BLUE SOURCE HENRICO COUNTY LANDFILL GAS COMBUSTION PROJECT

Document Prepared By: Blue Source LLC.

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1 PROJECT DETAILS

1.1 Summary Description of Project

A pre-project landfill gas collection and destruction system was voluntarily installed in the East Fill area of the Landfill in 2001 with the installation of 14 wells. Based on annecdotal evidence, gas was first flared in March 2002. However, sufficient evidence of the start date could not be provided and the project start date was selected as the expansion of the collection system in 2005. This results in a conservative estimate of the emission reductions from the project activity, because the original amount of gas combusted by the pre-project system is netted out of the total emission reductions claimed.

The Landfill consists of three smaller sanitary landfills; the East Fill, the West Fill and the Expansion. The Project consists of two stages, both implemented at the Springfield Road Landfill. Stage one (1) of the Project is owned and operated by Henrico County ("Henrico"). Stage two (2) of the Project is owned and operated by Ingenco Distributed Energy ("Ingenco").

The Project consists of two stages. Stage one (1) of the Project is the expansion of the pre-existing wellfield and installation of a larger capacity flare. During this stage, the captured landfill gas is flared, thereby converting methane to biogenic CO_2. As part of this project phase, in December 2004, Henrico decommissioned the pre-existing flare and in June 2005 a larger flare station was installed. The flare was installed on June 3rd, 2005. An additional 87 wells were also installed in all three of the landfills at this time. The wellfield was further expanded in 2006 with the addition of five new wells in the Expansion (Phases 2 and 3). In the fall of 2010 the collection system was expanded again where 18 wells were installed and connected by November 2010.

Stage two (2) of the Project involves the implementation of a beneficial use project. The captured biogas will be transported to a power generating facility located on-site, and used for electricity generation. As part of this phase, a 4 MW power generating facility was constructed by Ingenco. This stage of the project was operational in September 2010 and gas collected from the Landfill is destructed by Ingenco for electricity generation

Additional permits were not required by the VADEQ to construct or operate the Project in 2005. Rather, the Project was exempt from permitting requirements in Section 9 VAC 5-80-1100 through 1320 of Virginia's Regulations for the Control and Abatement of Air pollution, given the level of uncontrolled emissions from the installation of the new flare and the size of the flare. The following permits relate to the construction and operation of the Landfill[1]:

- Virginia Stationary Source Operating Permit: PRO-51286
- VADEQ Solid Waste Permit No. 545 – *This permit was amended in July 2006 for a number of activities including the expansion of the gas collection system at this time.*

The installation of the original landfill gas system by Henrico was completely voluntary. The expansion of the landfill gas collection and destruction system in 2005 and 2010 was also voluntary. The objective of this expansion was to be proactive and ensure that the Landfill was not off-gassing and causing odor complaints. The system was not installed in response to odor complaints or gas migration issues and no formal complaints were received. Rather, this was a proactive step taken by Henrico to be a good neighbor.

Henrico is required to submit NMOC emission calculations every five years to ensure the landfill is not required to install a landfill gas capture system. Based on the most recent calculations, the Landfill is not expected to exceed the 50 Mg per year NMOC threshold over the duration of the crediting period. The Landfill's NMOC emissions will be reassessed annually to ensure that the Landfill is not required to install a collection system and emission reductions remain surplus to regulatory requirements.

The Project was validated in accordance with the requirements of the Voluntary Carbon Standard 2007.1 in November 2009.

The table below provides a summary of the quantification of emission reductions generated by the project activity from October 1- December 31, 2013.

Summary of Emission Reductions (tonnes CO_2e)

	Current Verification Oct-Dec 2013
Baseline Emissions	15,487
Project Emissions	36
Total Emission Reductions	**15,451 (tCO2E)**

1.2 Sectoral Scope and Project Type

- Waste Handling and Disposal, Sectoral Scope 13
- Individual Project

1.3 Project Proponent

The gas collection system and flare are owned and operated by the County of Henrico. The Ingenco electricity generation facility is owned and will be operated by Ingenco Distributed Energy.
Operating Contact:

Organization name	County of Henrico- Department of Public Utilities
Contact person	Jon Clary, P.E
Title	Division Director – Solid Waste and Recycling
Address	P.O. Box 27032 Richmond, VA 23273
Telephone	(804)727-8217
Email	cla06@co.henrico.va.us

1.4 Other Entities Involved in the Project

Blue Source LLC ("Blue Source") has been contracted by Ingenco Distributed Energy to monetize the greenhouse gas (GHG) emission reduction credits generated by the Project.

Organization name	Blue Source
Role in the project	Project Developer
Contact person	Kevin Townsend
Title	Chief Commercial Officer
Address	1935 East Vine St, Suite 300; Murray UT 84121

Telephone	801-438-1540
Email	ktownsend@bluesource.com

1.5 Project Start Date

The project start date is 06/03/2005 when the County began collecting and destructing LFG from the project collection system.

