methane	23.7 (ft ³ /lb)
Carbon dioxide	8.62
Nitrogen	13.5
Oxygen	11.9
Argon	9.52
Hydrogen	188.2

* reference, Rev. 2016, GPA-2145 Midstream Standard, Selected Hydrocarbons 60°F





LABORATORY ANALYSIS REPORT

Hydrogen Sulfide and Reduced Sulfur Compounds
Analysis in Silco Canister Sample by Method ASTM D5504

Report Date: September 5, 2023
Client: Sanborn Head
Project Name: NCES Landfill
Project Location: Bethlehem, NH
Project No.: 2493.23
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

ANALYSIS DESCRIPTION

Total sulfur analysis measured by gas chromatography with sulfur chemiluminescence detector (SCD), SCAQMD 307.91

AtmAA Lab No.:	22353-21	22353-22	22353-23
Sample I.D.:	2023-08-21-NCES-02	2023-08-21-NCES-03	2023-08-21-NCES-04
Components	(Concentration in ppmv)		
Hydrogen sulfide	553	577	581
Carbonyl sulfide	<1.0	<1.0	<1.0
Methyl mercaptan	1.22	1.27	1.40
Ethyl mercaptan	<0.50	<0.50	<0.50
Dimethyl sulfide	0.88	0.91	0.99
Carbon disulfide	<0.50	<0.50	<0.50
i-Propyl mercaptan	3.25	3.35	3.61
t-Butyl mercaptan	<0.50	<0.50	<0.50
n-Propyl mercaptan	<0.50	<0.50	<0.50
s-Butyl mercaptan	2.90	2.97	3.20
i-Butyl mercaptan	<0.50	<0.50	<0.50
Dimethyl disulfide	<0.50	<0.50	<0.50
Tetrahydrothiophene	<0.50	<0.50	<0.50
Unidentified sulfurs	<0.50	<0.50	<0.50

(Concentration in ppmv, as H₂S)

Total Sulfur	561.3	585.0	589.7
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Brian W. Fung
Laboratory Director

QUALITY ASSURANCE SUMMARY
(Repeat Analyses)

Project Name: NCES Landfill
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

Components	Sample ID	Repeat Analysis		Mean Conc.	% RPD
		Run #1	Run #2		
<i>(Concentration in ppmv)</i>					
Hydrogen sulfide	2023-08-21-NCES-02	562	544	553	3.3
	2023-08-21-NCES-03	580	573	577	1.2
	2023-08-21-NCES-04	576	585	581	1.6
Carbonyl sulfide	2023-08-21-NCES-02	<1.0	<1.0	---	---
	2023-08-21-NCES-03	<1.0	<1.0	---	---
	2023-08-21-NCES-04	<1.0	<1.0	---	---
Methyl mercaptan	2023-08-21-NCES-02	1.25	1.19	1.22	4.9
	2023-08-21-NCES-03	1.28	1.25	1.27	2.4
	2023-08-21-NCES-04	1.38	1.41	1.40	2.2
Ethyl mercaptan	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
Dimethyl sulfide	2023-08-21-NCES-02	0.91	0.85	0.88	6.8
	2023-08-21-NCES-03	0.92	0.89	0.91	3.3
	2023-08-21-NCES-04	0.99	0.99	0.99	0.00
Carbon disulfide	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
i-Propyl mercaptan	2023-08-21-NCES-02	3.36	3.14	3.25	6.8
	2023-08-21-NCES-03	3.38	3.31	3.35	2.1
	2023-08-21-NCES-04	3.56	3.65	3.61	2.5
t-Butyl mercaptan	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
n-Propyl mercaptan	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
s-Butyl mercaptan	2023-08-21-NCES-02	2.97	2.83	2.90	4.8
	2023-08-21-NCES-03	3.00	2.94	2.97	2.0
	2023-08-21-NCES-04	3.16	3.24	3.20	2.5
i-Butyl mercaptan	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
Dimethyl disulfide	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
Tetrahydrothiophene	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---
Unidentified sulfurs	2023-08-21-NCES-02	<0.50	<0.50	---	---
	2023-08-21-NCES-03	<0.50	<0.50	---	---
	2023-08-21-NCES-04	<0.50	<0.50	---	---



