

Verification Report for the Hancock County Landfill Gas Collection Project—CAR635 Findlay, Ohio

Climate Action Reserve

December 2020

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1. Introduction

This report is provided to the Project Developer, 3Degrees Group, Inc. (3Degrees), as a deliverable of the Climate Action Reserve (CAR) project verification process. This report covers the verification of the Hancock County Landfill Gas Collection Project – CAR635 (the Project) for the period from July 1, 2019 through June 28, 2020, which is the last reporting period in the Projects first 10-year crediting period.

2. Objectives

The purpose of this verification was, through review of appropriate evidence, to establish that:

- the Project conforms to the requirements of the verification criteria, including all eligibility requirements, discussed in Section 4 of this report; and
- the data reported are accurate, complete, consistent, transparent, and free of material error or omission.

3. Verification Scope

Specific scope metrics for the verification are outlined in the table below:

Geographic Boundaries	Hancock County Landfill, Findlay, Ohio
Emission Reduction Sources, Project Emissions, and Greenhouse Gases	Emissions reductions (expressed in units of Carbon Dioxide equivalents (CO ₂ e)) resulting from methane destruction; Project emissions of CO ₂ from fossil fuel combustion and purchased electricity.
Reporting Period	July 1, 2019 through June 28, 2020
Data Sources	Metered Data and Emissions Reduction Calculations

4. Standards Used to Verify Emissions (Criteria)

The following table outlines the guidance and protocols used to conduct this verification:

Standard of Verification	• Climate Action Reserve Landfill Project Protocol, Version 5.0, April 24, 2019 (CAR Protocol) • Reserve Offset Program Manual, October 23, 2020 • Applicable Climate Action Reserve Policy Memos
Verification Process	• Section 8 of the CAR Protocol • Climate Action Reserve Verification Program Manual, February 8, 2017 • ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions, 2006

Level of Assurance	• Reasonable assurance
Materiality	• Misstatements greater than one percent of the Project's emission reductions assertion are considered material • Qualitative non-conformities with the CAR Protocol are also considered material

5. Overview of the Verification Process

The verification process was utilized to gain an understanding of the Project's emission sources and reductions and to evaluate and verify the collection and handling of data, the calculations that lead to the results, and the means for reporting the associated data and results.

The following verification process was used:

- conflict of interest review;
- selection of Verification Team;
- initial interaction and kickoff meeting with 3Degrees;
- development of the verification and sampling plan;
- review of management and data collection system;
- virtual site visit;
- assessment of raw data and calculations for period under review;
- follow-up interaction with 3Degrees for corrective action, clarification, or supplemental data as needed; and
- final statement and report submittal.

5.1 Conflict of Interest Review

Prior to beginning any verification project, First Environment conducts an evaluation to identify any potential conflicts of interest associated with the Project. No potential conflicts were identified for this Project. First Environment also received authorization to proceed with verification activities for the Project developer from CAR in a notification dated September 8, 2020.

5.2 Verification Team

First Environment's Verification Team consisted of the following individuals who were selected based on their verification experience, as well as familiarity with landfill operations.

Lead Verifier – Jeff Daley
Verifier – Emily Saul
Senior Internal Reviewer – Michael Carim

5.3 Verification Kick-off

The verification was initiated with a kick-off meeting on September 17, 2020 with the Project developer. The meeting focused on confirming the scope, schedule, and data required for verification.

5.4 Development of the Verification Plan

The Verification Team formally documented its verification plan as well as determined the data-sampling plan. The verification plan was developed based on the discussion of key elements of the project verification process during the kick-off meeting. The project developer was afforded the opportunity to comment on the key elements of the plan for verification. Based on items discussed and agreed upon with the project developer, the plan identified the First Environment project team members, project level of assurance, materiality threshold, and standards of evaluation and reporting for the verification. It also provided an outline of the verification process and established project deliverables. A separate data-sampling plan was designed to review all project elements in areas of potentially high risk of inaccuracy or non-conformance.

5.5 Site Visit

Due to the COVID-19 pandemic, 3Degrees requested that a virtual site visit be allowed for the current verification period. 3Degrees' request for a modification due to extraordinary circumstances was approved by the Reserve on October 15, 2020 (2019-7-2020-6-EXT-CIR-DET-CAR635) for the reporting period of July 1, 2019 through June 28, 2020. Mr. Jeff Daley conducted the virtual site visit on November 4, 2020. Table 1 summarizes the specific conditions of the approval.