1.6 Project Crediting Period

In June 2005, Henrico decided to invest significant capital to expand the landfill gas collection system. At this time the landfill gas capture system in the East Fill area was expanded and a collection system was installed in the remainder of the Landfill. The existing flare was decommissioned and two-3,014 scfm blowers and a new candlestick flare were also installed at this time. The landfill gas capture system was further expanded in the fall of 2010. This gas has been used in the Ingenco plant as well to generate electricity since September 2010.

The crediting period will depend on whether the landfill is subject to NSPS requirements. If the project is not required to install a landfill gas capture system the anticipated crediting period will be from January 1, 2009 to December 31, 2018.

The crediting period will be reassessed on an annual basis to ensure the Project does not exceed the NSPS threshold for NMOC emissions and is not required to collect and destruct landfill gas.

1.7 Project Location

The Landfill is a municipal solid waste landfill located on a 192 acres site in Henrico County,Virginia. It is located immediately northeast of Nuckols Road and north of Interstate 295.

The address of the facility is:

10600 Fords Country Lane
Glen Allen, Henrico County, VA

The latitude and longitude of the Landfill are as follows:

- Latitude: 37°40’45”
- Longitude: 77°33’58”

The Landfill opened in 1966 and based on the latest survey performed October 2011 the Landfill will receive waste until January 2015. The Landfill has a design capacity of 3.488 million megagrams.

The Landfill covers an area of 103 acres and is subdivided into six cells (three areas). These include the East Fill, the West Fill and the Expansion, consisting of Phases 1 through 4. The East Fill area was closed in 1994 and covers approximately 36 acres. The West Fill area was closed prior to 1983 and covers approximately 23 acres. Phase 1 of the Expansion Area covers 12 acres and was closed in 1994. Phase 2 is 14 acres and was constructed in 1994, Phase 3 covers 10 acres and was constructed in 1998, and Phase 4 is 8 acres and was constructed in 2007. Phases 2, 3 and 4 are still active.

1.8 Title and Reference of Methodology

Approved consolidated baseline methodology ACM0001: “Consolidated baseline and monitoring methodology for landfill gas project activities”: Version 10.0

1.9 Other Programs

This project is not registered under any other emission trading/ GHG programs for the destruction of methane gas from the landfill as well as the offsetting of fossil fuel based energy with renewable landfill gas.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The Project was fully operational throughout the monitoring period. However, during this reporting period the Ingenco plant caught on fire on October 30th, 2013. This fire resulted in the plant being out of commission the rest of the reporting period Oct 31- Dec 31st 2013. The landfill gas was directed and destroyed in the flare during this two month period. The Ingenco plant fire has reduced the project's fossil fuel emissions because lower amounts of diesel fuel has been consumed than normal.

2.2 Deviations

2.2.1- Methodology Deviations

Previous deviations from PDD and prior Monitoring Reports

Parameter	ACM0001 Requirement	Deviation from Requirement	Validation Conclusion
MDproject, y - Ex ante of the amount of methane that would have been destroyed or combusted during the year.	Use a first order decay model per the CDM Annex 10 "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site."	Emission reductions for 2010 through 2020 are estimated using the quantity of waste disposed at the Landfill and the US EPA's LandGEM model.	Deviation acceptable. The gas volumes generated by the LandGEM model are for illustrative purposes only, as emission reductions will be based on *ex-post* monitoring data of the Project performance.
EFEL,j,y – Emission factor for electricity generation for source *j* in year *y*.	Following option A2 of the "Tool to calculation baseline, project, and/or leakage emissions from electricity consumption," a conservative default value of 1.3 tCO2/MWh may be used.	An emission factor for electricity generation(EFEL,j,y) is assigned a value of 0.515 tonnes CO2 per MWh based on US EPA's eGrid 2007 for SRVC subregion. This value will be reviewed annually upon the release of updated eGrid data.	The 1.3 tCO2/MWh default value provided by the tool is not representative of the emission intensity of grid-connected electricity generation in the US.Further, the Project does not consume a significant quantity of electricity and electricity consumption does not represent a large emission source for the project. As such, this approach is reasonable.
ηflare,h – Flare efficiency	A default flare efficiency of 50% for open flares and 90% for enclosed flares must be applied in cases where methane	The flare efficiency has been fixed ex-ante as 98%.	For projects where gas composition is measured continuously, no such default values are specified. 40 CFR §60.18 specifies requirementsfor flare operating variables(i.e., Btu content,

	composition is measured quarterly.		exit velocity) that must be met in order to achieve a 98% or higher flare destruction efficiency. As long as the installed flare is designed and operated in accordance with 40 CFR §60.18, a 98% destruction efficiency is acceptable.

