Verification Report for the
Gaston County Landfill
Gas Destruction Project
Dallas, North Carolina

Climate Action Reserve—CAR475

November 2017

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1. Introduction

This report is provided to Gaston County Solid Waste and Recycling (Gaston County) as a deliverable of the Climate Action Reserve (CAR) project verification process. This report covers the verification of the Gaston County Landfill Gas Destruction Project – CAR475 (the Project) for the period from April 1, 2016 through March 31, 2017. First Environment, Inc. (First Environment) conducted the verification from the date of the kickoff meeting through November 13, 2017.

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	Gaston County Landfill, Dallas, North Carolina
Emission Reduction Sources, Project Emissions, and Greenhouse Gases	Emissions reductions (expressed in units of Carbon Dioxide equivalents (CO_2e)) resulting from methane destruction; Project emissions of CO_2 from purchased electricity and fossil fuel consumption.
Reporting Period	April 1, 2016 through March 31, 2017
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 U.S. Landfill Project Protocol, Version 3.0, December 2, 2009 (CAR Protocol) • Climate Action Reserve Landfill Project Protocol Version 3.0 Errata & Clarification, June 18, 2015 (Errata and Clarification) • Climate Action Reserve Program Manual, September 1, 2015
Verification Process	• Section 8 of the CAR Protocol, Version 3.0, December 2009 • Errata and Clarification • 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 Gaston County;
- development of the verification and sampling plan;
- review of management and data collection system;
- site visit;
- assessment of raw data and calculations for period under review;
- follow-up interaction with Gaston County 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 found for this Project. First Environment also received authorization to proceed with verification activities for the Project developer from CAR in a notification dated August 1, 2017.

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
Senior Internal Reviewer – Jay Wintergreen

5.3 Verification Kick-off

The verification was initiated with a kick-off meeting on October 2, 2017 with Gaston County. 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. Gaston County was afforded the opportunity to comment on the key elements of the plan for verification. Based on items discussed and agreed upon with Gaston County, 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

Mr. Jeff Daley conducted a site visit on November 7, 2017 to assess the Project's data management systems and interview personnel relevant to the Project for the verification period.

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 requests during the verification process. Gaston County provided sufficient responses to all corrective action 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 Gaston County, 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 Gaston County Landfill is located in Dallas, North Carolina and is owned/operated by Gaston County.

The Project consists of the voluntary collection and destruction of landfill gas in two open flares and three GE Jenbacher 420 internal combustion engine generators. Gaston County completed installation of a landfill gas (LFG) well field and active gas collection and control system in 2008. Prior to this system, LFG was not collected at the landfill. The Project destroys landfill gas that otherwise would be vented to the atmosphere, resulting in a net reduction of CO_2-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

Gaston County is the owner and operator of the landfill and, as such, holds title to the associated emission reduction credits. The landfill Permit to Operate identifies that the Gaston County NC Register of Deeds lists Gaston County as the legal property owner. Additionally, the relevant Air Permits identify Gaston County as the entity with authority to construct and operate the destruction devices. Purchase records for the flares and the engine generator sets were also reviewed, which all identified that Gaston County is the owner of the project equipment. Power produced by the engine generator sets is sold by Gaston County to Duke Energy Carolinas, LLC by way of a Power Purchase Agreement (PPA). Relevant sections of the PPA and an ownership representation from the Gaston County Attorney's office were provided to confirm that Gaston County retains ownership of the associated carbon offset credits. The ownership status was also confirmed at the site visit through interviews conducted with Project personnel.

Additionally, First Environment relied on the Attestation of Title completed by Gaston County 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 November 18, 2008, which was confirmed during the initial verification through review of the landfill's daily activity logbook and flare skid logbook records.

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, because no collection or control system existed prior to the Project start date. It was also confirmed at the 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. The most recent NMOC Emissions calculations, dated June 2013, indicated that the NMOC emission rate was estimated to be 41.43 megagrams (Mg) per year in 2016 and 42.57 Mg per year in 2017, both of which are below the 50 Mg per year threshold requiring a landfill gas collection system established by the NSPS regulation. Therefore, the landfill is not required to operate an active collection system under NSPS requirements. The NSPS regulation and associated NMOC threshold limit are currently in the process of being updated by the United States Environmental Protection Agency. However, the 50 Mg per year threshold was the applicable standard during the current reporting period. First Environment also reviewed the Solid Waste Permit and Air Permit to confirm that the LFG collection and destruction is voluntary.

