

PERFORMANCE TEST REPORT
for the
NORTH & SOUTH LANDFILL NON-ASSISTED
FLARES

at

Delta Solid Waste Management Authority
Delta County Landfill
(SRN: N6035)

5701 19th Avenue North
Escanaba, Michigan

Test Date: September 19, 2022

Report Date: October 19, 2022

Prepared by:

*Environmental Partners, Inc.
305 Hoover Boulevard, Suite 200
Holland, Michigan 49423*

1.0 Introduction

On September 19, 2022 Environmental Partners, Inc. performed a flare performance test on both the North and South landfill flares at the Delta Solid Waste Management Authority (DSWMA) landfill Landfill located at 5701 19th Avenue North, Escanaba, Michigan. Testing was performed in accordance with the test plan dated August 8, 2022. The purpose of the test was to verify the performance criteria of the non-assisted flare used to control the organic compounds associated with the landfill gas generated from the cells of the north and south municipal solid waste (MSW) landfills at the Escanaba facility. Testing was performed under representative meteorological and source operating conditions.

The facility is regulated by the New Source Performance Standard (NSPS) for MSW landfills (40 CFR Part 60 subpart WWW). NSPS General Provision §60.18(c) outlines the requirements of a non-assisted flare control device. General Provision §60.8 requires a performance test be completed to demonstrate compliance with the performance requirements listed under §60.18(c).

The test program was coordinated by David Lundquist, Operations Manager of the Delta County Landfill. The test program was conducted by Bruce Connell, of Environmental Partners, Inc.

2.0 Testing Methodologies and Results

All testing for the North and South landfill flares was performed in accordance with the Test Plan dated August 8, 2022, using the test methodologies as detailed in the *Code of Federal Regulations, Title 40 Part 60 Appendix A* as follows:

Test Methods

USEPA Method	Description
2A	Direct Measurement of Gas Volume Through Pipes and Small Ducts
3C	Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources
22	Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions From Flares

Testing was performed to:

1. Determine the cumulative time of visible emissions observed during the prescribed 2 hour observation period.
2. Determine the exit velocity of the landfill gas at the flare tip.
3. Determine the heat content of the collected landfill gas.

2.1 Visible Emissions Test

Verification of visible emissions was conducted utilizing USEPA Method 22 as described in the *Code of Federal Regulations, Title 40, Part 60, Appendix A*. In accordance with NSPS General Provision §60.18(f)(1), the observation period was two hours. No visible emissions were observed from either flare. The Field Data Sheet for the Visible Emission Tests are included in Appendix A. A diagram showing the relative positions of the flare and the Method 22 observer are included as Figure 1 (North Flare) and Figure 2 (South Flare).

2.2 Flare Exit Velocity Test

The exit velocity of the landfill gases at the flare tip was determined by obtaining 3 hours of cumulative volumetric measurements in accordance with US EPA Method 2A, determining the average flow rate, and dividing the standard volumetric flow rate (in units of standard temperature and pressure) by the unobstructed cross sectional discharge area of the flare tip. The diameter of the discharge point of each flare tip is 8 inches.

The volumetric flow rate was determined in accordance with US EPA Method 2A using a Fluid Components International (FCI) Model ST51-4G11CA001 in-situ thermal

dispersion air flow meter for the North Flare and an FCI Model GF90 in-situ thermal dispersion air flow meter for the South Flare. Both units have an accuracy of $\pm 1\%$.

The exit velocity for the North flare was determined to be 1.84 feet per second and the South Flare was determined to be 6.93 feet per second. The flare exit velocity calculations are included in Table 1 (North) and Table 2 (South). The Field Data Sheets for each of these tests are included in Appendix A.

2.3 Net Heating Value Test

In accordance with §60.754(e), three duplicate 30 minute integrated landfill gas samples were taken in sealed Tedlar bags from the gas supply line leading to each flare. One of each duplicate pair was analyzed for methane content per US EPA Method 3C. The net heating value of the collected landfill gas was determined using the average of the methane concentration in the three gas samples, and applying the higher heating value of methane (1014 BTU/ft³) as described in the reference manual "Combustion – Fossil Power Systems" by Combustion Engineering, 1981. The net heating value of the collected landfill gas for the North landfill was determined to be 476.6 BTU/ft³ and 291.3 BTU/ft³ for the South landfill. The landfill gas net heating value calculations are presented in Table 1 (North) and Table 2 (South). The Field Data Sheets for the test are included in Appendix A.

3.0 Operating Conditions and Process Data Monitoring

Open Flare Operation

Testing was conducted on each non-assisted flare was operating under representative conditions, in accordance with the test methods and procedures set forth in Michigan Air Pollution Control Rules R336.2003.

