

Verification Report for the Morehead Landfill Morehead, Kentucky

Climate Action Reserve-CAR592

March 2019

**Prepared for: Advanced Disposal Services Morehead
Landfill, Inc.**

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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 March 1, 2017 through February 28, 2018.

During the verification process, Element Markets, LLC (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	March 1, 2017 through February 28, 2018
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 4.0, June 29, 2011 (CAR Protocol) • Climate Action Reserve Landfill Project Protocol Version 4.0 Errata & Clarification, June 18, 2015 (Errata and Clarification) • Climate Action Reserve Program Manual, September 1, 2015 • Applicable CAR Policy Memos
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Verification Process	• Section 8 of the CAR Protocol • 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 three 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 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 January 4, 2019.

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 January 7, 2019 with Element Markets. 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 January 18, 2019 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. Advanced Disposal 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 Advanced Disposal, a verification statement, and a list of findings all of which are 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 Phases I, 2A, 2B, 3A, 4, 5A, and 5B. The landfill gas collection system is currently in all Phases except Phase 5B.

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 during the initial verification for the Project.

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 Waste Holdings, Inc. (parent company of 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 is December 3, 2009, which was confirmed during the initial verification period through review of 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 Requirement 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 (A)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. The Project does not involve the generation of electricity and therefore the size threshold requirement of the Performance Standard Test does not apply. It was also confirmed at the site visit that the landfill is not a bioreactor.

6.2.3.2 Legal Requirement Test

The landfill has a permitted capacity above the 2.5 million cubic meter threshold that triggers New Source Performance Standard (NSPS) requirements. As such, the landfill is required to conduct Tier II testing to determine non-methane organic compound (NMOC) emissions. The most recent Tier II testing event occurred on August 31, 2016. The associated emissions rate report, dated September 30, 2016, identifies NMOC emission rates of 7.47 Mg/year for 2017 and 7.86 Mg/year for 2018. The landfill's permitted design capacity has not been modified since July 17, 2014; therefore, these NMOC results are below the 50 Mg/yr. threshold established by the NSPS regulation (40CFR60, Subpart WWW).

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 Requirement 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, interviewed Morehead Landfill personnel, and generated a compliance report on January 4, 2019 using the Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO).

The EPA ECHO database report indicated that the site had stormwater discharge exceedances during the current reporting period. The exceedances listed in the U.S. EPA ECHO report are related to iron level and total suspended solids limit exceedances as a result of the naturally occurring iron levels in the soil. First Environment reviewed the Discharge Monitoring Reports that were submitted to the state to confirm that the stormwater discharge exceedances were not related to the Project activity or any of the Project equipment and therefore, it was determined that this issue does not impact the Project's eligibility under the CAR Landfill Protocol. The facility had several routine site inspections conducted by KDEP throughout the course of the reporting period, all of which indicated the facility was in compliance with required regulations.

Additionally, the 2017 and 2018 Title V compliance certification reports were reviewed, which indicated the landfill was in compliance with the requirements of the Title V permit.

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 CAR 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

Two identical Fluid Components International (FCI) Model ST98 thermal mass flow meters (FCI ST98) were used during the reporting period to continuously measure landfill gas flow. Both meters standardize flow readings to a pressure of one atmosphere and a temperature of 70°F. The data are transmitted to a Yokogawa data logger that electronically archives all flow data.

An Elkins Earthworks EDGE analyzer continuously measures gas composition for methane. The data are transmitted to a Yokogawa data logger that electronically archives all methane concentration data.

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

The flare incorporates a thermocouple to monitor flare temperature. The data logger records flare temperature data measured by the thermocouple.

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	FCI ST98 flow meter	Continuous	At least every 15 minutes	Yokogawa digital chart recorder
Methane Concentration	Elkins Earthworks EDGE Continuous Gas Analyzer	Continuous	At least every 15 minutes	Yokogawa digital chart recorder
Hourly Operation of Destruction Device	Thermocouple	Continuous	At least every 15 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, except where noted below.

The flow meter is cleaned and inspected with activities and results documented on a regular basis as specified in the Project's Monitoring Plan. The flow meter is field checked for calibration accuracy by a third party (Monitoring Control and Compliance, Inc.) within two months of the end of the reporting period. The field checks of both the primary and rental flow meter identified that both meters were operating within the five percent accuracy threshold specified by the Protocol. The manufacturer recommends a factory calibration at an interval of every 18 months. The meters were calibrated every 18 months in accordance with the manufacturer's recommendations with the exception of meter serial number 322620, which was in service past the manufacturer's recommended calibration interval. As a result, the Project Developer requested a variance as discussed in Section 6.5 below.