2.2.2 Project Description Deviations

There are a couple minor deviations to the monitoring plan that do not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology. These minor deviations are:

PDD States on page 37 Annual Verification under the 'Schedule" in section 7	Alternative verification periods	Verification for this last verification period was for 16 months instead of the annual verification	Deviation acceptable. Does not impact eligibility, conformance, or performance of Project against ACM001.
PDD states on page 2 that "The Landfill's NMOC emissions will be assessed annually to ensure that the landfill is not required to install a collection system	Alternative monitoring method	A five year assessment is done. Also monitoring is performed by the County and Engineering firm constantly reviewing any new local, state, regional or federal updates to the regulations as well performing the appropriate documentation for the Title V and GHG reporting.	Deviation acceptable. Does not impact eligibility, conformance, or performance of Project against ACM001.
PDD states on page 31- "Section 4.4 "Emission reductions are calculated as the difference between the baseline methane emission rate and project emissions from electricity and fuel consumption at the site." but no equation was given therefore Equation 17 was included.	None – for clarification purposes only	Added equation 17 in the Monitoring Report : ERy = BEy - PEy Where: ERy = Emission reductions in year y (tCO2e) PEy = Project emissions in year y (tCO2e) BEy = Baseline emissions in year y (tCO2e)	Deviation acceptable. Does not impact eligibility, conformance, or performance of Project against ACM0001.
PDD states on page 25- Methane Density at 70 F & 1 atm is 0.000669 to be used in the calculations	Alternative factor	The correct value is 00664321412 for 7 0 degrees & 1 atm, because 70 degrees is what all flows are adjusted to.	Deviation acceptable. Does not impact eligibility, conformance, or performance of Project against ACM0001.

2.3 Grouped Project

This section is not applicable as the project is an individual project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

A listing of the variables that are estimated or quantified using emission factors or default values is provided below

Data / Parameter:	$MD_{BL,y}$
Data unit:	tonnes CH_4
Description:	Amount of methane destroyed historically for the previous year before the start of the project activity.
Source of data:	Henrico historical data. Flow was metered continuously using a Fluid Components International ST98 Thermal Gas Flow Meter and corrected to standard temperature and pressure conditions of 70 degrees F and 1 atm. Composition was measured using a Landtec Gem 500 gas analyzer.
Value applied:	376.2 t CH4
Justification of choice of data or description of measurement methods and procedures applied	Calculated from flow and methane composition data obtained from "Flare Operating Report" spreadsheets
Purpose of the data:	This is used for baseline emissions
Any comment:	Prior to project implementation, landfill gas captured by the pre-existing system was flared. Since emission reductions are claimed for flaring landfill gas, the incremental quantity of landfill gas that would have gone to the flare in the baseline must be accounted for. This gas would not have been vented in the baseline condition and a baseline deduction is required. Henrico metered the flow and composition of gas flared from 2002 through 2004, prior to the project activity and the baseline quantity of landfill gas flared is presented below.

Year	Flow (scfm)	Flow (scf/yr)	%CH4	tCH4
2002	66.7	15,066,885	42.97	283.7
2003	103.7	27,149,032	49.83	511.2
2004	79.1	17,718,296	42.63	333.6
Mean	**83.2**	**19,978,071**	**45.14**	**376.2**

Data / Parameter:	$\eta_{flare,h}$
Data unit:	%

Description:	Default Flare Efficiency
Source of data:	CDM Methodological "Tool to determine project emissions from flaring gases containing methane)
Value of data applied:	50 (if composition is metered periodically) 98 (if composition is metered continuously)
Justification of choice of data or description of measurement methods and procedures applied	According to ACM0001, in cases where less than continuous composition measurements are used, the default flare efficiency from the CDM flaring tool must be applied. In the future, methane composition may be metered continuously. In this case, a more accurate flare efficiency for the open flare will be used based on guidance from the US EPA and the Climate Action Reserve (CAR). This approach is justified on the basis that it is more accurate for equipment and conditions in the United States (versus ACM0001). Further, the flare is designed and operated in accordance with 40 CFR 60.18. This standard specifies requirements for flare operating variables (i.e. Btu content, exit velocity) that must be met in order to achieve a 98% or higher flare destruction efficiency.
Purpose of the data:	Project Emissions
Any comment:	

Data / Parameter:	GWP_{CH4}
Data unit:	$tCO_2e/tCH4$
Description:	Global warming potential of CH_4
Source of data:	IPCC
Value of data applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Justification of choice of data or description of measurement methods and procedures applied	IPCC
Purpose of data:	Baseline and Project Emissions
Any comment:	

Data / Parameter:	D_{CH4}
Data unit:	tCH_4/m^3CH_4
Description:	Density of Methane is recorded at 68 F & 1 atm but adjusted to 70 F & 1 atm
Source of data:	http://cdm.unfccc.int/methodologies/inputsconsmeth/MGM_methane.pdf for 70 degrees F (see comments)
Value of data applied:	70 degrees F and 1 atm: 0.664321
Justification of choice of data or description of measurement methods and procedures applied	http://cdm.unfccc.int/methodologies/inputsconsmeth/MGM_methane.pdf for 70 degrees F, (see comments)
Purpose of data:	Project and Pre-Project Emissions
Any comment:	Density at 70 degrees F and 1 atm is calculated using the ideal gas law, P*V = n*R*T = (m/M)*R*T, where: M = Molar mass of methane (16.04 g/mol) M = Mass of methane (g) P = Pressure, 1 atm = 101.325 kPa = 14.7 psia

	T = Temperature, 75 F = 21.111 C = 294.261 K R = Ideal Gas Constant = 8.314 J/(mol K)

Data / Parameter:	F
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	Site Specific Data
Value of data applied:	0.45
Justification of choice of data or description of measurement methods and procedures applied	Site Specific information
Purpose of data:	This is used for baseline and project emissions
Any comment:	This factor is a more accurate representation of the composition of gas historically collected from the Landfill and is based on facility records.

