

1.0 INTRODUCTION

Environmental Information Logistics, LLC (EIL) was retained by Wood Island Waste Management, Inc., to perform a Tier 2 landfill gas sampling and analysis test at the Wood Island Landfill in Wetmore, Michigan. The test was performed to determine a new five-year non-methane organic compound (NMOC) concentration and compare the result to the Landfill NSPS (40 CFR Part 60 Subpart XXX) emission threshold of 34 megagrams per year (Mg/year). 40 CFR 60.764(a)(3)(iii) requires the landfill owner to retest the site-specific NMOC concentration every five years. The previous test was conducted April 5, 2017.

The testing was conducted in accordance with the Landfill NSPS and Method 25C of 40 CFR 60 Appendix A. A Tier 2 test protocol was submitted to the Air Quality Division for Michigan Department of Environment, Great Lakes, and Energy (EGLE) February 10, 2022. No comments were received from EGLE. Testing was initiated on March 15, 2022 and was completed by March 17, 2022.

2.0 REGULATORY BACKGROUND

The Wood Island Landfill is owned and operated by Wood Island Waste Management, Inc. The landfill began accepting waste in 1992. Approximately 34.7 acres of waste has been in place for at least two years and is subject to the Tier 2 sampling requirement. 28.5 acres of the 34.7 acres is closed with final composite cover constructed and a passive gas venting system installed. The remaining acreage consists of Cell 11 in the active site.

The facility is subject to 40 CFR 60, Subpart XXX – Landfill New Source Performance Standards Federal Plan Requirements for Municipal Solid Waste Landfills that Commenced Construction, Reconstruction or Modification after July 17, 2014. The facility submitted an initial Design Capacity Report and NMOC Emissions Rate Report to EGLE in May, 2017 and is on a program to test NMOC concentrations every five years thereafter.

The average measured NMOC concentration from the March 2022 five-year Tier 2 test was 257.07 ppm NMOC as hexane. Laboratory results are provided in Appendix B. The results indicate that

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the NMOC emissions rate from the facility is 12.10 Mg/year in the year 2022. Calculations are provided in Appendix C.

Projected NMOC emissions are not estimated to exceed 34 Mg/yr for the next five years, using an assumed waste intake rate of 300,000 tons/year. The five-year projection was prepared based on a conservative estimate of past waste intake. The five-year projection is provided in Appendix C of this report. Pursuant to §60.767(b)(1)(ii), the landfill owner or operator may submit a five-year report in lieu of annual reports, as long as the actual waste volumes received in subsequent years are less than the estimated projections.

The Tier 2 testing results are valid for five years according to §60.76(a)(3)(iii). A new site-specific NMOC concentration will have to be obtained by 2027, within five years from the completion of the previous test date (March 17, 2022).

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 Sample Locations

The Tier 2 methodology requires collection of two gas samples per hectare of landfill surface area in which waste has been in-place for a minimum of two years. At Wood Island Landfill, approximately 34.7 acres, or 14 hectares, have had waste in place for more than two years. Therefore, a minimum of 28 gas samples are required to be collected. Samples were collected from passive vents located in closed areas and from temporary test probes installed in active areas of the site.

The closed area has 20 existing passive vents which were utilized for collection of samples. Some of the vents are connected to solar flares. The vents are connected to a series of perforated horizontal collection pipes extending under the final cover of all the closed cells. EIL collected gas samples at 19 of these passive vents, plus a second sample at passive vent 6. One vent was not accessible, so an additional test probe was installed and sampled in Cell 11 to replace it. EIL installed and sampled a total of 13 Tier 2 test probes in Cell 11. A total of 33 gas samples were

collected, exceeding the minimum number required. Gas vent, solar flare and probe sample locations are shown in Figure 1.

