



Verification Report for CAR495 Greenville County Landfill Gas Utilization
Project

May 1, 2012 – February 28, 2013 Reporting Period

Prepared for:
Greenville Gas Producers, LLC

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1.0 Introduction

Ruby Canyon Engineering (RCE) was contracted to perform the verification of the Greenville County Landfill Gas Utilization Project (Project) for the reporting period May 1, 2012 through February 28, 2013 to the Climate Action Reserve (CAR) Landfill Project Protocol Version 3.0 (Protocol). The Project involves GHG emission reductions from the capture and use of methane from the Enoree Landfill located in Greer, South Carolina.

1.1 *Project Background & Site Description*

The Enoree Landfill is owned and operated by Greenville County. There are two waste-containing cells at the Enoree Landfill, referred to as Phase I and Phase II. Phase I of the landfill was operational for three years (1991 – 1994). Detailed waste acceptance records were not required during Phase I operation, but the amount of waste in place upon closure is estimated to be 750,000 – 1,000,000 tons (680,000 – 907,000 tonnes). Phase II of the landfill is about 71 acres in area, with an average depth of 40 feet, and a design capacity of approximately 2,600,000 Mg (2.86 million tons). Phase II began accepting MSW in 1996 and continued until early 2007 when the landfill was closed and subsequently capped with a high-density polyethylene material cover. The amount of waste in place at the time of closure was 2,573,786 tons (2,334,899 tonnes). The landfill was constructed with a liner and leachate drainage system designed in compliance with Subtitle D of the Resource Conservation and Recovery Act (RCRA). The landfill is not considered a bioreactor.

The current project includes an open flare component and an electricity component with an installed capacity of 3.2 MW. The flare began operating in August, 2007, and the electricity generation plant was completed in August, 2008.

1.2 *Responsible Parties*

Project Developer: Greenville Gas Producers, LLC (GGP)

Technical Consultant: Amy Figuerido, Enerdyne Power Systems

1.3 *Verification Team*

The RCE verification team consisted of the following individuals who were selected based upon verification experience and knowledge of the landfill methane sector.

Lead Verifier: Eric Ripley

Team Members: Phillip Cunningham and Zach Eyler

Senior Internal Reviewer: Bonny Crews

1.4 *Objectives*

The goal of the verification activities was to ensure that the claimed GHG emission reductions were complete, consistent, accurate, transparent, and permanent and that the Project was in compliance with CAR project additionality, monitoring, and reporting requirements. Furthermore, the verification activities ensure that the data provided to RCE is well documented and free of any material errors or omissions.

1.5 Scope

The scope of the verification consists of the following independent and objective activities:

- Review the Project Monitoring Plan
- Review the Project Monitoring Report
- Conduct a site visit to the Project
- Review the project data acquisition and quality control procedures
- Review the Project's baseline emissions and verify that the project boundaries have not changed
- Review the Project's emission reduction calculations
- Review of the Project documents and data against the verification criteria in Table 1
- Issue requests for additional documentation, clarifications, and corrective actions as necessary
- Issue a verification report, verification statement, and list of findings to GGP and CAR

1.6 Verification Criteria

Table 1 – Summary of Verification Criteria

Standard of Verification	• Climate Action Reserve Landfill Project Protocol Version 3.0, • Errata and Clarifications to Landfill Project Protocol Version 3.0 (August 16, 2012) • CAR Program Manual (October 26, 2011) • CAR Verification Program Manual (December 20, 2010)
Verification Process	CAR and ISO 14064-3 Specification with guidance for the validation and verification of greenhouse gas assertions
Level of Assurance	Reasonable assurance
Materiality	A +97% accuracy level (less than 3% error) because total annual ERs are greater than 25,000 tCO ₂ e but less than or equal to 100,000 tCO ₂ e.

2.0 Verification Activities Summary

The verification of the emission reductions for the May 1, 2012 through February 28, 2013 reporting period was a repeat verification of the Project. The Project was already listed with the Reserve, and the previous five verifications, three with site visits and two desktop verifications, were performed by RCE.

Prior to starting the verification, RCE developed a verification plan that was followed throughout the verification. The verification plan consisted of the following activities:

- RCE completed the Project NOVA/COI form to identify any potential conflicts of interest with the Project or Project developer. The NOVA/COI form was submitted to the Reserve's website, and the COI assessment revealed no conflicts of interest and was approved by CAR on February 8, 2013.
- RCE held a verification kickoff meeting with GGP on February 21, 2013. During the kickoff meeting RCE reviewed the verification objectives, verification process and the verification schedule.
- RCE performed a strategic review and risk assessment of the received data and support documents in order to understand the scope and areas of potential risk in the GHG emissions reductions.