Data / Parameter:	Lo
Data unit:	m^3/Mg
Description:	Potential methane generation capacity
Source of data:	US EPA LandGEM Model
Value of data applied:	100
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of this data	This is used for baseline and project emissions
Any comment:	The LandGEM model has default values for Inventory Conventional and CAA Conventional values. To be conservative the Inventory Conventional value is applied.

Data / Parameter:	k
Data unit:	-
Description:	Decay rate
Source of data:	US EPA LandGEM model default parameter
Value of data applied:	0.04
Justification of choice of data or description of measurement methods and procedures applied	EPA default parameter
Purpose of this data	Baseline and Project emissions
Any comment:	The LandGEM model has a decay rate for Inventory Conventional and CAA Conventional values. To be conservative the Inventory Conventional value is applied.

Data / Parameter:	$NCV_{methane}$
Data unit:	GJ / scf
Description:	Energy content of methane
Source of data:	U.S. EPA Landfill Methane Outreach Program Interactive Conversion Tool (http://www.epa.gov/lmop/projects-candidates/interactive.html)

	The value of 1,012 Btu per scf was obtained from US EPA and was converted to units of GJ per scf by dividing the factor by a conversion factor of 947,817 Btu per GJ.
Value applied:	0.0010677
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data:	This is used for baseline and project emissions
Any comment:	Values will be reviewed annually to ensure they are appropriate or following any future revision of US EPA guidelines, as applicable.

Data / Parameter:	$NCV_{propane}$
Data unit:	MMBtu / gallon
Description:	Energy content of propane
Source of data:	U.S. EPA Guidelines, Inventory of US Greenhouse Gas Emissions and Sinks, April 2011, Annex 2, Table A-46 The value of 3.836 MMBtu per barrel was obtained from US EPA and was converted to units of MMBtu per gallon by dividing the factor by a conversion factor of 42 gallons per barrel.
Value applied:	0.09133
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data:	This is used for baseline emissions
Any comment:	Values will be reviewed annually to ensure they are appropriate or following any future revision of US EPA guidelines, as applicable. Note that IPCC values are not available for propane.

Data / Parameter:	$EF_{CO2,Propane,y}$
Data unit:	t CO_2 / MMBtu
Description:	CO_2 emission factor for propane
Source of data:	U.S. EPA Guidelines, Inventory of US Greenhouse Gas Emissions and Sinks, April 2011, Annex 2, Table A-46 The value of 16.76 kg C per MMBtu was obtained from the US EPA, and was multiplied by a factor of 44/12 to convert carbon to carbon dioxide and divided by 1000 to convert from kilograms to tonnes.
Value applied:	0.061453 tonnes CO_2 / MMBtu
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data	This is used for baseline emissions
Any comment:	Value will be reviewed annually to ensure it is appropriate or following any future revision of the US EPA emission factors, as applicable. Note that IPCC values are not available for propane.

Data / Parameter:	NCV_{Diesel}
Data unit:	MMBtu / gallon
Description:	Energy content of diesel
Source of data:	U.S. EPA Guidelines

	The value of 5.825 MMBtu per barrel was obtained from US EPA and was converted to units of MMBtu per gallon by dividing the factor by the a conversion factor of 42 gallons per barrel.
Value applied:	0.1387
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data	This is used for project emissions
Any comment:	Values will be reviewed annually to ensure they are appropriate or following any future revision of US EPA guidelines, as applicable.

Data / Parameter:	$EF_{CO2,Diesel,y}$
Data unit:	t CO_2 / MMBtu
Description:	CO_2 emission factor for diesel
Source of data:	U.S. EPA Guidelines The value of 19.95 kg C per MMBtu was obtained from the US EPA, and was multiplied by a factor of 44/12 to convert carbon to carbon dioxide and divided by a factor of 1,102 to convert from kilograms to tonnes.
Value applied:	0.07315 tonnes CO_2 / MMBtu
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data	This is used for project emissions
Any comment:	Value will be reviewed annually to ensure it is appropriate or following any future revision of the US EPA emission factors, as applicable.

Data / Parameter:	$FE_{EL,Grid,y}$
Data unit:	lbs CO_2/MWh
Description:	Emission factor for electricity generation in year y
Source of data:	Following the CDM Annex 7 “Tool to calculate baseline, project and / or leakage emissions from electricity consumption” Option A2, regional values are used as the default value provided by the tool was not representative of the emission intensity of grid-connected electricity generation in the United States. Emission factor sourced from the US EPA’s Emissions & Generation Resource Integrated Database (eGrid) 2012, Version 1.0: Year 2009 Summary Tables. Emission factor for SRVC.
Value applied:	1,035.87
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data:	This is used for baseline and project emissions
Any comment:	This value should be updated annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.