Additionally, First Environment relied on the Attestation of Voluntary Implementation completed by Gaston County 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 facilities' Air Permits, Industrial User Permit, Storm Water Permit, Permit to Operate, generated compliance reports on October 10, 2017 using the Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO) database, reviewed North Carolina Department of Environmental Quality inspection reports, and interviewed site personnel to determine regulatory compliance. The cursory review of permits, compliance reports, state inspection reports, and interviews conducted at the site visit indicated that there was no evidence of non-compliance during the reporting period.

Additionally, First Environment relied on the Attestation of Regulatory Compliance completed by Gaston County 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. Gaston County 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 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

Landfill gas flow is continuously monitored using three Rosemount flow meters. Flow to each flare is measured independently with dedicated meters, while total flow to the engines is measured with one meter located on the main gas header line leading to the engine facility. The flow data is transmitted to a Yokogawa data logger that electronically archives all flow data. Flow data to all destruction devices are recorded at standard conditions of 60ºF and one atmosphere, respectively. The data are exported to Microsoft Excel for review and quantification.

The methane concentration of the landfill gas is continuously measured with a Siemens Ultramat 23 methane analyzer. Methane content of the landfill gas is recorded by the Yokogawa data logger. The data are exported to Microsoft Excel for review and quantification.

Both gas flow rates and methane concentration are measured on the same relative moisture basis relative to the flares. Gas flow to the engines is measured on a dry basis while associated methane concentration is measured on a wet basis (this arrangement is acceptable as per Errata & Clarification No. 13, June 18, 2015)

Engine kilowatt hour production is continuously monitored for each engine and recorded at least hourly by the plants PLC electronic chart recorder. The data are also exported to Microsoft Excel for review and quantification.

Table 1 summarizes the Project monitoring system parameters and monitoring equipment employed by the Project.

TABLE 1: Monitoring Equipment

Parameter	Monitoring Equipment	Frequency of Measurement	Frequency of Recording	Recording Device
Landfill gas flow	Rosemount Flow Meter	Continuous	Every 10 minutes	Yokogawa digital chart recorder
Methane Concentration	Siemens Ultramat 23	Continuous	Every 10 minutes	Yokogawa digital chart recorder
Operation of Flares	Thermocouple	Continuous	Every 10 minutes	Yokogawa digital chart recorder
Operation of Engines	Electricity meter	Continuous	At least hourly	PLC chart recorder

6.3.2 Instrument Quality Assurance/Quality Control

Gaston County's instrument quality assurance/quality control (QA/QC) plan for the Project's monitoring equipment complies with CAR Protocol's requirements as described below.

Each flow meter is cleaned and inspected on a quarterly basis by a third party with as-found/as-left conditions documented, and is also field checked for calibration accuracy on a quarterly basis by the same third party, including one field check within two months prior to the end of the reporting period. First Environment reviewed all third-party field calibration checks performed during the current reporting period which indicated that all flow meters were operating within the required five percent accuracy range, with the exception of the March 31, 2017 check of the Flare #1 meter (s/n: 36913) which was found to be under reporting flow. Because this meter was underreporting flow outside of the five percent accuracy threshold, all affected flow is used "as is" without adjustment as required per Section 6.2 of the Protocol. The meter was calibrated in-situ on March 31, 2017 with the as-left condition well within the required five percent accuracy threshold. The manufacturer recommended calibration frequency is greater than once every five years; therefore, the Protocol default frequency of once every five years applies. All Project flow meters are calibrated quarterly which is more frequent than manufacturer recommendations, and the Protocol's default frequency of once every five years.

The continuous gas analyzer is cleaned and inspected on a quarterly basis by a third party with as-found/as-left conditions documented, and is also field checked for calibration accuracy on a quarterly basis by the same third party, including one field check within two months prior to the end of the reporting period. First Environment reviewed all third-party field calibration checks performed during the current reporting period which indicated that the analyzer was operating within the required five percent accuracy range with the exception of the December 14, 2016 field check which identified that the analyzer was under reporting methane concentration outside of the five percent accuracy threshold. Because the analyzer was underreporting methane concentration outside of the five percent accuracy threshold, all affected methane concentration data is used "as is" without adjustment as required per Section 6.2 of the Protocol. The analyzer was successfully calibrated in-situ during the December 14, 2016 field check with as-left conditions well within the required five percent accuracy threshold. The

manufacturer does not recommend a specific interval to perform calibrations on an ongoing basis; however, the gas analyzer undergoes quarterly in-situ calibrations.