Process Monitoring

The following process and control device parameters were monitored and recorded during testing:

1. North Flare
 - a. Meter Volume (SCF) – FCI Model ST51-4G11CA001
 - b. Meter Temperature
 - c. Meter Pressure (in. w.c.)
 - d. Barometric Pressure (in. Hg)
 - e. Instantaneous Flow Meter Volume Rate (SCFM) – ST51-4G11CA001
 - f. Flare Temperature (°F)

During the test the gas flow valve position always read “Open”.

2. South Flare
 - a. Meter Volume (MSCF) – FCI Model GF90
 - b. Meter Temperature (F)
 - c. Flare Temperature (F)
 - d. Barometric Pressure (in. Hg)
 - e. Instantaneous Flow Meter Volume Rate (SCFM) – GF90

During the test the gas valve position signal read “On”

3. The flow of landfill gas to each flare was measured by an in-situ thermal dispersion air flow meter. The North landfill flare gas flow was measured by Fluid Components International (FCI) Model ST51-4G11CA001 and the South landfill flare gas flow was measured by FCI Model GF90. The Calibration Certificate for each flare is included with the Field Data Sheets in Appendix A.

Table 1

**Delta Solid Waste Management Authority
Delta County Landfill**

North Landfill Gas (LFG) Test Calculations

Flare Exit Velocity Test

	<u>Time</u>	<u>Meter Volume (std ft³)</u>
Ending	10:30	60401830.6
Starting	07:30	60394891.0
Difference	03:00	6,939.6 std ft ³

$$\text{Flare Exit Tip Diameter} = 8 \text{ inches} \quad \text{Area} = \frac{\pi D^2}{4} = \frac{\pi (8/12)^2}{4} = 0.349 \text{ ft}^2$$

$$\text{Flare Exit Velocity} = \frac{6,939.6 \text{ std ft}^3}{180 \text{ min}} \times \frac{\text{min}}{60 \text{ sec}} \times \frac{1}{0.349 \text{ ft}^2} = 1.84 \text{ ft/sec}$$

Limit <60 ft/sec

LFG Net Heating Value Test

<u>Gas Sample ID</u>	<u>%Methane</u>
NLFG-1A	47.0
NLFG-2A	47.2
NLFG-3A	46.8
Average =	47.0%

Higher Heating Value of Methane = 1014 BTU/ std ft³
(Source: Combustion Engineering – Fossil Power Systems, 1981)

$$\text{LFG Net Heating Value} = 1014 \text{ BTU/ std ft}^3 \times 47.0\% = 476.58 \text{ BTU/ std ft}^3$$

Limit \geq 200 BTU/std ft³

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Table 2

Delta Solid Waste Management Authority
Delta County Landfill

South Landfill Gas (LFG) Test Calculations

Flare Exit Velocity Test

	<u>Time</u>	<u>Meter Volume (std Mft³)</u>
Ending	14:25	429715.1
Starting	11:34	429690.3
Difference	02:51	24.8 std Mft ³ 24,800 std ft ³

$$\text{Flare Exit Tip Diameter} = 8 \text{ inches} \quad \text{Area} = \frac{\pi D^2}{4} = \frac{\pi (8/12)^2}{4} = 0.349 \text{ ft}^2$$

$$\text{Flare Exit Velocity} = \frac{24,800 \text{ std ft}^3}{171 \text{ min}} \times \frac{\text{min}}{60 \text{ sec}} \times \frac{1}{0.349 \text{ ft}^2} = \underline{6.93 \text{ ft/sec}}$$

Limit < 60 ft/sec

LFG Net Heating Value Test

<u>Gas Sample ID</u>	<u>%Methane</u>
SLFG-1A	28.6
SLFG-2A	28.3
SLFG-3A	<u>29.3</u>
Average =	28.73%

Higher Heating Value of Methane = 1014 BTU/ std ft³
(Source: Combustion Engineering – Fossil Power Systems, 1981)

$$\text{LFG Net Heating Value} = 1014 \text{ BTU/ std ft}^3 \times 28.73\% = \underline{291.3 \text{ BTU/ std ft}^3}$$