3.2 Probe Installation and Probe/Vent Sampling

The sampling in Cell 11 was conducted by installing a series of temporary collection probes into the waste, in accordance with Method 25C. A geoprobe rig was used to push the temporary probes into the waste a minimum of three feet below the interim or daily cover surface, as required by Method 25C. Non-vented, stainless-steel drill tips were placed on 4 feet long by 1.5 inch diameter stainless steel sampling rods. A stainless-steel sampling probe with a 24 inch perforated stainless-steel screen was present inside the sampling rods. The geoprobe rig pushed each sampling rod coupled with a 5-foot push rod at least three feet into underlying waste material. The geoprobe rig then withdrew the outer sampling rod by 12 – 24 inches, which exposed the perforated steel screen within the waste, allowing any landfill gas present to enter the probe. The rods were then capped with a stainless-steel flush threaded cap with a 1/4" barbed fitting. Sample tubing was attached to the top of each probe via a 1/4" barbed fitting to prevent ambient air from entering the probes, or accumulated gas from seeping out of the landfill gas sampling location. A sample train comprised of stainless steel and PTFE tubing was attached to the rods via the barbed fitting to purge the sample probe prior to sampling, and for sample collection. A schematic of the sample train is provided in Figure 2. Probes were installed, sampled, and abandoned one at a time.

The gas vents were fitted with a 1/4" barbed fitting prior to sampling. These fittings were attached to a valve which was closed to prevent ambient air from entering the vents. A sample train comprised of stainless steel and PTFE tubing was attached to the vents via the barbed fitting to purge the sample train prior to sampling, and for sample collection. A schematic of the sample train is provided in Figure 2.

At both the vents and sample probes, field measurements were taken before the Tier 2 gas samples were collected. This included gas quality, barometric pressures and ambient temperatures. Prior to sampling at each probe location, the gas/air inside the sample locations was evacuated at least twice with the Landtec™ meter. The vents were not purged since gas has been flowing freely for several years at each location. Next, the methane, carbon dioxide, and oxygen levels in each

sample location were measured with a Landtec™ GEM 5000 gas analyzer. An evacuated stainless steel canister was then attached to each sample location each location via the sampling train in Figure 2. Landfill gas samples were collected from each location at a flow rate of less than 500 ml/min.

3.3 Composite Sampling and Analysis

The Method 25C procedures allow for composite sampling to occur in the field, as long as approximately equal volumes of sample are collected from each gas probe/sample location. A minimum volume of one liter per sample location must be collected (see F.R. Volume 65, No. 201 Page 62067, October 17, 2000).

Twenty-eight locations/samples were required. Thirty-three locations/samples were collected. With exception of locations V19, V6-2, and P13, composite sampling was conducted using two sample locations for each of the composites. At locations V19, V6-2, and P13 a single sample was collected per canister.

Each six (6) liter sample canister was evacuated to -30 in Hg and then partially pre-filled with helium. The initial canister pressure was recorded prior to sampling to determine the final canister pressures required to achieve equal sample volumes of at least one liter for each sample location. Gas samples were collected in equal volumes based on pre-determined initial and final pressures calculated for each composite sample.

With exception of sample locations V19, V6-2, and P13, composite sampling was performed by taking an initial vacuum reading from the sample canister. To assure that a vacuum was maintained in the sample canister throughout sampling, two inches of mercury (Hg) were subtracted from the initial canister pressure that was recorded prior to sampling. Since two samples were collected in one canister, the initial vacuum was subtracted by two inches Hg and divided by two (2). The samples for each canister would use the set amount of vacuum as calculated above. Upon completion of the second sample, the remaining vacuum in the canister was two inches Hg. At sample locations V19, V6-2 and P13, a single sample was collected per canister. Two inches

Hg vacuum was also left in each canister at the conclusion of the sampling for these single sample locations.

The attached Table 1 contains the composite information for each sample point including sampling rate, collection times and beginning and ending canister vacuums, as required by Method 25C. The sample flow rate was set to approximately 300 - 500 cc/min and was adjusted as necessary during the sample collection to maintain a constant sample flow rate no greater than 500 ml/min.