First Environment confirmed that the equipment used to perform the third-party field calibration accuracy checks and calibrations of the Project flow meters was calibrated and maintained per manufacturer's requirements. Additionally, First Environment reviewed the calibration gas certificates for the calibration gas used to calibrate the Project methane analyzer to confirm that the calibration gas was within its recommended lifespan.

Table 2 shows the dates during the current reporting period when instrument QA/QC was performed.

TABLE 2: Instrument QA/QC

Monitoring Equipment	Calibration	Field Checked	Inspected/Cleaned
Rosemount flow meter. (s/n 36913, Flare #1)	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017
Rosemount flow meter. (s/n 36914, Flare #2)	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017
Rosemount flow meter. (s/n 38101, Engines)	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017
Siemens Ultramat 23 Gas Analyzer	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017	6/21/2016; 9/13/2016; 12/14/2016; 3/31/2017

6.3.3 Project Emissions

Project emissions sources and the associated monitoring methodology are summarized in Table 3.

TABLE 3: Project Emissions

Project Emissions Source	Monitoring
Consumption of Purchased Electricity	Utility Invoices
Consumption of propane	Purchase Invoices
Consumption of diesel	Purchase Invoices and facility usage 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 computed by multiplying the average landfill gas flow rate in a given interval by the length of the interval. Flow totals are aggregated on a daily and monthly basis. Metered gas flow volumes were measured at standard conditions at one atmosphere of pressure and a temperature of 60ºF by all of the Rosemount flow meters. The total volume of methane destroyed by the Project was computed in daily intervals by multiplying the daily gas flow to the flares and engines by the daily average of methane concentration measurements and is converted to a mass flow using the density of methane at 60ºF and one atmosphere of pressure. The total quantity of methane destroyed by the Project is aggregated monthly and summed over the reporting period to obtain the total baseline emissions. Project emissions were calculated by multiplying activity data by appropriate emission factors. Because one flow meter is monitoring flow to all three engines, it was confirmed through review of the raw flow data that during any intervals when one or more engines was not operational, the remaining engines had the available capacity to destroy all of the available landfill gas. Additionally, it was confirmed during the site visit that the engines are designed in such a manner that it is physically impossible for gas to pass through while the engine(s) are non-operational, and that each engine is equipped with an automatic safety shut-off valve. No data substitution was performed during the current reporting period. The total emission reductions were determined by subtracting the Project emissions from the baseline emissions.

Table 4 summarizes the input parameters used in the emission reduction calculations.

TABLE 4: Input Parameters

Input Parameter	Name	Description/ Value
$LFG_{i,t}$	Total quantity of landfill gas sent to the flares and engines	Summed daily from metered data, measured at standard conditions of 60ºF and one atmosphere of pressure
$PR_{CH4,t}$	Methane content	Averaged daily from continuously recorded data
DE_i	Default destruction efficiencies	93.6% - Lean Burn Engine 96.0% - Open Flare
OX	Oxidation Factor	10%
DF	Discount Factor	0
Flare Temperature Cut-off	Metered data below corresponding temperature cut-off are excluded from calculations	500ºF
EF_{FF}	Propane emission factor	5.74 kg CO_2/gal
EF_{FF}	Diesel emission factor	10.15 kg CO_2/gal
EF_{EL}	Purchased electricity emission factor	856.58 lb. CO_2/MWh (eGrid Region: SRVC Virginia/Carolina)

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 entire verification period was 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 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 April 1, 2016 through March 31, 2017 can be considered with a reasonable level of assurance:

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

Verified results show:

April 1 to December 31, 2016	Total
Baseline Emissions (tCO_2e)	76,368
Project Emissions (tCO_2e)	494
Emissions Reductions (tCO_2e)	75,874

January 1 to March 31, 2017	Total
Baseline Emissions (tCO_2e)	24,298
Project Emissions (tCO_2e)	141
Emissions Reductions (tCO_2e)	24,157

8. Lead Verifier Signature

Jeff Daley
Environmental Specialist

9. Senior Internal Reviewer Signature

Jay Wintergreen
Senior Associate