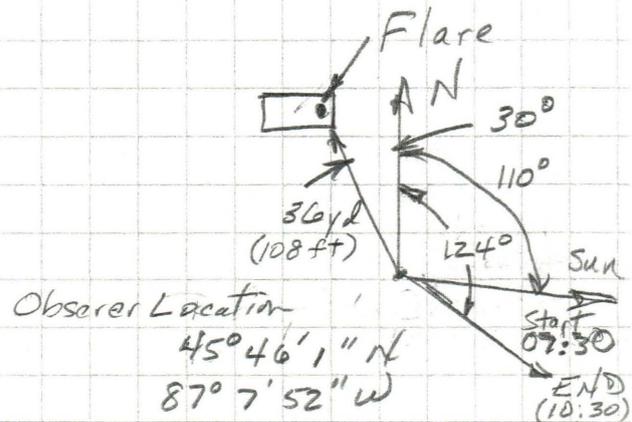
Limit \geq 200 BTU/std ft³

FIGURE 1
 North Landfill Flare Location
 Delta Solid Waste Management Authority



North
 Landfill

Flare Location
 $45^{\circ}46'1.72''N$
 $87^{\circ}7'53.66''W$



Observer Location
 $45^{\circ}46'1''N$
 $87^{\circ}7'52''W$

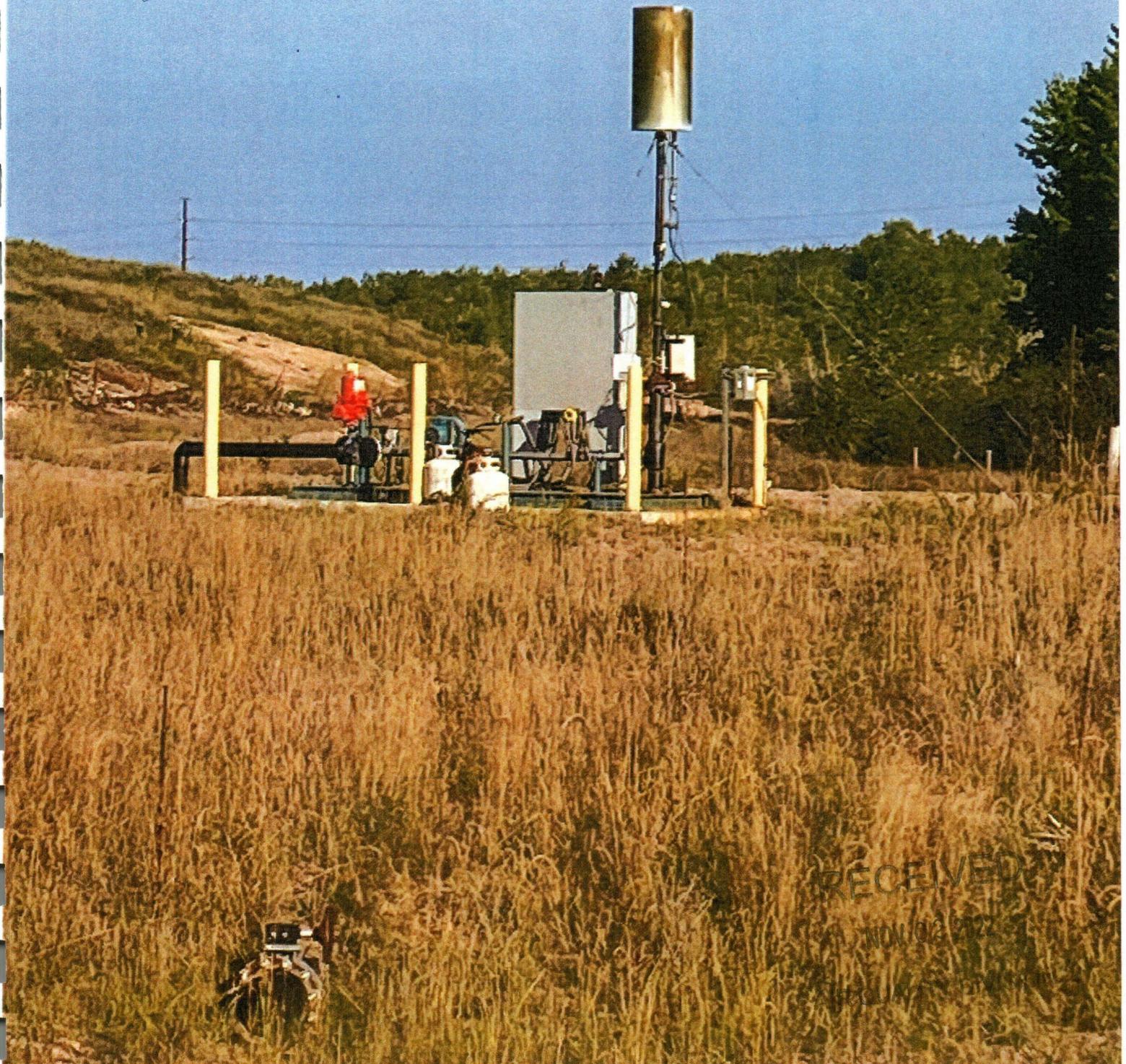
19th Avenue N, Escanaba, MI

Method 22
 Observation period
 07:30 EDST - 10:30 EDST
 September 19, 2022

Observer: Bruce H. Connell
 Environmental Partners

Bruce H. Connell

NORTH LANDFILL FLARE
FROM POSITION OF VIEWER.