- RCE developed a risk-based sampling plan based upon the strategic review and risk assessment. The verification plan and sampling plan were used throughout the verification and were revised as needed based upon additional risk assessments.
- RCE conducted a site visit on February 28, 2013. During the site visit RCE performed key personnel interviews, inspected the Project equipment, and observed the onsite GHG management systems, and data gathering, monitoring, and handling practices.
- RCE performed a risk-based desktop review of the submitted verification documents including an assessment of the GHG calculation methods and inputs, source data completeness, GHG management and monitoring systems, evidence of regulatory compliance, continued additionality, and record retention practices.
- RCE submitted requests for additional documentation to GGP.
- RCE's senior internal reviewer conducted a review of the verification sampling, verification report, and verification statement.
- RCE developed a final verification report, verification statement, and list of findings.
- RCE held an exit meeting with the client on April 9th, 2013.

3.0 Verification Findings

3.1 *Assessment of the GHG Reduction Project Operations*

The Greenville County Landfill Gas Utilization Project currently collects landfill gas (LFG) from the Enoree Landfill and destroys it via combustion in a pair of Caterpillar G3520C gas generator sets housed in a container adjacent to the flare skid. An open candlestick flare is available to handle destruction of excess LFG or for gas diversion when one or both gensets is offline. The LFG is pulled by a blower located at the flare skid through a gas collection system that consists of 51 wellheads connected by lateral piping to the main header pipe.

During the site visit, RCE did not observe any evidence that Project design or operational boundaries had changed from the previous verification. The landfill remains closed and there were no new wells added to the Project.

3.2 *GHG Project Boundary (sources, sinks and/or reservoirs)*

According to the Protocol, carbon dioxide and methane are the only GHGs included in the Project boundary from both the baseline and Project activities. The emissions resulting from the Project activity must be deducted from the Project baseline emissions in order to calculate total emission reductions. These Project emissions include carbon dioxide resulting from both the consumption of electricity from the grid and from the on-site destruction of fossil fuel related to Project activities. The calculation of baseline emissions takes into account the total methane destroyed based on the destruction efficiency of the Project flares and engines and the oxidation of methane by soil bacteria.

Table 2 lists the sources of GHG emissions reviewed during the verification of the Project.

Table 2 – Summary of the Project GHG Sources, Sinks and Reservoirs

Activity	GHG Sources, Sinks & Reservoirs
Baseline	• CH₄ vented to the atmosphere. • Percent methane oxidized by soil bacteria. The landfill is capped with a synthetic cover, therefore no oxidation factor is applied.
Project	• CH₄ from the incomplete combustion of LFG sent to the flare and engines. • CO₂ from the combustion of fossil fuels used during operation and maintenance activities for the Project activity. • CO₂ resulting from the consumption of imported electricity.

3.3 Project Eligibility Criteria

The Protocol specifies four eligibility rules that a GHG Project Developer must meet in order to register reductions with the Reserve: Location, Project Start Date, Additionality, and Regulatory Compliance. During RCE's first verification of the Project, the Project's location and the Project start date were verified. At that time, RCE also confirmed that the Project passed the Performance Standard Test. During this verification, RCE reconfirmed that the Project continues to meet these eligibility requirements and observed no changes since the previous reporting period related to these requirements.

Below is a summary of the CAR eligibility requirements and the Project's compliance to each requirement.

- **Eligibility Rule 1: Location:**

The Project is a US-based landfill located in the town of Greer in Greenville County, South Carolina, USA. The Project therefore meets this eligibility requirement.

- **Eligibility Rule 2: Project Start Date:**

During RCE's first verification of the Project, RCE reviewed the landfill's Air Permit, the South Carolina Office of Environmental Quality Control Construction Permit, and the Temporary Operating Permit which show that the Project began flaring gas on August 1, 2007 and began generating power from LFG combustion on September 1, 2008. RCE confirmed August 1, 2007 as the Project start date.

- **Eligibility 3: Additionality**

Performance Standard Test

During the first verification of the Project, RCE confirmed that prior to the Project activity, the Enoree Landfill in Greenville County neither collected nor destroyed any LFG. Thus the Project meets the Performance Standard Test through installation of an LFG collection system and new qualifying destruction devices at an eligible landfill where LFG has never been collected and destroyed prior to the project start date.

Legal Requirement Test

During the site visit, RCE interviewed the Project Developer about the procedures to ensure that the Project meets environmental compliance requirements and the Legal Requirement Test. Project personnel conduct regular reviews of state, local, and federal LFG regulatory requirements to ensure that the Project is in environmental compliance and that there is no

mandate to collect and combust LFG. RCE confirmed that there are currently no laws or ordinances requiring the landfill to collect and destroy LFG. RCE also reviewed the Project's Monitoring Plan which defines how the Project continues to exceed the Legal Requirement Test. RCE reviewed the Attestation of Voluntary Implementation form signed after the end of the reporting period and uploaded to the CAR website which states that the project was implemented and established voluntarily.