QUALITY ASSURANCE SUMMARY
(continued)

Project Name: NCES Landfill
Date Received: August 23, 2023
Date Analyzed: August 24, 2023

Components	Blank PQL	Std Conc.	Initial		Closing	
			Conc.	% Rec.	Conc.	% Rec.
			<i>(Concentration in ppmv)</i>			
Hydrogen sulfide	<0.10	30.29 60.47	28.30 58.66	93.4 97.0	27.91 60.0	92.1 99.3
Carbonyl sulfide	<0.10	30.37	31.03	102.2	31.78	104.6
Methyl mercaptan	<0.10	30.58	31.20	102.0	33.12	108.3
Ethyl mercaptan	<0.10	29.92	30.52	102.0	32.58	108.9
Dimethyl sulfide	<0.10	28.93	29.71	102.7	31.72	109.6
Carbon disulfide	<0.10	30.25	30.62	101.2	31.55	104.3
i-Propyl mercaptan	<0.10	31.52	32.13	101.9	34.58	109.7
t-Butyl mercaptan	<0.10	30.94	31.62	102.2	34.32	110.9
n-Propyl mercaptan	<0.10	31.67	32.26	101.9	34.66	109.4
s-Butyl mercaptan	<0.10	29.79	30.35	101.9	30.03	100.8
i-Butyl mercaptan	<0.10	30.59	31.17	101.9	30.03	98.2
Tetrahydrothiophene	<0.10	31.11	31.43	101.0	30.87	99.2



CHAIN OF CUSTODY RECORD

Client/Project Name: **Sanborn Head** | **NCES Landfill**
 Project Number: **2493.23**

Project Location: **Bethlehem, NH**
 Field Logbook Number:

ANALYSES REQUESTED

SCA QMPD Method 307-91	ASTM 3588-08 (BAM)	EPA Method 303	
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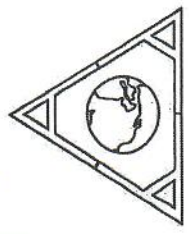
REC'D
2-REGULATORS

Client Sample Identification	Type of Sample Canister ID	AtmAA Lab Number	Turnaround Times: <u>Standard</u> 30 day		Sampling Time	Special Remarks
			Expedited: 24hr / 48hr / 72hr / 5 day	Sampling Date		
2023-08-21-NCES-01	LF6 22353-23	0526		8/21/23	10:52	HOLD
2023-08-21-NCES-02	-21	0523		8/21/23	11:10	SN: 416620
2023-08-21-NCES-03	-22	05131		8/21/23	11:50	SN: 27858
2023-08-21-NCES-04	-23	0518		8/21/23	12:29	SN: 416613

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
<i>[Signature]</i>	8/21/23	16:30	<i>[Signature]</i>		
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
<i>[Signature]</i>			<i>[Signature]</i>		
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time
<i>[Signature]</i>			<i>[Signature]</i>	8/23/23	10:00

Company Info:

Company: Sanborn Head	Analytical Laboratory
Street Address: 187 St. Paul St Suite 241	AtmAA Inc.
City/State/Zip: Burlington, VT 05401	23917 Craftsman Rd.
Telephone No.: 802.391.8504	Calabasas, CA 91302
Email Address: me@sanbornhead.com	TEL: (818) 223-3277
	Email Address: info@atmaa.com



Sanbornhead.com

Appendix C

Calibration Log and Calibration Gas Certifications

Elkins Lab

From: notifications@zohocrm.com
Sent: Thursday, July 13, 2023 8:09 AM
To: RMA Services
Subject: RMA Request 0500-6496



PLEASE PRINT THIS DOCUMENT AND RETURN WITH EQUIPMENT

**Return to: 150 Smokerise Drive
Wadsworth, OH 44281**

Customer & Shipping Information

RMA #:	0500-6496	Shipping Account:	
Date Shipped:	07/15/2023	Insurance Amount:	
Contact Name:	Nathan Huntington	Return Address:	581 Trudeau Rd
Company Name:	Casella	City, State:	Bethlehem, New Hampshire
Phone:	16039917647	ZIP:	03574
Email:	nathanhuntington@casella.com	Include boot on quote:	NO

Equipment Information

Equipment Serial Number 1:	2212202B
Equipment Serial Number 2:	
Equipment Serial Number 3:	
Reason for Return:	Annual calibration
Issue Category:	Annual Cal Request
Description of Issue:	Annual Calibration
EPA Temp Probe Conformance Verification?	false
Additional Equipment Shipped:	

Please Note: If you are requesting an Envision Annual Calibration, the service time is generally 7-10 days from the date that we receive your equipment.