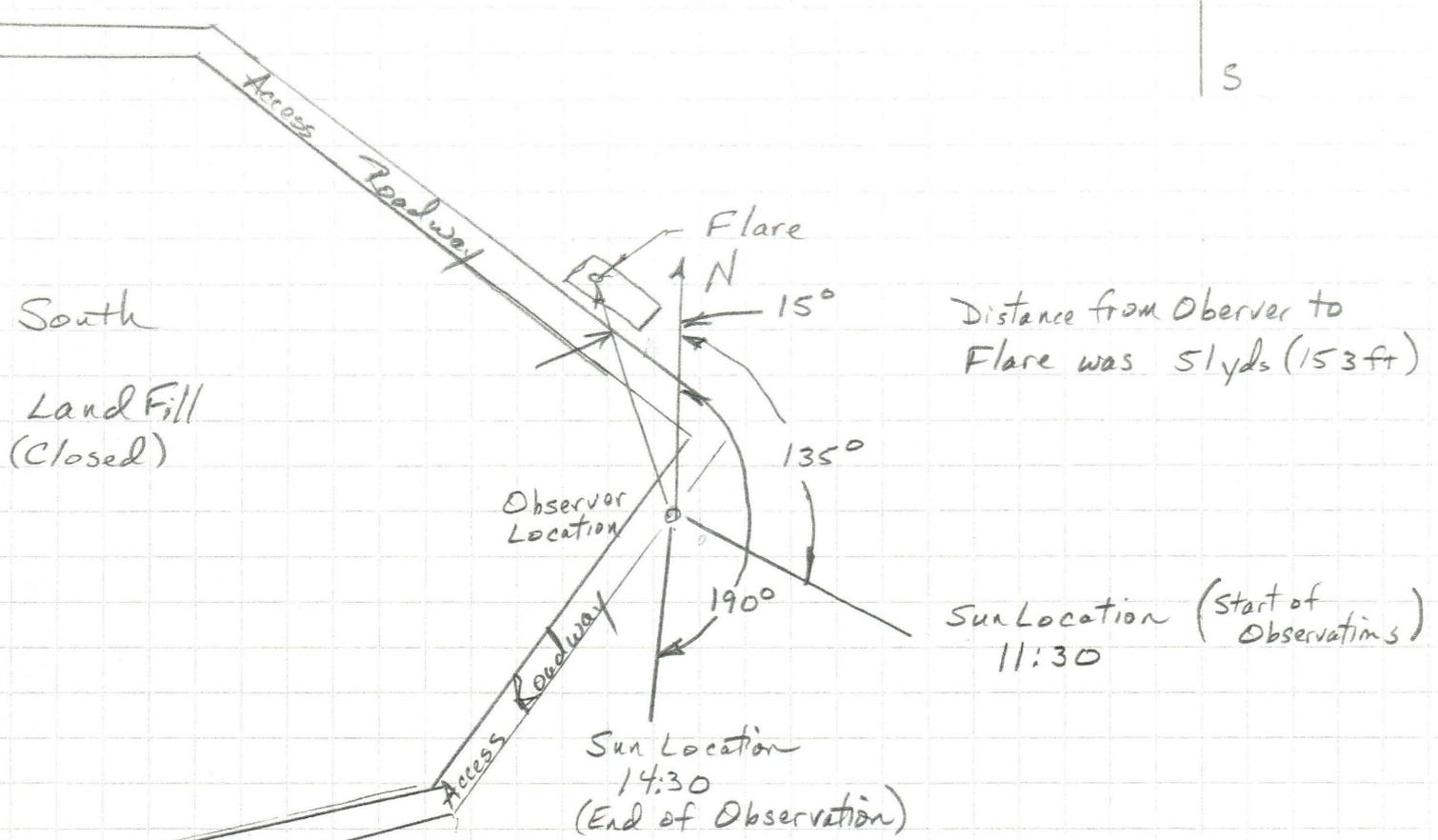
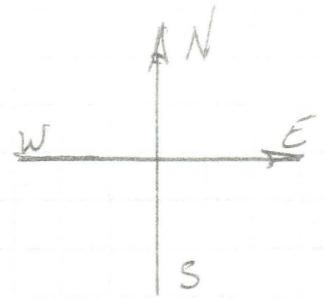


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FIGURE 2
 South Landfill Flare Location
 Delta Solid Waste Management Authority



Observer Location: $45^{\circ} 45' 53'' N$
 $87^{\circ} 7' 39'' W$

Flare Location $45^{\circ} 45' 55'' N$
 $87^{\circ} 7' 40'' W$

Method 22
 Observation Period
 11:33 EDST - 14:25 EDST
 September 19, 2022

Observer: Bruce H. Connell, Principal
 Environmental Partners

Bruce H. Connell

SOUTH LANDFILL FLARE
FROM POSITION OF OBSERVER