TABLE 1: Virtual Site Visit Requirements

Extraordinary Circumstances Determination Requirement	Verification Adherence
The verifier is able to conduct a full assessment of the implementation and operation of the project activity through the virtual site visit.	First Environment conducted a full assessment of the implementation and operation of the project activity. Live video conference calling software was utilized to assess the Project's data management systems and interview personnel relevant to the Project for the verification period.
The verifier is able to request a full walk through of the facility and is able to verify all necessary items for Landfill projects, pursuant to the protocol.	Both live and recorded video were utilized to conduct a full virtual walk through and tour the Project activity, which included confirming project monitoring, metering devices, and all necessary verification items pursuant to the Protocol.
The verification body adheres to all the requirements for virtual site visits, as they are described in the email connected to this determination.	First Environment adhered to all requirements contained in the email communication attached to the determination. Including, implementing additional planning and preparation for the virtual site visit, utilizing recommended software, and updating the verification risk assessment relative to risks associated with a virtual site visit.

5.6 Emissions Reduction Data and Calculation Assessment

This assessment used information and insights gained during the previous steps to evaluate the collected data and the reported emissions reduction quantities and identify if either contained material or immaterial misstatements.

5.7 Corrective Actions and Supplemental Information

The team issued corrective action and clarification requests during the verification process. 3Degrees provided sufficient responses to all corrective action and clarification requests.

5.8 Verification Reporting

Verification reporting, represented by this report, documents the verification process and identifies its findings and results. Verification reporting consists of this report for 3Degrees Group, Inc., a verification statement, and a list of findings, all to be submitted to the Climate Action Reserve.

6. Site's Conformance with Verification Criteria

6.1 Project Description

The Hancock County Landfill is located in Findlay, Ohio and is owned by the Board of County Commissioners of Hancock County. The landfill opened in 1969 and currently receives municipal solid waste.

The Project consists of the voluntary collection and destruction of landfill gas in an open flare and four Caterpillar lean burn combustion engine generator sets. The landfill gas (LFG) well field and active gas collection and control system was installed in 2010. The Project destroys landfill gas that otherwise would be vented to the atmosphere, resulting in a net reduction of CO₂-equivalents. No combustion devices existed on site prior to the implementation of the Project activity. The baseline scenario is defined as the total release of landfill gas to the atmosphere.

6.2 Eligibility

The Project meets the eligibility requirements set forth in the CAR Protocol, as described below.

6.2.1 Ownership and Title

Hancock County is the owner and operator of the landfill. Hancock County entered into a landfill gas lease with Granger Electric of Hancock County, LLC (Granger Electric) on March 24, 2009 which explicitly gives Granger Electric title to all emission reduction credits that are associated with landfill gas collection and destruction. Additionally, it was confirmed through review of the Power Purchase Agreement between Granger Electric and Buckeye Power, Inc. that Granger Electric retains ownership of emission reduction credits associated with landfill gas collection and destruction. On July 7, 2017, Energy Developments purchased Granger in a 100 percent equity share purchase of the company, which buys all of the Granger projects, assets, employees, and contracts. On March 9, 2018, 3Degrees Group, Inc. entered into an emission reduction purchase agreement with Energy Developments. The emission reduction purchase agreement explicitly identifies that title and ownership of the emission reduction credits is transferred to 3Degrees Group, Inc. The ownership status was also confirmed at the virtual site visit.

Additionally, First Environment relied on the Attestation of Title completed by 3Degrees Group, Inc. for the current reporting period. The Attestation is on file with CAR and was reviewed to confirm that it was completed correctly.

6.2.2 Project Start Date

First Environment confirmed that the Project meets CAR's start date requirements. The Project start date is June 29, 2010, which was confirmed through review of various documents including the Ohio EPA permit for construction/installation of the flare, the Shaw LFG sales agreement for the flare skid, and records identifying first ignition of the flare.

6.2.3 Additionality

The Project passes both the Performance Standard Test and the Legal Requirements Test, as described below.

6.2.3.1 Performance Standard Test

The Project consists of the installation of a landfill gas collection and control system and therefore exceeds the performance standard defined by the CAR Protocol, specifically Scenario 1 from the list provided in Section 3.4.1 of the CAR Protocol. It was also confirmed during the virtual site visit that the landfill is not a bioreactor.