If you would like to schedule a rental, please click here.

Terms and Conditions:

1. Service: By shipping this equipment to EEW and filling out this form the client agrees to pay a \$200 Inspection fee if instruments are found in good working order after inspection. An estimate of pricing will be sent after inspection, at which time the client will approve and provide associated PO# proceed or disapprove the quote and terminate repair. If the quote is disapproved the unit will be returned to the client with responsibility for the associated inspection fee and shipping costs. All estimates are valid for 30 days. If client is non-responsive to the supplied quote, Elkins Earthworks reserves the right to return equipment to the address it was shipped from after 14 days.

2. Annual Calibration: Any instrument sent in for an Annual Calibration or service will receive a quote after the equipment has been inspected by the lab.

3. Items sent to Elkins Earthworks: The client is responsible for listing all items shipped to Elkins Earthworks. Please list these items in the sections on page 1 of this document. Elkins Earthworks will review this list and the contents of what is shipped within 48 hours of receiving the package. If there is a discrepancy the client will be notified within 48 hours and Elkins Earthworks will not be held liable for those items in question.

4. Payment Terms: Payment terms will be due upon receipt unless client and Elkins Earthworks agree upon a different payment term. Client will supply their shipping account number for instrument to be returned via their account. If no account is provided, EEW will pre-pay and bill customer for shipping and handling.

150 Smokerise Drive Wadsworth, OH 44281

330-725-7766 www.elkinsearthworks.com

Don't want to hear from us anymore? Unsubscribe Instantly.



Testing and Calibration Report

Date: 7/27/2023
 Meter Serial Number: 2212202B

RMA# 0500-6496
 Model # ENV200

Communications Testing

- PDA
- Bluetooth

Firmware Testing:

- Test/Update Firmware

Battery Testing:

- Battery Charger Check
- Battery Life Check
- Number of Cycles

Thermistor Testing

- Thermistor

Pressure Sensor Testing:

- Available Pressure
- Impact Port
- Static Port

Gas Sensor Testing:

- O2 Sensor
- CO2 Sensor
- CH4 Sensor

Calibration Results:

Gas Sensors:

Gas	Standard %	Reading %	Standard %	Reading %
CH4	0.0%	0.0%	50.0%	50.0
CO2	0.0%	0.0%	35.0%	35.0
O2	0.0%	0.0%	20.9%	20.9

Pressure Sensors (Low Pressure)

Sensor	Pressure	Reading	Pressure	Reading
Applied	0.000	0.000	-4.500	-4.50
Differential	0.000	0.000	4.500	4.527

Pressure Sensors (High Pressure)

Sensor	Pressure	Reading	Pressure	Reading
Available	0.000	0.000	-100.00	-100.23
Differential	0.000	0.000	20.000	20.063
Applied	0.000	0.000	-100.00	-99.62



Ship returns to: Elkins Earthworks
150 Smokerise Drive
Wadsworth, OH 44281

Comments Back to the Customer:

- O2 Sensor replaced
- Annual calibration performed

Handled by:

Niki Ryan

Completion Date:

7/27/2023

Appendix D

Certification of Accuracy Statement

Certification of Truth, Accuracy, and Completeness

I am authorized to make this submission on behalf of the facility for which the submission is made. Based on information and belief formed after reasonable inquiry, I certify that the statements and information in the enclosed documents are to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

John Gay

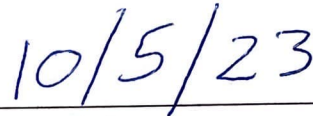
Name of Responsible Official



Signature of Responsible Official

Engineer

Title



Date

802-651-5454

Phone Number