Analysis of collected gas samples was performed at the laboratory using gas chromatography equipped with a flame ionization detector (GC/FID) for EPA Method 25C and gas chromatography equipped with a thermal conductivity detector (GC/TCD) for EPA Method 3C. The samples were analyzed for NMOC (following EPA Method 25C) and for methane, carbon dioxide, hydrogen, carbon monoxide, oxygen and nitrogen (following EPA Method 3C). NMOC results are reported as ppmv-carbon. A schematic of the Method 25C sampling train is shown in Figure 2.

4.0 RESULTS

Per the Tier 2 testing protocol requirements, the landfill gas sample is acceptable if the concentration of N₂ is less than 20 percent. Alternatively, the oxygen content of each sample must be less than 5 percent. One of the samples (Vent 1/Vent 2 composite) had nitrogen that was greater than the 20% threshold; however, the oxygen content of this sample was less than 5%. Another sample (Probe 9/Probe 10 composite) has oxygen greater than 5%; however, the nitrogen concentration of this sample was less than 20%. Both of these samples were therefore able to be used in the final NMOC determination. The remaining samples were less than both the 20% nitrogen and the 5% oxygen thresholds. Thus, all collected were suitable for use in the determination of a site-specific NMOC concentration. Although only 28 samples were required to be tested, all 33 samples were analyzed by the lab. Pursuant to 40 CFR 60.764(a)(3), if more than the required number of samples are taken, all samples must be used in the analysis. Analytical data is provided in Appendix B. A summary of laboratory results is shown in Table 2. As shown in Table 2, a total of 33 samples were analyzed and used for the final NMOC average result. This exceeded the minimum number of required samples by five.

The average NMOC value for the site was 257.04 parts per million (ppm) as hexane. The equation provided in 40 CFR 60.764(a)(1)(i)(A) was used to recalculate the NMOC emissions for Wood Island Landfill for the year 2022 (see Appendix C). Waste acceptance rate data is provided in Appendix D. Documented non-MSW waste was subtracted out, as allowed by 40 CFR 40 CFR 62.16718(a)(1)(i)(B). Laboratory QA/QC data is provided in Appendix E.

The NMOC emission rate of 12.10 Mg/yr for the year 2022 is well below the 34 Mg NMOC/year trigger for installation of gas collection and control systems for the Landfill NSPS. The Tier 2 sampling results are valid for five years, until 2027. At that time, a new Tier 2 value will need to be determined.

Appendix C also contains the calculations for projected yearly uncontrolled NMOC emissions for five years, as permitted by §60.767(b)(1)(ii). Based on the conservative projected waste intake rate of 300,000 tons/year, emissions of NMOC stay below 34 Mg/year for the next five years.

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TABLES

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**Table 1: Wood Island Landfill
Tier 2 Sampling Field Data March 15 - 17, 2022
Munising, Michigan**