6.2.3.2 Legal Requirements Test

The landfill has a permitted capacity above the 2.5 million cubic meter threshold of municipal solid waste that triggers New Source Performance Standard (NSPS) requirements. As such, non-methane organic compounds (NMOC) emissions rate testing is conducted. The most recent Tier II testing event occurred on June 8, 2018. The emissions rate report, dated July 17, 2018, was prepared in accordance with 40CFR60, Subpart WWW and identifies that the NMOC emission rates are calculated to be 0.429 Megagrams (Mg) in 2019, and 0.4487 Mg in 2020 which is below the 50 Mg per year threshold established by the NSPS regulation. Therefore, the landfill is not required to operate an active collection system under NSPS requirements. In July 2018, the landfill received an addendum to the Solid Waste Permit which allows for expansion of the landfill waste acceptance area. Therefore, it is anticipated in future reporting periods, that 40CFR60; Subpart XXX will become applicable with an associated NMOC emission limit of 34 Mg. / year. However, the landfill is currently well under both emissions limits (i.e., Subpart WWW and Subpart XXX) and the gas collection system remains voluntary.

Additionally, First Environment relied on the Attestation of Voluntary Implementation completed by 3Degrees for the current reporting period. The Attestation is on file with CAR and was reviewed to confirm that it was completed correctly.

6.2.4 Regulatory Compliance

First Environment reviewed the landfill's current solid waste permit, Title V permits, water discharge permit, state inspection report, Ohio EPA online regulatory database, and generated compliance reports on October 8, 2020 using the Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO) database, as well as conducted interviews with site personnel to determine regulatory compliance.

The EPA ECHO database report indicated that the site had an effluent limit exceedance during the period of April to June 2020. The exceedance is related to total suspended solids effluent at outfall 006 which is fed by a dewatering pond for new cell construction. The outfall and associated dewatering pond are physically separate and distinct from the Project activity and are not related in any way to the project equipment. The ECHO database also lists a Clean Air Act issue identified as "TV ACC Facility Report Deviations." It was confirmed through review of annual Title V compliance certification report that the self-reported deviations are related to

issues such as instances when the flare was not operating in excess of one hour, and extraction wells that exceed temperature, pressure, or oxygen thresholds. There have been no enforcement actions taken or violations issued as a result. For both of these issues, First Environment has confirmed through review of the Ohio EPA online regulatory database that there have been no violations issued to the facility in both 2019 and 2020. No additional evidence of non-compliance was identified during the reporting period.

Additionally, First Environment relied on the Attestation of Regulatory Compliance completed by 3Degrees for the current reporting period. The Attestation is on file with CAR and was reviewed to confirm that it was completed correctly.

6.3 Project Performance Against CAR Protocol and Project Management System

The Project was implemented in conformity with the CAR Protocol. 3Degrees developed and implemented a Monitoring Plan to track relevant project parameters and data sources. The Monitoring Plan, including the Project Diagram, was reviewed to determine compliance with the protocol requirements. Based on observations made during the virtual site visit and review of relevant project documentation, First Environment found the Monitoring Plan and Project Diagram to meet the requirements set forth by the CAR Protocol and the Project to be implemented in accordance with the Monitoring Plan.

6.3.1 Project Monitoring

The Project's monitoring conforms to the requirements of the CAR Protocol, as discussed below.

Landfill gas flow to the engines is continuously measured using a Veris Verabar in conjunction with two Yokogawa pressure transmitters. The flow meter standardizes the flow rates from ambient conditions to a standard temperature and pressure of 70°F and one atmosphere.

Landfill gas flow to the flare is measured with an FCI-ST51 mass flow meter. The flow meter standardizes the flow rates from ambient conditions to a standard temperature and pressure of 70°F and one atmosphere.

Methane concentration of the landfill gas sent to the engines and flare is measured continuously using two Siemens Ultramat continuous gas analyzers. One analyzer measures methane concentration of the landfill gas sent to the engines, and the other measures methane concentration of the landfill gas sent to the flare.

Flare flow and methane concentration data are transmitted to a Yokogawa FX100 data logger that electronically archives all data. Engine flow and methane concentration data are transmitted to the facilities SCADA system that electronically archives all data. All data are exported to Microsoft Excel for review and quantification.

Both gas flow rates and methane concentrations are measured on the same relative moisture basis.

The operation of the flare is monitored by a thermocouple located in the flare that measures the temperature on a continuous basis. The operation of each engine is monitored independently through kilowatt production data which is recorded at least hourly.

Table 2 summarizes the Project monitoring system parameters and monitoring equipment employed by the Project.

