

Verification Report for the Morehead Landfill—CAR592 Morehead, Kentucky

Climate Action Reserve

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1. Introduction

This report is provided to Advanced Disposal Services Morehead Landfill, Inc. (Advanced Disposal) as a deliverable of the Climate Action Reserve (CAR) project verification process. This report covers the verification of the Morehead Landfill – CAR592 (the Project) for the period from April 1, 2012 through March 9, 2013. First Environment, Inc. (First Environment) conducted the verification from May through August, 2013.

During the verification process, Element Markets acted as the project advisor for the project developer, Advanced Disposal. As such, First Environment communicated directly with Element Markets regarding all verification activities.

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	Morehead Landfill, Morehead, Kentucky
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	April 1, 2012 through March 9, 2013
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 2.1, October 14, 2009 (CAR Protocol) • Climate Action Reserve Landfill Project Protocol Version 2.1 Errata & Clarification, June 3, 2013 (Errata and Clarification) • Climate Action Reserve Program Manual, October 26, 2011
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Verification Process	• Landfill Project Verification Protocol, Version 2.0, November 18, 2008 • Errata and Clarification • Climate Action Reserve Verification Program Manual, December 20, 2010 • 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 three percent of the Project's emission reductions assertion for the verification reporting period 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 kick-off meeting with Advanced Disposal;
- 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 Advanced Disposal 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 May 1, 2013.

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
Verifiers – Ross MacWhinney
Senior Internal Reviewer – Michael Carim

5.3 Verification Kick-off

The verification was initiated with a kick-off meeting on May 14, 2013 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. Advanced Disposal was afforded the opportunity to comment on the key elements of the plan for verification. Based on items discussed and agreed upon with Advanced Disposal, 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 June 12, 2013 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 and clarification requests during the verification process. Advanced Disposal 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 Advanced Disposal, a verification statement, and a list of findings to be submitted to the Climate Action Reserve.

6. Site's Conformance with Verification Criteria

6.1 Project Description

The Morehead Landfill is an active municipal landfill located at 300 Old Phelps Road, Morehead, Kentucky. The landfill began accepting municipal solid waste in 1974 and currently consists of Cells 1 through 5. The landfill is currently filling in Cells 4 and 5.

In the future, the landfill will be expanded into Cells 6 through 9.

The project collects and combusts landfill gas in an open flare. No combustion devices existed on site prior to the initiation of the project activity. The baseline scenario is defined as the total release of landfill gas to the atmosphere and was confirmed through review of facility air permits

6.2 Eligibility

Advanced Disposal meets the eligibility requirements set forth in the CAR Protocol, as described below.

6.2.1 Ownership and Title

The landfill was originally owned and operated by Veolia ES Solid Waste. In November 2012, Advanced Disposal acquired Veolia ES Solid Waste. As such, Advanced Disposal is the owner and operator of the landfill and holds title to the associated emission reduction credits. First Environment reviewed an affidavit of sale demonstrating the acquisition of Veolia ES Solid Waste by Advanced Disposal. First Environment also reviewed the landfill's Solid Waste Permit and Industrial Use Permit, which are both issued to Advanced Disposal, in order to confirm that Advanced Disposal is the owner and operator of the landfill and holds title to the emission reduction credits associated with the landfill gas.

Additionally, First Environment relied on the Attestation of Title completed by Advanced Disposal 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 of December 3, 2009 is when landfill gas was first combusted in the Project's flare. First Environment reviewed a start-up service invoice from the flare skid installer, Shaw LFG Specialties, LLC, as well as field monitoring reports.

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 new qualifying destruction device 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 landfill gas had never previously been collected and destroyed prior to the project start date. It was also confirmed during the site visit that the landfill is not a bioreactor.

6.2.3.2 Legal Requirements Test

The landfill's Title V Permit, Industrial Use Permit, Solid Waste Permit, Kentucky Pollution Discharge and Elimination System (KPDES) Permit, and Tier II test results were reviewed during this verification period to confirm conformance with the Legal Requirement Test. The Morehead Landfill is subject to New Source Performance Standard (NSPS) rules requiring the facility to conduct Non-Methane Organic Compound (NMOC) emission rate testing. The most recent Tier II emissions rate testing occurred on October 3, 2011. Tier II testing is not required

to occur again until 2016. The results of the 2011 Tier II testing indicated that NMOC emission rates were forecasted to be 17.3 Mg/yr for 2012, and 18.1 Mg/yr for 2013, both below the 50 Mg/yr threshold that would require the installation of a gas collection and control system.

To further inform the assessment of regulatory additionality, First Environment performed a review of relevant Kentucky Department of Environmental Protection regulations for municipal solid waste landfills. This cursory review indicated that the Project is not required by regulation; therefore, the Project passes the CAR Protocol's Legal Requirements Test.