Sample Location Name	Sample Date	Pre-Sample Purging (<500 ml/min)		LFG Quality - Pre-Sampling			Sample Collection		LFG Quality - Sample Train				Sample Tank Pressures		Sample Canister#	Lab ID#	Barometric Pressure (inches Hg)	Ambient Temperature (°F)	
		Start	Stop	CH4 (%)	CO2 (%)	O2 (%)	BAL (%)	Start	Stop	CH4 (%)	CO2 (%)	O2 (%)	BAL (%)	Pre-Test Pressure (" Hg)					Post-Test Pressure ("Hg)
V1	3/15/2022	8:50	8:53	33.8	16.3	0.9	48.9	8:56	9:01	35.5	17.1	0.3	47.1	16.0	9.0	20573	22A0586-06	29.15	21.0
V2	3/15/2022	9:19	9:22	45.6	16.2	1.4	36.2	9:24	9:29	46.1	16.3	1.3	36.4	9.0	2.0	20573	22A0586-06	29.15	22.0
V3	3/15/2022	9:38	9:40	47.6	18.9	0.9	32.5	9:42	9:47	50.7	20.0	0.0	29.4	16.0	9.0	39973	22A0586-07	29.11	24.0
V4	3/15/2022	9:57	9:59	54.8	28.6	0.6	16.0	10:01	10:06	53.5	30.0	0.0	11.4	9.0	2.0	39973	22A0586-07	29.11	24.0
V5	3/15/2022	9:54	9:57	62.2	32.1	2.4	3.5	9:58	10:03	61.8	32.0	0.6	5.5	11.0	2.0	39968	22A0586-05	29.05	19.0
V6	3/15/2022	9:38	9:42	61.0	32.5	1.9	4.9	9:45	9:51	62.5	33.5	2.3	0.8	20.0	11.0	39968	22A0586-05	29.04	19.0
V7	3/15/2022	10:10	10:14	62.0	33.8	1.4	2.6	10:15	10:21	60.8	33.0	1.6	3.9	20.0	11.0	39982	22A0586-08	29.06	20.0
V8	3/15/2022	10:20	10:24	62.6	33.4	1.3	2.8	10:25	10:31	61.8	32.7	1.4	3.2	11.0	2.0	39982	22A0586-08	29.06	20.0
V9	3/15/2022	10:42	10:45	62.8	33.0	0.5	3.6	11:00	11:05	65.5	34.4	0.0	0.1	19.0	10.5	38759	22A0586-10	29.08	25.0
V10	3/15/2022	10:44	10:50	61.6	62.6	2.8	3.2	10:51	10:57	59.9	32.0	1.2	6.7	20.0	11.0	29400	22A0586-12	29.06	21.0
V11	3/15/2022	11:33	11:37	62.6	34.5	1.1	0.9	11:38	11:44	60.2	33.7	1.4	2.3	11.0	2.0	29400	22A0586-12	29.06	22.0
V12	3/15/2022	11:29	11:31	63.4	33.7	0.1	2.7	11:33	11:38	65.3	34.6	0.0	0.1	10.5	2.0	38759	22A0586-10	29.11	25.0
V13	3/15/2022	11:58	12:00	66.1	32.9	0.0	1.1	12:01	12:07	66.4	33.5	0.0	0.1	20.0	11.0	31334	22A0586-09	29.09	26.0
V14	3/15/2022	11:53	11:57	63.3	34.3	1.4	1.2	11:58	12:02	62.2	34.1	0.6	1.9	18.0	10.0	38690	22A0586-13	29.03	24.0
V15	3/15/2022	12:09	12:13	63.2	34.6	0.5	1.7	12:14	12:19	63.4	34.9	0.0	1.5	10.0	2.0	38690	22A0586-13	29.03	26.0
V16	3/15/2022	12:22	12:24	64.8	35.1	0.0	0.1	12:26	12:31	64.7	35.2	0.0	0.1	11.0	2.0	31334	22A0586-09	29.05	32.0
V17	3/15/2022	13:55	13:59	62.5	35.5	0.5	1.5	14:00	14:06	62.3	35.4	0.1	2.0	18.0	10.0	38691	22A0586-14	29.03	27.0
V18	3/15/2022	14:11	14:15	62.9	35.3	0.4	1.2	14:16	14:22	61.1	34.2	1.0	2.3	10.0	2.0	38691	22A0586-14	29.05	27.0
V19 V6-2 (duplicate)	3/15/2022	14:38	14:40	63.0	34.7	0.6	1.9	14:41	14:50	63.4	35.0	0.1	1.5	18.0	2.0	38956	22A0586-11	29.02	32.0
P1	3/16/2022	13:29	13:33	58.5	32.5	1.4	7.6	10:20	10:45	57.2	32.1	1.7	8.9	16.0	2.0	41731	22A0586-02	28.77	35.0
P2	3/16/2022	13:49	13:53	70.5	26.4	0.4	2.7	13:34	13:39	67.4	30.0	0.2	1.8	20.0	11.0	38755	22A0586-16	29.88	50.0
P3	3/16/2022	14:13	14:15	57.1	40.8	0.3	1.7	13:54	13:59	57.0	40.4	0.1	1.9	11.0	2.0	38755	22A0586-16	28.87	50.0
P4	3/16/2022	14:37	14:40	57.8	35.4	0.2	5.6	14:18	14:23	57.1	36.5	0.1	6.1	20.0	11.0	31011	22A0586-15	28.87	50.0
P5	3/16/2022	15:01	15:03	62.7	31.8	0.5	4.4	14:41	14:46	64.2	32.8	0.2	2.6	11.0	2.0	31011	22A0586-15	28.87	50.0
				60.6	36.0	0.3	3.0	15:04	15:09	59.6	36.1	0.4	3.9	20.0	11.0	30634	22A0586-18	28.83	50.0