The design capacity of the landfill exceeds the 2.5 million Mg threshold, therefore it is subject to the New Source Performance Standards (NSPS) for MSW Landfills. The regulation requires that landfills above the threshold size calculate their annual NMOC emissions. The most recent Tier II NMOC emission rate test was conducted when the landfill was closed in 2007. The projected NMOC rate for 2012 was 11.11 Mg/year and 10.57 Mg/year for 2013. Since the landfill is closed this rate is not expected to exceed the regulatory threshold of 50 Mg/year which would trigger mandatory emissions control.

During the review of the supporting evidence, RCE did not observe any indication that Greenville County was mandated to collect and combust LFG from the Enoree Landfill. Additionally, there are no local, state or Federal mandatory requirements for the installation of a gas collection and combustion system. Therefore the results of the regulatory review indicated that GGP is following their Monitoring Manual procedures to ensure they pass the Legal Requirements Test and the Project is in compliance with all Federal, State and local regulations.

- **Eligibility 4: Regulatory Compliance:**

RCE reviewed the procedures described in the Project Monitoring Manual to ensure that the Project remains in compliance with all applicable local, state, and federal requirements. RCE reviewed the landfill's air permit and the closure construction certificate. During RCE's review there was no evidence of non-compliance found, and the procedures for ensuring regulatory compliance in the Monitoring Manual were being properly followed. Finally, RCE confirmed signature of the Attestation of Regulatory Compliance, after the end of the reporting period, which was uploaded to the Reserve.

3.4 Ownership of GHG Reductions

RCE reviewed evidence that GGP has ownership of the GHG emission reductions. Ownership documentation consists of the redacted contract agreement between GGP and the County of Greenville, South Carolina for evidence of ownership of the generated emission reductions. The presented evidence clearly demonstrates that GGP holds the legal title and exclusive ownership rights of the emission reductions associated with the Project. Finally, RCE reviewed the completed Attestation of Title which was uploaded to the CAR website following the end of the reporting period.

3.5 GHG Monitoring and Management Systems

RCE reviewed the data management systems during the site visit and desktop review. RCE completed the majority of the GHG management systems review during the site visit by observing the onsite procedures and interviewing the Project personnel. The onsite review included an assessment of the Project data collection, processing and handling procedures; recordkeeping and data storage; quality control and assurance procedures; project personnel competencies; and a field tour of the Project equipment. The desktop review included a detailed review of the Project monitoring plan and its

conformance to Protocol requirements. RCE also confirmed that the Project was implemented according to the Monitoring Plan.

The primary Project data includes the total LFG flow, the LFG flow to the flare, LFG flow to the engines, temperature of the flare, methane content of the LFG, and operation of the engines. There are three points of LFG flow measurement in the Project system: the total LFG drawn from the Enoree Landfill is measured downstream of the last knockout with a Lambda Square Venturi flowmeter at 60°F and 1 atm, coupled with a pressure transmitter; the LFG flared is measured downstream of the blowers and methane measurement with a Veris Verabar flow meter at 59°F and 1 atm, coupled with a pressure transmitter; the amount of LFG sent to the generators is measured downstream of the blowers and methane measurement (after a split that sends LFG to the flare and the gensets) with a Lambda Square Venturi flowmeter at 60°F and 1 atm, coupled with a pressure transmitter.

The methane fraction in the LFG is measured downstream of the blowers with a Siemens Ultramat 23. All data are measured continuously and recorded every 5 minutes and compiled into a database by the SCADA system. The SCADA data files are transferred weekly by the Site Operator to the Operations Manager, who reviews and transfers the data to GGP's Carbon Advisor. The Carbon Advisor conducts quality checks and incorporates the data into the emission reduction workbook. An electronic chart recorder records 2-second data that is maintained as a backup in the event of SCADA failure.

The operation and temperature of the flare is continuously monitored by a thermocouple. Operation of the engines is monitored through the SCADA system which monitors individual engine output in kilowatts on a continuous basis as well as through the engine run hour (totalizer) meters. The site operator also records electricity production from each engine on a daily basis and the run hours of each engine monthly. Additionally, there is the electricity meter which measures the amount of electricity sold to the grid.

During the site visit RCE reviewed the data storage and retention policies of the Enoree Landfill and verified they were in conformance with the Protocol requirements and followed the Monitoring Plan.

3.6 Instrument QA/QC

RCE reviewed evidence that the LFG flow meters and methane analyzer met all instrument QA/QC requirements as outlined in the protocol for cleaning, inspection, calibration checks, and calibration by the manufacturer or a certified third-party calibration service.