TABLE 2: Monitoring Equipment

Parameter	Monitoring Equipment	Frequency of Measurement	Frequency of Recording	Recording Device
Landfill gas flow to the engines	Veris Verabar / Yokogawa pressure transmitters	Continuous	Totalized and recorded at least daily	SCADA system
Landfill gas flow to the flare	FCI-ST51 Mass Flow Meter	Continuous	Totalized and recorded at least daily	Yokogawa data logger
Methane Concentration	Siemens Ultramat 23 Continuous Gas Analyzers	Continuous	At least once every 15 minutes	Yokogawa data logger (flare data) SCADA system (Engine data)
Hourly Operation of flare	Thermocouple	Continuous	At least once every 15 minutes	Yokogawa data logger
Hourly Operation of engines	Electric meter	Continuous	At least once every 15 minutes	SCADA system

6.3.2 Instrument Quality Assurance/Quality Control

3Degrees' instrument quality assurance/quality control (QA/QC) plan for the Project's monitoring equipment complies with CAR's requirements. Flow meters and methane analyzer calibrations were documented to show that the instruments were calibrated to a range of conditions corresponding to those expected at the landfill.

The Veris Verabar and Yokogawa pressure transmitters are inspected and cleaned on a quarterly basis, with as-found/as-left conditions documented, field checked for calibration accuracy, and calibrated by a third party (Newkirk Electric Associates) within two months prior to/after the end of the reporting period. The field check / calibration performed during the current reporting period indicated the instrument was within the five percent accuracy threshold required by the CAR Protocol. The manufacturer of the flow meter assembly does not have any published recommended calibration intervals. Therefore, the Protocol's minimum requirement of calibration every five years applies. However, the flow meter is field calibrated by a third party at least annually.

The FCI-ST51 flow meter is inspected and cleaned on a quarterly basis, with as-found/as-left conditions documented, field checked for calibration accuracy, and calibrated by a third party (Aptim Engineering Solutions) several times throughout the reporting period including once within two months prior to/after the end of the reporting period. The field check performed during the current reporting period indicated the instrument was within the five percent accuracy threshold required by the CAR Protocol. The manufacturer of the flow meter recommends calibration at least once every 18 months. The flow meter is field calibrated at least annually.

Each Siemens Ultramat 23 gas analyzer is inspected and cleaned on a quarterly basis, with as-found/as-left conditions documented, undergoes routine field checks for calibration accuracy

and in-situ calibration by facility personnel, and are also checked for calibration accuracy within two months prior to / after the end of the reporting period by a third party (Aptim Engineering). Field calibration accuracy checks performed during the reporting period showed each analyzer was within the five percent accuracy threshold required by the CAR Protocol. The Siemens Ultramat located at the flare failed at the end of June 2020. The analyzer was removed from the field and sent to a third party for repair and calibration where it was discovered that the analyzer pump was not functioning, and the oxygen sensor had gone bad. The analyzer was repaired and recalibrated within two months after the end of the reporting period. However, since the analyzer pump was not functioning, an “as-found” drift could not be documented. As a result, the Project Developer is conservatively only claiming credit for landfill gas destroyed in the flare within two months of the last successful third-party calibration, which occurred on March 24, 2020. The manufacturer does not recommend a specific interval to perform calibrations on an ongoing basis. Therefore, the Protocol’s default calibration interval of once every five years applies. However, the analyzers are calibrated at least monthly according to the manufacturer’s procedure.

Additionally, First Environment confirmed that the Fluke pressure calibrator, Yokogawa calibrator, and TSI Manometers used to conduct field checks of the flow meters were maintained per the manufacturers’ requirements. It was also confirmed that the calibration gases used to perform field checks/calibrations of the continuous gas analyzers were within their useful life span.

Table 3 shows the dates during the current reporting period when instrument QA/QC was performed.

TABLE 3: Instrument QA/QC

Monitoring Equipment	Location	Calibration	Calibration Accuracy Check	Inspected/Cleaned
Veris Verabar / Yokogawa pressure transmitters	Engines	6/25/2020	6/25/2020	8/6/2019; 12/9/2019; 3/24/2020; 6/25/2020; 6/30/2020
FCI-ST51 Mass Flow Meter	Flare	8/1/2019; 3/24/2020; 6/30/2020	8/1/2019; 3/24/2020; 6/30/2020	8/1/2019; 12/9/2019; 3/24/2020; 6/30/2019
Siemens Ultramat 23 Continuous Gas Analyzer	Engines	3/24/2020; * 6/30/2020 *	3/24/2020; * 6/30/2020 *	8/6/2019; 12/9/2019; 3/24/2020; 6/30/2020
Siemens Ultramat 23 Continuous Gas Analyzer	Flare	3/24/2020*; 8/7/2020*	3/24/2020*	8/1/2019; 12/9/2019; 3/24/2020; 6/30/2020; 8/7/2020

* These calibrations and calibration accuracy checks were performed by a third party. Additional field calibration accuracy checks are performed throughout the reporting period by facility personnel.