Sample Location Name	Sample Date	Pre-Sample Purging (<500 ml/min)		LFG Quality - Pre-Sampling			Sample Collection		LFG Quality - Sample Train			Sample Tank Pressures		Sample Canister#	Lab ID#	Barometric Pressure (inches Hg)	Ambient Temperature (°F)	
		Start	Stop	CH4 (%)	CO2 (%)	O2 (%)	BAL (%)	Start	Stop	CH4 (%)	CO2 (%)	O2 (%)	BAL (%)					Pre-Test Pressure (" Hg)
P6	3/16/2022	15:21	15:24	60.1	37.3	0.2	2.4	15:25	15:30	59.9	37.5	0.1	2.4	11.0	2.0	22A0586-18	28.81	50.0
P7	3/16/2022	15:40	15:42	58.2	39.1	0.0	2.6	15:44	15:50	58.2	39.1	0.0	2.3	20.0	11.0	22A0586-17	28.81	50.0
P8	3/16/2022	16:05	16:07	62.0	36.5	0.1	1.2	16:09	16:15	60.8	37.1	0.0	1.9	11.0	2.0	22A0586-17	28.79	50.0
P9	3/17/2022	7:54	7:56	57.1	40.8	0.4	1.3	8:01	8:06	48.0	35.0	4.0	17.3	17.0	9.5	22A0586-01	28.78	33.0
P10	3/17/2022	8:21	8:23	56.1	41.8	0.2	1.7	8:23	8:28	54.1	41.1	0.4	3.3	9.5	2.0	22A0586-01	28.80	33.0
P11	3/17/2022	9:02	9:03	54.2	41.5	0.7	3.0	9:05	9:10	56.3	42.4	0.2	1.1	17.0	9.5	22A0586-03	28.78	34.0
P12	3/17/2022	9:17	9:19	56.0	42.8	0.1	0.7	9:20	9:25	56.4	43.1	0.0	0.4	9.5	2.0	22A0586-03	28.78	34.0
P13	3/17/2022	9:33	9:35	56.3	43.0	0.0	0.6	9:36	9:45	56.4	42.8	0.0	0.7	18.0	2.0	22A0586-04	28.78	34.0