Additionally, First Environment relied on the Attestation of Voluntary Implementation completed by Advanced Disposal 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 Title V Permit, Industrial Use Permit, Solid Waste Permit, Kentucky Pollution Discharge and Elimination System (KPDES) Permit, and interviewed Morehead Landfill personnel to determine regulatory compliance. The cursory review of permits and interviews conducted indicated that the site was in compliance and no notices of violation were issued during the reporting period. Quarterly inspection reports by the Kentucky Energy and Environment Cabinet were also reviewed, along with the most recent air quality monitoring report from the Kentucky Department of Air Quality, all of which indicated the landfill was in compliance. First Environment also reviewed the Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO) database which indicated the project was in compliance during the reporting period.

Additionally, First Environment relied on the Attestation of Regulatory Compliance completed by Advanced Disposal 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. Advanced Disposal 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

A Fluid Components International (FCI) Model ST98 thermal mass flow (FCI ST98) continuously measures landfill gas flow of the gas stream. The meter standardizes flow readings to a pressure of one atmosphere and a temperature of 70°F. The data are transmitted to a Yokogawa datalogger that electronically archives all flow data. The project utilized two identical flow meters throughout the reporting period in order to facilitate factory calibration requirements.

Methane content was monitored using both a continuous Elkins Earthworks EDGE continuous analyzer and portable Envirovision gas analyzers. The portable Envirovision analyzers were used until September of 2012, after which the landfill purchased and installed the continuous analyzer.

The portable Envision analyzers are also maintained and used as a backup source of methane data should issues arise with the operation of the continuous analyzer. Table 1 summarizes the periods during which the portable gas analyzers were used to record project methane concentration data:

Table 1: Portable Analyzer in-Service Dates

Envision Analyzer Serial No.	Dates Used
903006	6/1/2012 – 6/7/2012
1003018	3/30/2012 – 4/5/2012; 5/25/2012 – 5/31/2012
1003019	4/6/2012 – 5/24/2012; 6/8/2012 – 7/5/2012; 7/27/2012 – 8/2/2012; 8/17/2012 – 8/23/2012; 9/7/2012 – 9/13/2012
1101004	7/6/2012 – 7/19/2012; 8/17/2012 – 9/6/2012; 12/14/2012 – 12/20/2012
1101009	8/3/2012 – 8/9/2012

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

The flare incorporates a thermocouple that is designed to shut down the flare when the flare temperature drops below the set point of 200°F. As described in Table 4 below, all metered data with corresponding flare temperatures below 500°F have been excluded from the emission reduction assertion.

A PLC system continuously records gas flow, continuous methane concentration, and flare temperature data on a Yokogawa digital chart recorder.

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	FCI ST98 flow meter	Continuous	Every 8 minutes	Yokogawa digital chart recorder
Methane Concentration	Elkins Earthworks EDGE Continuous Gas Analyzer	Continuous	Every 14 minutes	Yokogawa digital chart recorder
	Envision portable gas analyzer	Periodic	As measured	Field logs
Hourly Operation of Destruction Device	Thermocouple	Continuous	Every 8 minutes	Yokogawa digital chart recorder

6.3.2 Instrument Quality Assurance/Quality Control

Advanced Disposal's instrument quality assurance/quality control (QA/QC) plan for the Project's monitoring equipment complies with CAR's requirements.

The FCI ST98 flow meter is field checked for calibration accuracy once per month, including at least one occurrence no more than two months prior to the end of the reporting period. All field checks performed during the current reporting period indicated the instrument was within the five percent accuracy range required by the CAR Protocol. First Environment also reviewed documentation confirming that the flow meter was inspected and cleaned on a monthly basis, thus meeting the quarterly requirement required by the CAR Protocol. The manufacturer recommends a factory calibration at an interval of every 18 months. During the current reporting period, the project flow meter was not factory calibrated at the interval recommended by the manufacturer. As a result of the missed factory calibration, Advanced Disposal requested a monitoring variance, which was approved on July 15, 2013 as further described in Section 6.5 below.

The Elkins Earthworks EDGE continuous gas analyzer was field checked for calibration accuracy once per quarter, including at least one occurrence no more than two months prior to the end of the reporting period. All field checks performed during the current reporting period indicated the instrument was within the five percent accuracy range required by the CAR Protocol. The analyzer is also cleaned and inspected quarterly. The manufacturer does not recommend a specific interval to perform factory calibrations on an ongoing basis, so the instrument is calibrated at a minimum every five years.

The landfill used five Envision portable gas analyzers to take manual methane readings prior to purchasing and installing the continuous analyzer and for use at any time, the continuous analyzer is not operating (if needed). The manufacturer of the Envision portable analyzers recommends a field calibration check prior to each use and annual factory calibration. First Environment reviewed evidence of field calibration checks prior to each use, demonstrating that the portable analyzers used were within the required five percent accuracy threshold. First Environment also confirmed, through review of calibration records, that each portable analyzer was calibrated in accordance with manufacturer's recommendations; and these factory calibration records further demonstrated that the portable analyzers used were within the required five percent accuracy threshold.