The monitoring equipment was cleaned and inspected on a quarterly basis. The calibration field checks for the flow meters and methane analyzer were performed within two months of the end of the reporting period and indicated that all equipment was reading accurately within the ± 5 percent threshold as required by the Protocol. In addition to Protocol requirements for monitoring instrument maintenance, the flow meters and methane analyzer are also calibrated semi-annually by a certified third-party calibration service. This exceeds the manufacturers' guidance for each piece of equipment.

The dates for the quarterly cleaning, inspections and calibration checks for each piece of monitoring equipment are listed in Table 3.

Table 3 Protocol required Project Quarterly Cleaning, Inspection and Field Calibration Checks

Monitoring Equipment	Quarterly Maintenance Checks		
Flow Meters	7/2/2012	10/1/2012	1/2/2013
Siemens Ultramat Gas Analyzer (Ultramat 23)			
Monitoring Equipment	Calibration Checks		
Flow Meters	2/20/2013		
Siemens Ultramat Gas Analyzer (Ultramat 23)	2/20/2013		

3.7 Assessment of GHG Emissions Reductions Calculations

The emission reduction calculations assessment included a review of the Project assumptions, raw data inputs, and accuracy of calculations. RCE first assessed the completeness of the raw data and how the data is transferred to the calculation spreadsheet. Next, the formulas and raw data inputs were reviewed for accuracy and compliance with the Protocol. RCE sampled all data from the reporting period and recalculated methane destruction and compared these values to the values in the GGP calculation spreadsheet. RCE also reviewed the check built into the spreadsheet that totalizes flow only at times when the flare is operational (thermocouple readings greater than 500°F). RCE confirmed that the appropriate destruction efficiencies were applied for the open flare (96 percent destruction efficiency) and lean-burn combustion engines (93.6 percent destruction efficiency).

A conservative check on flow measurements and calculations is applied in the spreadsheet which compares the sum of LFG_{flare} and $LFG_{electricity}$ with LFG_{total} , and the lower of the two values is used for the emission reductions calculations. These data manipulations are carefully explained in the Monitoring Report and are consistent and transparent in the calculation spreadsheet.

Since the volume of gas flow to the flare is recorded at a temperature of 59 °F and 1 atm, the flow readings were appropriately adjusted to a standard temperature and pressure of 60 °F and 1 atm per the Protocol's requirement. The volume of gas flow to the electricity generators and the total LFG flow is measured at 60 °F and 1 atm and therefore does not require adjustment.

RCE reviewed source documentation for Project emissions from purchased electricity and propane, confirmed that appropriate emission and conversion factors were used, and reviewed the use of Protocol equations for Project emissions in the GHG assertion.

Lastly, RCE recalculated the GHG emission reductions and compared the results to GGP's calculations to determine if there was a material difference. The difference between RCE's and GGP's emission reductions was non-material.

4.0 Verification Results

GGP provided sufficient evidence and documentation of emission estimates, data collection procedures, and monitoring and quality control procedures. The verification process focused on verifying the emissions estimates and the source data used by GGP to quantify the emissions reductions in

accordance with the CAR Landfill Project Protocol 3.0. The following is a summary of the verification results.

The Project reported emission reductions of 55,313 metric tons CO₂e in 2012 and 12,026 metric tons CO₂e in 2013. During final review, RCE identified no material misstatements in the data or emissions calculations. Table 3 defines the emission reductions verified for this reporting period.

During the verification process, RCE made requests for supplemental documentation to complete the verification. GGP sufficiently addressed all requests. The details of the requests for supplemental documentation are documented in RCE's List of Findings provided to CAR and GGP.

5.0 Verification Statement

RCE conducted a risk-based analysis of the Greenville County Landfill Gas Utilization Project GHG assertion including a strategic review of the Project data and evidence. Based upon the processes and procedures and the evidence collected, RCE concludes that the GHG assertion is a fair representation of the Project emission reductions resulting from the capture and destruction of landfill gas during the reporting period May 1, 2012 through February 28, 2013 and can be considered:

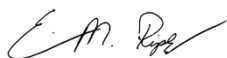
- in conformance with the CAR Landfill Project Protocol 3.0,
- without material discrepancy, and
- verified to a reasonable level of assurance.

The verified emission reductions are listed in Table 3.

Table 3 - Emission Reductions Verified for May 1, 2012 through February 28, 2013

Emissions Verified	Baseline Emissions	Project Emissions	Emission Reductions CO₂e (metric tons)
2012 Emission Reductions	55,641	328	55,313
2013 Emission Reductions	12,084	58	12,026
Total	67,725	386	67,339

Lead Verifier Signature



Eric Ripley

Senior Internal Reviewer Signature



Bonny Crews