6.3.3 Project Emissions

Project emissions sources and the associated monitoring methodology are summarized in Table 4.

TABLE 4: Project Emissions

Project Emissions Source	Monitoring
Consumption of Purchased Electricity to power the Project equipment	Monthly electrical utility bills
Propane consumption for the flare pilot	Propane purchase records

6.4 Emissions Reduction Calculation Assessment

The emission reduction calculations were reviewed to ensure accuracy in the formulas used and the raw data used as inputs. The formulas were tested to ensure consistency with the calculation methodology described in the CAR Protocol.

Total landfill gas flow is obtained from totalized flow recordings over each recorded interval. Flow totals are aggregated on a daily basis. Metered gas flow volumes were measured at standard conditions at one atmosphere of pressure and a temperature of 70°F by all flow meters. Flow was corrected in the emission reduction calculations to standard conditions of one atmosphere of pressure and a temperature of 60°F. The total volume of methane destroyed by the Project was computed in daily intervals by multiplying the daily gas flow to the engines or flare, by the daily average of methane concentration measurements at the engines or flare, respectively, and is converted to a mass flow using the density of methane at 60°F and one atmosphere of pressure. The total quantity of methane destroyed by the Project is aggregated daily and summed over the reporting period to obtain the total baseline emissions. Project emissions were calculated by multiplying activity data by an appropriate emission factor. The total emission reductions were determined by subtracting the Project emissions from the baseline emissions. Because one flow meter is monitoring flow to all four engines, it was confirmed through review of the raw flow data that during any intervals when one or more engines were not operational, the remaining engines had the available capacity to destroy all of the available landfill gas, and that engine output corresponds to the flow of gas. Additionally, it was confirmed during the virtual site visit that the engines are designed in such a manner that it is physically impossible for landfill gas to pass through the engines while the engines are non-operational, and that each engine is equipped with an automatic safety shut-off valve. No data substitution was applied during the current reporting period.

Table 5 summarizes the input parameters used in the emission reduction calculations.

TABLE 5: Input Parameters

Input Parameter	Name	Description/ Value
LFG _{i,t}	Total quantity of LFG	Aggregated daily from metered data, recorded at 70°F and one atmosphere of pressure
PR _{CH₄,t}	Methane content	Averaged daily from continuous data
DE _i	Default destruction efficiencies	93.6% - Lean Burn Engines 96.0% - Open Flare

Input Parameter	Name	Description/ Value
OX	Oxidation Factor	10%
DF	Discount Factor	0
Flare Temperature Cut-off	Metered data below corresponding temperature cut-off are excluded from calculations.	500°F
EF _{FF}	Propane default emission factor	5.721 kg CO ₂ /gallon
EF _{EL}	Purchased electricity emission factor	1,166.10 lb. CO ₂ /MWh (RFCW e-Grid Region)
GWP _{CH₄}	Global Warming Potential of Methane	25 (IPCC 4 th Assessment Report)

Copies of the raw data used in the calculations, including flow data and methane content data, were compared with the data used in the final calculations and tested for transcription or mathematical errors. A representative sample of raw data sources and calculations over the verification period were reviewed. First Environment performed recalculations of emission reductions for the entire reporting period to assess whether they were free of material misstatement. First Environment found the emission reduction calculations to be free of material misstatement.

6.5 *Approved Variance or Deviations*

No variances or deviations were obtained for the Project in this verification period.

7. Verification Conclusion

Based on the historical evidence collected and the assessments performed, First Environment concludes that the Project's GHG emissions reductions achieved through the collection and combustion of landfill gas for the period July 1, 2019 through June 28, 2020 can be considered with a reasonable level of assurance:

- in conformance with the verification criteria, and
- without material discrepancy.

Verified results show:

July 1 to December 31, 2019	Total
Baseline Emissions (tCO ₂ e)	53,920
Project Emissions (tCO ₂ e)	12
Emissions Reductions (tCO ₂ e)	53,908

January 1 to June 28, 2020	Total
Baseline Emissions (tCO ₂ e)	55,958
Project Emissions (tCO ₂ e)	14
Emissions Reductions (tCO ₂ e)	55,944

8. Lead Verifier Signature



Jeff Daley
Environmental Specialist

9. Senior Internal Reviewer Signature



Michael Carim
Senior Associate