TABLE 2
SUMMARY OF METHOD 25C AND METHOD 3C DATA
Wood Island Landfill

Sample ID	Sample Location	Date Sampled	CH4 (%)	CO2 (%)	O2 (%)	N2 (%)	NMOC N2 Corrected (ppm as carbon)	NMOC O2 Corrected (ppm as carbon)	NMOC (ppm as hexane)
22A0586-01	P9-P10	3/17/2022	41.30	32.60	5.06	18.20	2130.00	2150.00	355.00
22A0586-02	V6	3/17/2022	46.30	27.20	4.52	16.90	2000.00	2000.00	333.33
22A0586-03	P11-P12	3/17/2022	51.40	43.00	ND	ND	2380.00	2380.00	396.67
22A0586-04	P13	3/17/2022	51.90	43.40	ND	ND	1960.00	1960.00	326.67
22A0586-05	V5-V6	3/15/2022	56.40	32.50	0.75	4.88	1410.00	1370.00	235.00
22A0586-06	V1-V2	3/15/2022	41.10	16.30	0.99	36.40	2150.00	1210.00	201.67
22A0586-07	V3-V4	3/15/2022	50.50	24.50	ND	17.60	1400.00	1080.00	233.33
22A0586-08	F7-F8	3/15/2022	59.50	36.90	ND	1.41	1260.00	1240.00	210.00
22A0586-09	V13-V16	3/15/2022	60.30	34.80	ND	1.00	1250.00	1230.00	208.33
22A0586-10	V9-V12	3/15/2022	55.00	32.30	1.55	6.41	1560.00	1550.00	260.00
22A0586-11	V19	3/15/2022	59.50	35.30	ND	0.47	1270.00	1260.00	211.67
22A0586-12	V10-V11	3/15/2022	59.20	34.40	ND	1.45	1340.00	1320.00	223.33
22A0586-13	V14-V15	3/15/2022	55.90	33.60	ND	1.26	1480.00	1460.00	246.67
22A0586-14	V17-V18	3/15/2022	57.90	37.60	ND	1.53	1500.00	1470.00	250.00
22A0586-15	P3-P4	3/16/2022	58.90	34.80	ND	1.18	1310.00	1290.00	218.33
22A0586-16	P1-P2	3/16/2022	56.60	36.30	ND	ND	1420.00	1420.00	236.67
22A0586-17	P7-P8	3/16/2022	53.60	39.10	ND	ND	1470.00	1470.00	245.00
22A0586-18	P5-P6	3/16/2022	53.80	35.00	ND	0.94	1410.00	1400.00	235.00
	Average		53.84	33.87	2.57	7.83	1,594.44	1,514.44	257.04

Notes:

ND = Not Detected

Sample Numbering Key: V = Vent, F = Vent location with Solar Flare, P = Tier 2 Test Probe

Samples were composited in the field at a 2:1 ratio with the exception of a few locations.

Due to recent changes in Method 25C, nitrogen-corrected NMOC values must be used unless nitrogen is greater than 20%. Therefore, all nitrogen-corrected NMOC concentrations were used in the calculation for the average NMOC with the exception of Sample ID 22A0586-06 (Vents 1 & 2), where nitrogen exceeded 20%. However, since oxygen was less than 5% at this location, the sample was still valid and the oxygen-corrected NMOC value was used in the average.