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

Table 3: Instrument QA/QC

Monitoring Equipment	Calibration	Field Checked	Inspected/Cleaned
FCI ST98 flow meter (s/n 322620)	11/29/2011	4/11/2012; 5/10/2012; 6/11/2012; 7/12/2012; 8/8/2012	4/11/2012; 5/10/2012; 6/11/2012; 7/12/2012; 8/8/2012;

Monitoring Equipment	Calibration	Field Checked	Inspected/Cleaned
FCI ST98 flow meter (s/n 258405)	2/21/2011	10/22/2012; 11/20/2012; 12/14/2012; 1/11/2013; 2/25/2013; 3/18/2013	10/22/2012; 11/20/2012; 12/14/2012; 1/11/2013; 2/25/2013; 3/18/2013
Elkins Earthworks EDGE continuous gas analyzer (Installed September 14, 2012)	4/21/2011	9/14/2012; 12/3/2012; 1/9/2013	12/3/2012; 1/9/2013
Elkins Envision portable gas analyzer (Serial No: 903006)	8/24/2011	Prior to each use	Prior to each use
Elkins Envision portable gas analyzer (Serial No: 1003018)	6/9/2011; 8/31/2011;	Prior to each use	Prior to each use
Elkins Envision portable gas analyzer (Serial No: 1003019)	12/8/2011; 12/27/2012	Prior to each use	Prior to each use
Elkins Envision portable gas analyzer (Serial No: 1101004)	8/6/2012; 1/26/2013	Prior to each use	Prior to each use
Elkins Envision portable gas analyzer (Serial No: 1101009)	6/21/2012	Prior to each use	Prior to each use

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
Purchased Electricity	Monthly utility invoices
Propane consumption	Invoices

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 basis. Metered gas flow volumes are recorded at standard conditions of one atmosphere of pressure and a temperature of 70°F by the flow meter, and are then adjusted in the emission reduction calculations to a standard condition 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 flare by the daily or weekly average of methane concentration measurements 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 monthly 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.

Emission reduction calculations contained three instances of data substitution for weekly measured methane concentration. First Environment reviewed the data substitution performed during the reporting period against the requirements identified in Appendix E of the CAR protocol and confirmed that Advanced Disposal applied the specified procedures correctly.

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 landfill gas fed to flare	Summed daily from metered data, internally corrected to 70°F and one atmosphere of pressure
PR _{CH₄,t}	Methane content	Averaged daily from continuously recorded data, or weekly from weekly readings
DE _i	Default destruction efficiency for open flare	96%
OX	Oxidation Factor	10%
DF	Discount Factor	0 % -or- 10% during periods when weekly methane readings were applied
Flare Temperature Cut-off	Metered data below corresponding temperature cut-off are excluded from calculations	500°F
EFFF	Propane emission factor	5.74 kg CO ₂ /gal
EFEL	Purchased electricity emission factor	1,357.71 lb CO ₂ /MWh

Copies of the raw data used in the calculations, including flow data, methane content data, and utility and other fossil fuel invoices, 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 all calculations over the entire 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*

Advanced Disposal requested a variance from the CAR Landfill Protocol for the current reporting period as noted in Section 6.3.2 above. The variance request was approved by CAR on July 15, 2013 (2013-VAR-DET-CAR592) for the period of April 1, 2012 through July 12, 2013. Table 6 summarizes the specific conditions of the variance approval and First Environment's verification conclusions.

Table 6: Assessment of Variance Requirements

Variance Requirement	Verification Conclusion
The verifier confirms that the flow meter (SN 258405) was removed on July 12, 2013.	First Environment reviewed correspondence from the third party field services vendor Monitoring Control and Compliance, Inc which stated that the meter (s/n 258405) was removed from service on July 12, 2013 and a spare meter was installed in its place.
The verifier confirms that each check for calibration accuracy performed on flow meter (SN 258405) prior to removal was within the +/-5% accuracy tolerances.	First Environment confirmed that all monthly calibration accuracy checks that occurred prior to removal indicated percent drifts of less than 1%, which is within the required 5% accuracy tolerance.

6.6 *Changes Due to Errata & Clarifications Issued by CAR*

The issuance of the Errata and Clarification, dated June 3, 2013, resulted in a change to the following aspects of verification:

- Attestation forms that the project developer submitted to CAR. Clarification No. 1 further clarifies that the Legal Requirement Test and the Regulatory Compliance require the execution of both attestations of Voluntary Implementation and Regulatory Compliance. First Environment reviewed these two attestation forms and confirmed that these forms were completed correctly and are on file with the CAR.

The Errata and Clarification did not result in any other changes to the verification process.

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, 2012 through March 9, 2013 can be considered with a reasonable level of assurance:

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

Verified results show:

Reporting Period: April 1 to December 31, 2012	Total
Baseline Emissions (tCO ₂ e)	29,044
Project Emissions (tCO ₂ e)	28
Emissions Reductions (tCO ₂ e)	29,016

Reporting Period: January 1 to March 9, 2013	Total
Baseline Emissions (tCO ₂ e)	8,648
Project Emissions (tCO ₂ e)	11
Emissions Reductions (tCO ₂ e)	8,637

8. Lead Verifier Signature



Jeff Daley
Environmental Specialist

9. Senior Internal Reviewer Signature



Michael Carim
Senior Associate