Data / Parameter:	$TDL_{Grid,y}$
Data unit:	%
Description:	Average technical transmission and distribution losses for grid in year y
Source of data:	Recent, accurate and reliable data from the United States is used to quantify the average line losses. This value is obtained from the US EPA eGRID2012 Year 2009 Grid Gross Loss- Eastern Region[2]
Value applied:	5.82%
Justification of choice of data or description of measurement methods and procedures applied	US EPA number
Purpose of the Data:	This is used for baseline and project emissions
Any comment:	This value should be updated annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.

3.2 Data and Parameters Monitored

Data / Parameter:	Regulatory requirements relating to LFG
Data unit:	-
Description:	Regulatory requirements relating to LFG
Source of data:	Publicly available information of the host country's regulatory requirements relating to LFG.
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Annual
Value Monitored	N/A
Monitoring equipment	N/A
QA/QC procedures:	N/A
Purpose of the data	N/A
Calculation Method:	N/A
Any comment:	Annual review of the Landfill's NSPS status and any other applicable regulations, followed by a review of the Project's crediting period, to ensure the Project is still surplus to regulatory requirements. The information though recorded annually, will be used for changes to $MD_{BL,y}$ at the renewal of the credit period. Changes to regulation will be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$).

Data / Parameter:	$LFG_{total,y}$
Data unit:	m^3
Description:	Total amount of landfill gas flared and used to generate

[2] U.S EPA eGRID2012 http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html page 9

	electricity at standard temperature and pressure conditions. Data is recorded at 68 F & 1 atm but is manually corrected to 70 degrees F and 1 atm.
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of Monitoring/Recording	
Value Monitored	
Monitoring Equipment	
QA/QC procedures:	
Purpose of the data	Calculation of baseline emissions
Calculation Method:	N/A
Any comment:	This parameter represents the total amount of landfill gas flared and used to generate electricity and is calculated as the sum of $LFG_{flare,y}$ and $LFG_{electricity,y}$.

Data / Parameter:	$LFG_{flare,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured / total amount of landfill gas flared at standard temperature and pressure conditions. Data is recorded at 68 F & 1 atm but is manually corrected to 70 degrees F and 1 atm.
Source of data:	Measured
Description of measurement methods and procedures to be applied:	Rosemount Orifice Plate Model 1495C flowmeter with a Rosemount 3095 Multi-Variable Pressure Transmitter
Frequency of Monitoring/Recording	Continuous: Readings from the open flare are taken and totalized two times per second.
Value Monitored	N/A
Monitoring Equipment	Rosemount Orifice Plate Model 1495C flowmeter with a Rosemount 3095 Multi-Variable Pressure Transmitter
QA/QC procedures:	The flowmeter was calibrated by a certified third party on December 18, 2013 during the monitoring period. The previous calibration was on January 8, 2013, putting this calibration within the annual basis frequency Rosemount does not have a recommended time interval. However, going forward this flow meter will be calibrated on an annual basis.
Purpose of the data	Calculation of baseline emissions
Calculation Method	N/A
Any comment:	Flow is measured on a wet basis and the flow meter is located at the blower / flare station. In particular, it is located after the condensate knockout pot and after the blowers.

Data / Parameter:	$LFG_{electricity,y}$
Data unit:	m^3
Description:	Total amount of landfill gas combusted by Ingenco electricity generation at standard temperature and pressure conditions. Data is

	recorded at 68 F & 1 atm but is manually corrected to 70 degrees F and 1 atm.
Source of data:	Measured and/or based on supplier invoices
Description of measurement methods and procedures to be applied:	Gas flow and composition to the Ingenco facility is metered for invoicing purposes. Rosemount orifice plate flowmeter Model 1595 C with Rosemount 3095 Multi-Variable Pressure Transmitter
Frequency of Monitoring/Recording	Continuous Monitoring;
Value Monitored	N/A
Monitoring Equipment	Rosemount Orifice Plate, Model 1595C with Rosemount 3095 Mult-Variable Pressure Transmitter, Serial Number- Transmitter: 306661 O-Plate SN- 2551704
QA/QC procedures:	The official Emerson manufacturer recommended maintenance practices are that Rosemount orifice plate technologies should be inspected once every 3 years. Emerson also recommends that calibration occur once every 3 years. The sensors do not have separate model numbers from the 3051. Since it is an orifice-based flow meter, calibration is addressed by checking the pressure sensor. The pressure sensor is currently calibrated on an approximately annual basis, but this may be extended to the 3 year interval in accordance with the manufacturer's recommendations. The flow meter was configured by a Rosemount technician. A calibration was performed on 8/12/2013. If an alternate flowmeter is purchased it will be calibrated following manufacturer recommendations.
Purpose of the data	Calculation of baseline emissions
Calculation Method:	N/A
Any comment:	