CH4: methane

CO2: carbon dioxide

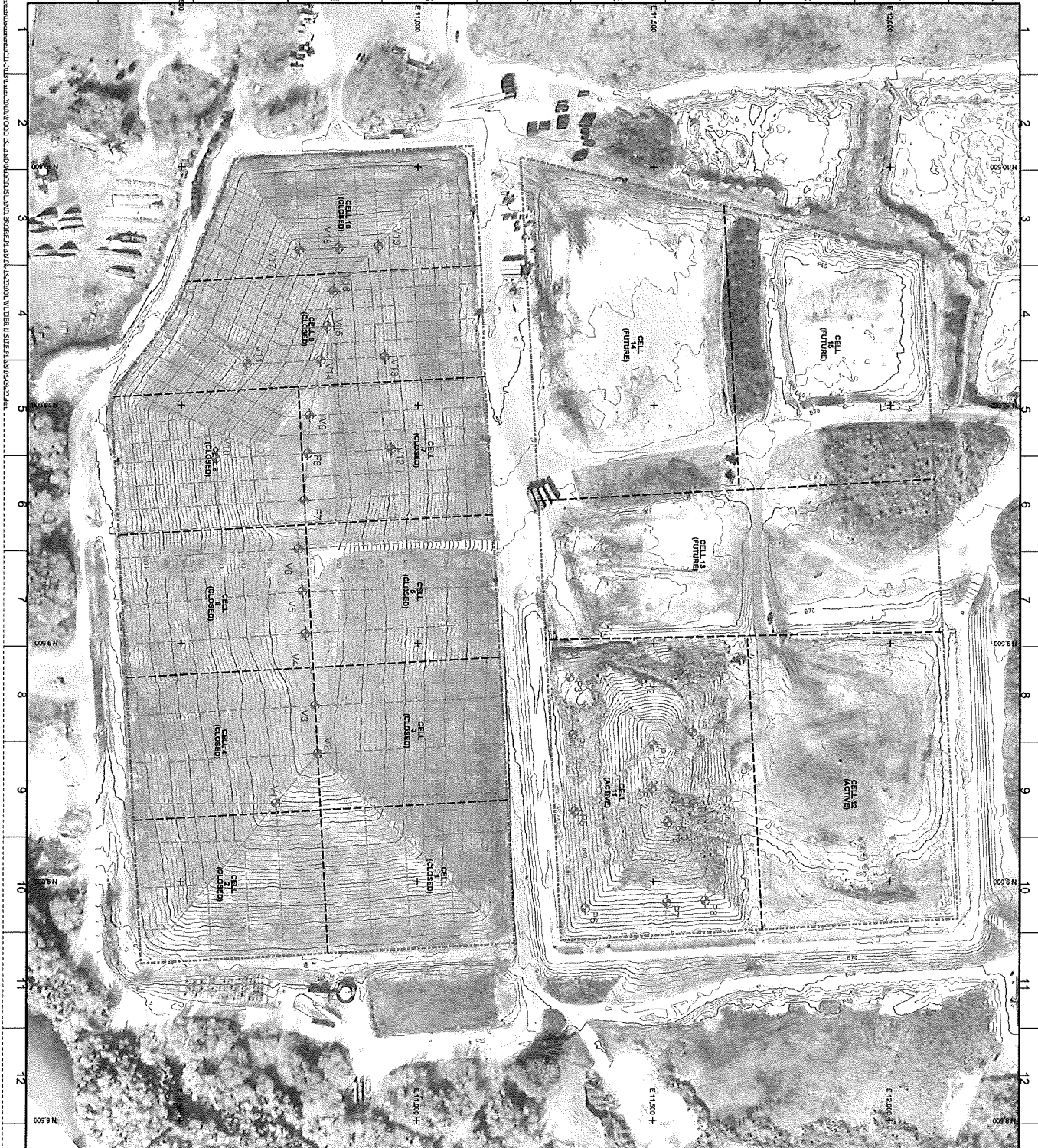
O2: oxygen

N2: nitrogen

%, percent

NMOC as hexane: Non Methane Organic Compounds as hexane (NMOC as carbon divided by six)