The Elkins Earthworks EDGE continuous gas analyzer is cleaned and inspected with activities and results documented on a regular basis as specified in the Project's Monitoring Plan. The analyzer is also field checked for calibration accuracy and calibrated in-situ by a third party (Tetra Tech, and Monitoring Control and Compliance, Inc.) on a routine basis including at least once within two months of the end of the reporting period. The May 17, 2017 accuracy check identified the analyzer was under reporting methane concentration outside of the five percent accuracy threshold. As a result, all data is left as is with no drift correction. The analyzer was subsequently field checked and calibrated on March 21, 2018 which identified that the meter

was operating within the required five percent accuracy threshold specified by the Protocol. The manufacturer does not recommend a specific interval to perform calibrations on an ongoing basis, however, the instrument is field calibrated by a third party at least once per year.

Additionally, First Environment confirmed that the Elkins Earthworks Envision portable gas analyzers used to perform the third-party field calibration accuracy check were maintained per the manufacturer's requirements, and that the calibration gas used to check the gas analyzer was still within its useful life span.

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

TABLE 2: Instrument QA/QC

Monitoring Equipment	Dates of service	Calibration	Field Checked	Inspected/Cleaned
FCI ST98 flow meter (s/n 322620). Primary meter.	3/1/2017 – 1/16/2018	2/12/2015; 2/27/2018	1/16/2018	1/16/2018; 2/27/2018
FCI ST98 flow meter (s/n 619445). Rental meter.	1/16/2018 – 2/28/2018	1/9/2018	2/6/2018	2/6/2018
Elkins Earthworks EDGE continuous gas analyzer	Entire reporting period	9/20/2016; 5/17/2017; 3/21/2018	5/17/2017; 3/21/2018	5/17/2017; 3/21/2018

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
Purchased Electricity	Monthly utility invoices
Propane consumption	Monthly blower flare station reports

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 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.

There were four instances of methane concentration data substitution applied during the reporting period, all for outages lasting greater than one day. First Environment reviewed and confirmed that all data substitution calculations were performed in accordance with the requirements of Appendix E of the Protocol.

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 fed to flare	Summed daily from metered data, internally corrected to 70°F and one atmosphere of pressure
$PR_{CH_4,t}$	Methane content	Averaged daily from continuously recorded data
DE_i	Default destruction efficiency for open flare	96%
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
EFFF	Propane emission factor	5.74 kg CO ₂ /gal
EFEL	Purchased electricity emission factor	1,185.43 lb CO ₂ /MWh (SRTV subregion)
GWP_{CH_4}	Global Warming Potential of Methane	25 (IPCC 4 th Assessment Report)

Copies of the raw data used in the calculations, including flow data, methane content data, and utility 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 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

As noted above, Advanced Disposal requested a variance from the CAR Protocol for the current reporting period. The variance request was approved by CAR on March 1, 2019 (2017-3-2018-2-VAR-DET-CAR592) for the period of March 1, 2017 through February 28, 2018. Table 5 summarizes the specific conditions of the variance approval and First Environment's verification conclusion.

TABLE 5: Assessment of Variance Requirements

Variance Requirement	Verification Conclusion
The verification body confirms that all data was properly adjusted, if necessary, according to factory calibration results.	The Project flow meter was calibrated by the manufacturer on February 27, 2018. The as found meter conditions were documented by the manufacturer and identified that the greatest drift was 3.9%, which is within the Protocol's five percent accuracy threshold. Therefore, no drift adjustments to the Project flow data were necessary.
The verification body confirms that regular cleanings, inspections, and field checks for calibration accuracy for the flow meter(s) and methane analyzer are appropriately outlined in the project's monitoring plan.	Section 4 of the Monitoring Plan has been revised to appropriately outline all required QA/QC requirements as specified by the Protocol. The Monitoring Plan identifies that flow meter and methane analyzer will be field checked for calibration accuracy within two months prior to the end of the reporting period. Additionally, the Monitoring Plan identifies that the flow meter and methane analyzer will be cleaned and inspected when the instruments are calibrated and/or field checked for calibration accuracy.
The verification body confirms that any other QA/QC requirements are accurately stated in the monitoring plan and have been met by the project.	Section 4 of the Monitoring Plan identifies QA/QC meeting the minimum requirements consistent with the Protocol, all of which have been met by the Project during the current reporting 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 March 1, 2017 through February 28, 2018 can be considered with a reasonable level of assurance:

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

Verified results show:

March 1 to December 31, 2017	Total
Baseline Emissions (tCO ₂ e)	42,910
Project Emissions (tCO ₂ e)	23

Emissions Reductions (tCO ₂ e)	42,887
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January 1 to February 28, 2018	Total
Baseline Emissions (tCO ₂ e)	6,759
Project Emissions (tCO ₂ e)	6
Emissions Reductions (tCO ₂ e)	6,753

8. Lead Verifier Signature



Jeff Daley
Environmental Specialist

9. Senior Internal Reviewer Signature



Jay Wintergreen
Senior Associate