Data / Parameter:	$w_{CH4\ flare,y}$ / $w_{CH4\ electricity,y}$
Data unit:	ft^3 CH4 / ft^3 LFG
Description:	Methane fraction in the LFG flared and Methane fraction in the LFG delivered to the Ingenco facility
Source of data:	FAU-TDL Continous Gas analyzer
Description of measurement methods and procedures to be applied:	Measured
Frequency of Monitoring/Recording	FAU-TDL Monitored Continuously;
Value Monitored	50% used in ex-ante projections
Monitoring Equipment	FAU-TDL Continuous Gas Analyzer: SN: 1006; 1007;1037
QA/QC procedures:	FAU-TDL Continuous Gas Analyzer's does not require factory calibration and service however it is recommended that the instrument be checked for proper operation at least annually." Therefore the FAU will be checked annually and sent off to be calibrated at a frequency of every 2 years. The following describes the equipment, Serial Number and

	calibration date. FAU-TDL CGA- SN- 1006: 08/30/2010; 3/14/2012; 11/02/2012; 8/26/2013 FAU-TDL CGA- SN- 1007: 05/17/2011 FAU-TDL CGA- SN- 1037: 09/19/2011; 4/23/2012; 12/07/2012; 12/12/2013
Purpose of the data	Calculation of baseline emissions
Calculation Method:	N/A
Any comment:	Composition is measured on a wet basis.

.	$PE_{flare,y}$
Data unit:	tonnes CO_{2E}
Description:	Project emissions from flaring of the residual gas stream in year y
Source of data:	Calculated as per the "Tool to determine project emissions from flaring gases containing Methane".
Description of measurement methods and procedures to be applied:	Calculated
Frequency of monitoring/recording	Annual
Value Monitored	242 tCO2e
Monitoring Equipment	N/A
QA/QC procedures:	N/A
Purpose of the data	Calculation of baseline emissions
Calculation Method	See Equation (15 flaring tool)
Any comment:	For this project flare efficiency is not monitored and a default value is used.

Data / Parameter:	W_x
Data unit:	tons
Description:	Total amount of waste disposed in year x
Source of data:	Measured
Description of measurement methods and procedures to be applied:	Measured by the Project Proponent
Frequency of monitoring/recording	Annual
Value Monitored	85,660.98 tons
Monitoring Equipment	Continuous with monthly and annual aggregation of data
QA/QC procedures:	N/A
Purpose of the data	N/A
Calculation method:	N/A
Any comment:	Quantity of waste disposed determined based on facility records.

Data / Parameter:	Other flare operation parameters
Data unit:	-
Description:	This should include data to monitor whether the flare operates within the range of operating conditions specified by the manufacturer.
Source of data:	Measured
Description of measurement methods and procedures to be applied:	For the open flare system, thernocouples located at the pilot and at the flare are used detect the presence of a flame. The flare also has provisions for auto-shutdown if the flare flame fails. If a flame out occurs, the UV sensor will immediately detect this and the pilot system will turn on to attempt to relight the flare. Further, if for any reason the UV sensor fails to function, it is backed up by the temperature controller and the flare will shut down when the temperature drops to 400°F. After a preset delay time of 10 minutes, the system will try to restart. If not successful after three tries, the system will stop trying to start automatically. If the flare system shuts down, the flare's control system will automatically shut down the blowers and flare. During a shutdown, the automatic shutoff valve closes and the blowers turnsoff. As a result, no gas is discharged and no flow is recorded. If a thermocouple burns out, it will read an improperly low temperature causing the automatic control system to shut the station down.
Frequency of Monitoring/recording:	Continuous monitoring;
Value monitored	N/A
Monitoring equipment:	Pyromation thermocouple and ultraviolet flame
QA/QC procedures:	Thermocouples are replaced as required and are not calibrated.
Purpose of the data	N/A
Calculation method:	N/A
Any comment:	The thermocouples are checked annually, concurrent with calibration of the flowmeter. (Jan 10, 2012; Jan 8 2013 & Dec 18, 2013)

Data / Parameter:	Operation of the Ingenco energy plant
Data unit:	Hours
Description:	Operation of the energy plant
Source of data:	Measured
Description of measurement methods and procedures to be applied:	Wattmeter or similar
Frequency of monitoring/recording	Continuous with readings with daily aggregation
Value monitored	696 hours
Monitoring	Wattmeter or similar

equipment	
QA/QC procedures:	Maintenance will be performed according to instrument manufacturer's recommendations, if any.
Purpose of the data	N/A
Calculation method:	N/A
Any comment:	Note that the quantity of electricity produced will also be metered and this information may be used to demonstrate operation of the generators at the Ingenco facility.

Data / Parameter:	$PE_{EC,y}$
Data unit:	tonnes CO_2
Description:	Project emissions from electricity consumption by the project activity during the year y
Source of data:	Calculated as per the "Tool to determine project, baseline, and / or leakage emissions from electricity consumption".
Description of measurement methods and procedures to be applied:	Calculated
Frequency of monitoring/recording	Annual
Value monitored	9.76 tonnes of CO2
Monitoring equipment	N/A
QA/QC procedures:	N/A
Purpose of the data	Calculation of project emissions
Calculation method:	See Equation (1 electricity tool)
Any comment:	For this project electricity is sourced from the regional grid, and Scenario A applies.