FIGURES

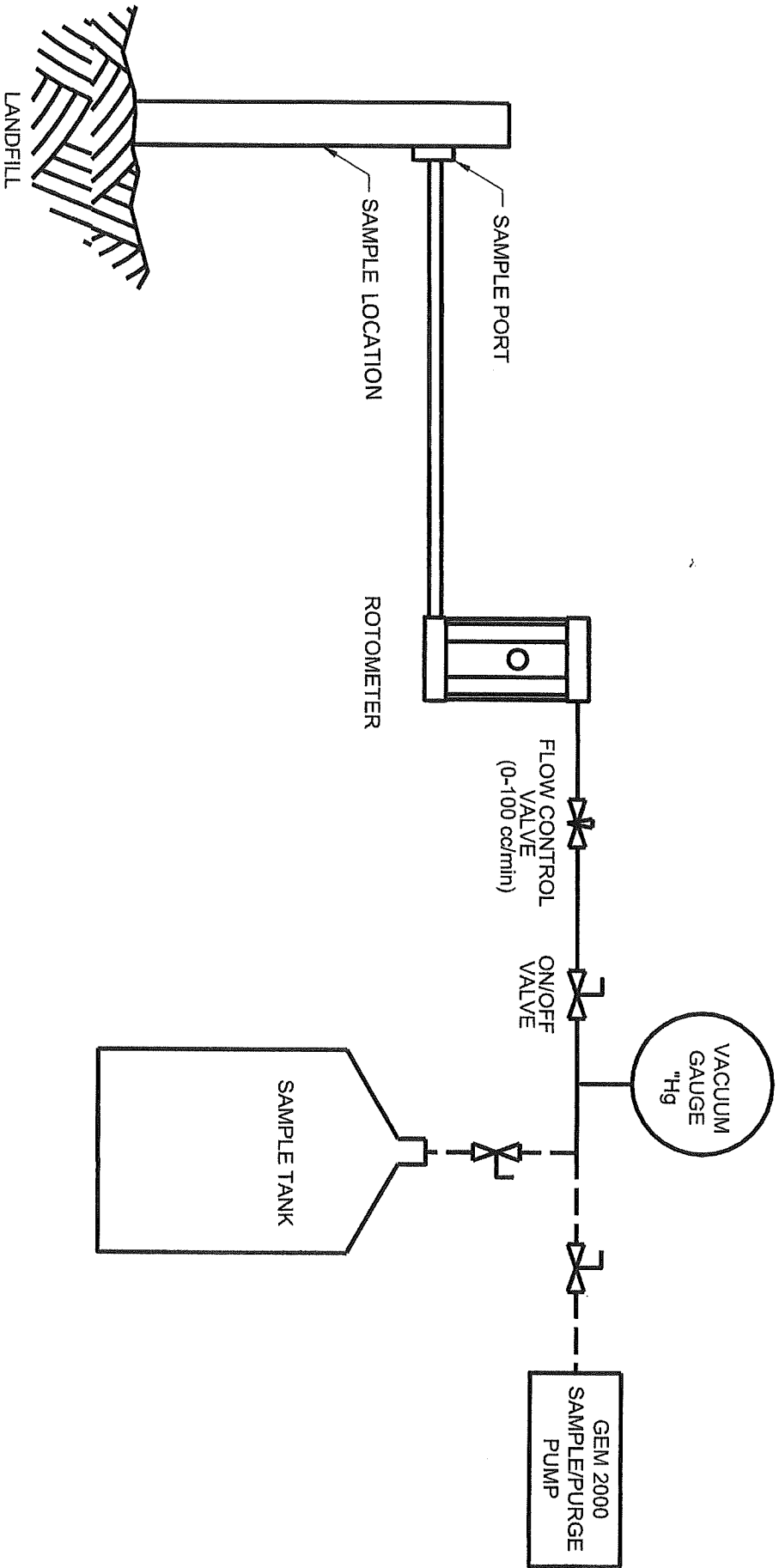


NOTE:
 1) THIS GRAPHIC MAP PROVIDED BY COOPER AERIAL, DATED OCTOBER 4, 2021.

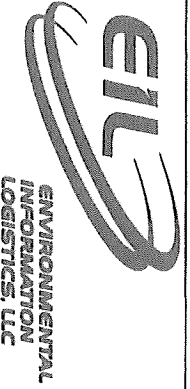
- LEGEND**
- + E 10,500 GRID COORDINATES
 - LIMITS OF WASTE
 - PHASE LIMITS
 - EXISTING TOPRO
 - EXISTING ROAD
 - ◆ TIER 2 SAMPLE LOCATIONS
 - GAS VENT STRINGERS

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DATE PROJECT NO. TIER 2 DATE DO NOT TEST SITE (MAY 16-22) SHEET NO. DRAWING NO.	GFL ENVIRONMENTAL WOOD ISLAND LANDFILL MUNICIPALITY, MICHIGAN TIER 2 SAMPLE LOCATIONS	PREPARED FOR PREPARED BY	  <small>ENVIRONMENTAL INFORMATION CONSULTANTS, LLC</small>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">DRN</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">DES</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">CHK</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">APP</td> <td style="width: 20px;"></td> </tr> </table> <p style="font-size: 8px;">Copyright © Environmental Information Logistics, LLC</p>	DRN		DES		CHK		APP		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">NO</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">REVISIONS</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">DRN</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">CHK</td> <td style="width: 20px;"></td> </tr> <tr> <td style="font-size: 8px;">DATE</td> <td style="width: 20px;"></td> </tr> </table>	NO		REVISIONS		DRN		CHK		DATE	
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FIGURE 2
METHOD 3C/25C TOTAL NON-METHANE ORGANIC COMPOUND SAMPLING TRAIN

WOOD ISLAND LANDFILL
WETMORE, MICHIGAN