Data / Parameter:	$EC_{PJ, Grid,y}$
Data unit:	MWh
Description:	Quantity of electricity consumed by the project in year y
Source of data:	Calculated as per the "Tool to determine baseline, project and / or leakage emissions from electricity consumption".
Description of measurement methods and procedures to be applied:	Direct metering and/or calculation based on equipment load ratings.
Frequency of monitoring/recording	Annual
Value monitored	19.62 MWh
Monitoring Equipment	N/A
QA/QC procedures:	N/A
Purpose of the data	Calculation of project emissions
Calculation method:	N/A
Any comment:	This parameter is calculated as the sum of $EC_{flare\ and\ pipeline}$,

Data / Parameter:	$EC_{flare\ and\ pipeline,y}$
Data unit:	MWh
Description:	Sum of quantity of electricity consumed to transport gas to the flare

	and quantity of electricity consumed to treat and compress gas for transportation to Ingenco facility
Source of data:	Measured
Description of measurement methods and procedures to be applied:	Electricity supplier invoices will be the source of this data.
Frequency of monitoring/recording	Monthly
Value monitored	19.62 MWh
Monitoring equipment	Dedicated electricity meter
QA/QC procedures:	3rd party statements/invoices are used to ensure accuracy of data.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Any comment:	Note that compression/treatment skids will be installed to transport LFG to the beneficial use facility. This system will also be used to provide vacuum to the well-field and transport any excess LFG to the flare. Following the energy project coming online, the existing blower is only be operated when the compression/treatment skid is down.

Data / Parameter:	$FE_{EL,Grid,y}$
Data unit:	lbs CO_2/MWh
Description:	Emission factor for electricity generation in year y
Source of data:	Following the CDM Annex 7 "Tool to calculate baseline, project and / or leakage emissions from electricity consumption" Option A2, regional values are used as the default value provided by the tool was not representative of the emission intensity of grid-connected electricity generation in the United States. The emission factor is sourced from the US EPA's Emissions & Generation Resource Integrated Database (eGrid) 2012, Version 1.0: Year 2009 Summary Tables. Emission factor for SRVC.
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording	Annual check for most recent value
Value monitored	1035.87
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method:	N/A
Any comment:	Value will be reviewed annually upon release of the US EPA eGrid Summary Tables to ensure they are appropriate. The "Tool to calculate the emission factor for an electricity system" Version 01.1 was not used as calculation of an emission factor is

	fairly extensive given that the project does not consume or generate a significant quantity of electricity and electricity consumption does not represent a large emission source for the project.

Data / Parameter:	$PE_{Propane,,y}$
Data unit:	tonnes CO_{2E}
Description:	Annual project emissions from fossil fuel combustion
Source of data:	Calculated as per the "Tool to determine project or leakage CO_2 emissions from fossil fuel combustion".
Description of measurement methods and procedures to be applied:	Calculated
Frequency of monitoring/recording:	Annual
Value monitored:	0.22 tonnes of CO2
Monitoring equipment:	N/A
QA/QC procedures:	N/A
Purpose of the data	Calculation of project emissions
Calculation method:	(equation 1 fuel tool)
Any comment:	

Data / Parameter:	$FC_{flare,propane,y}$
Data unit:	gallons / year
Description:	Quantity of propane combusted as flare pilot fuel during the year y
Source of data:	Measured
Description of measurement methods and procedures to be applied:	Based on an supplier invoices
Frequency of monitoring/recording:	Annual
Value monitored:	40 gallons of propane
Monitoring equipment:	N/A
QA/QC procedures:	3rd party statements/invoices are used to ensure accuracy of data.
Purpose of the data	Calculation of project emissions
Calculation method:	N/A
Any comment:	

Data / Parameter:	$FC_{Diesel,y}$
Data unit:	gallons / year
Description:	Quantity of diesel combusted by Ingenco fuel during the year y
Source of data:	Calculated or Measured
Measurement procedures (if any):	The amount of diesel required for engine operations will be based on Diesel invoices.
Frequency of monitoring	Continuous
Value Monitored	2559.5 gallons of diesel

Monitoring Equipment	N/A
QA/QC procedures:	
Purpose of the data	Calculation of project emissions
Calculation method:	N/A
Any comment:	

3.3 Description of the Monitoring Plan

The purpose of monitoring is to measure the quantity of methane captured by the Project Activity that would have been released to the atmosphere in the baseline condition.

Baseline Emissions

Gas Flow

Baseline emissions are monitored using two Rosemount Orifice Plate Model 1495C continuous gas flow meters (both with Rosemount 3095 Multi-Variable Pressure Transmitter) that measures flow on a wet basis and normalizes flow to standard temperature and pressure conditions. Data is recorded at 68 F & 1 atm but is manually corrected to 70 degrees F and 1 atm. Landfill gas flow is metered continuously at the blower / flare station and at the Ingenco plant, with readings being taken two times per second. A Red Lion data logger is installed to record flow, methane concentration and flare temperature continuously.

The flow meter to the flare (SN 135079) was factory calibrated 1/19/2010, 1/14/2011, 1/10/2012, 01/08/2013, 12/18/2013 and was found to be operating per manufacturer specifications. On a go forward basis, the flowmeter will continue to be calibrated annually.

The flow meter to the Ingenco plant (SN 306661) was factory calibrated on 9/1/2010 before it was installed and came online 9/8/2010. The flow meter was also calibrated 8/24/2011, 8/24/2012 and 08/12/2013 found to be operating per manufacturer specifications.

Flare Operation

Two LFG Industries Type k thermocouples are used to ensure the flare and pilot flame are burning. The data logger records flare temperature to show whether or not the flare was burning. Henrico has verified that when the station is running (i.e. showing a landfill gas flow rate), the flare is also burning.

During every monthly site visit, the temperature readout from the main flame thermocouple's (upper) is recorded. During these visits, if the temperature reading were to be inconsistent with the flame condition (i.e., temp reading indicating that the flame was burning while it was not or vice versa) this would have been apparent. No inconsistent readings were observed during the Reporting Period and both thermocouples were successfully calibrated by the manufacturer January, 8 2013.

Gas Composition

Gas composition (CH_4, CO_2, O_2 and balance gases) is measured by a FAU-TDL continuous gas analyzer.

The Landtec FAU-TDL continuous gas analyzer (SN# 1037) was in place during the monitoring period from October 1st – November 26th 2013, then it was replaced with SN#1006 which was installed from November 26th-December 31st. SN#1037 was then re-installed on December 31st, 2013. When the manufacturer was asked about calibrate frequency a statement of "The FAU-TDL will not require factory calibration and service however it is recommended that the instrument be checked for proper operation at least annually."

Pre-project Gas Flow

The quantity of landfill gas collected from the pre-existing landfill gas to energy system is determined based on historical records of the flow and methane concentration of gas from 2002 through 2004. The flow of gas from the pre-existing system was measured continuously using a Fluid Components International ST98 thermal mass flowmeter and recorded on a strip chart located at the blower / flare station. This flowmeter was factory calibrated. Data was aggregated on a daily and monthly basis and entered into spreadsheets by the Landfill Operator. Flow readings were corrected to standard conditions of 70 degrees F and 1atm.

The quantity of methane generated in the baseline condition is determined based on the quantity of waste received at the Landfill. Methane emissions are modeled based on default values from the US EPA's LandGEM model.

Project Emissions

Project emissions associated with flaring landfill gas, electricity consumption and fuel usage are estimated using both measured and default values.

Flaring Emissions

Emissions associated with methane destruction by flaring are determined based on the flare's destruction efficiency and the mass flow rate of methane in the gas stream (determined from the volumetric flow rate of landfill gas and the volumetric fraction of methane in the landfill gas being flared). The composition and flow rate of landfill gas flared are determined as outlined above.

Following ACM0001 the flare's operating parameters are to be continuously monitored to ensure compliance with manufacturer specifications. Accordingly, the temperature of the flare is monitored using a thermocouple and temperatures are recorded on the Red Lion data loggerlocated at the blower / flare station. Henrico and Blue Source have reviewed the data to ensure that emission reductions are only claimed for periods when the flare and or Ingenco plant was operating (i.e. to show that when the station was running and recording flow the flare was also burning).

Electricity and Fossil Fuel Combustion Emissions

Project emissions related to electricity consumption are estimated based on the quantity of electricity consumed to operate the Project, according to supplier invoices. The fossil fuel usage related to the landfill gas collection system, flare and Ingenco electricity plant is propane used to light the flare pilot, electricity for the flare skid and Ingenco plant and diesel used in the Ingenco plant. During this reporting period the Ingenco plant caught on fire on October 30th, 2013. This fire resulted in the plant being out of commission the rest of the reporting period Oct 31- Dec 31st 2013. The landfill gas was directed and destroyed in the flare during this two month period. The Ingenco plant fire has reduced the projects fossil fuel emissions because lower amounts of diesel fuel has been consumed than normal.

Roles and Responsibilities

The County's Public Works Department has partnered with engineering consultant Draper Aden Associates to oversee monitoring activities. In particular, DAA handles all the operations and management of gas collection system; has field technicians that balance the well field and downloads the data from the Red Lion data logger for off-site storage.DAA staff downloads the data from the data logger and submits data to Blue Source for integration into emission reductions calculations. Blue Source saves the raw data files and then after applying the appropriate emission reduction parameters creates the emission reduction calculations that undergoes an internal QA/QC checklist. The raw data used in the emission reduction calculations is also used for the County's Title V and GHG reporting. DAA also assists the County in areas of permitting

Note that all relevant documents and records have been retained since 2002 and will be retained for a period of at least two years following the end of the Project's crediting period. All records will be available for review by a verification body.

A listing of the variables that will be monitored, including the source of data and a description of measurement methods and QA/QC calibration procedures are provided in Section 3.1 & 3.2 above. It will be the responsibility of Henrico County staff to measure all variables and retain records for verification.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The following equation is used to determine baseline emissions:

$$BE_y = (MD_{project,\ y} – MD_{BL,y}) * GWP_{CH4} + EL_{LFG,y} * CEF_{elec,\ BL,\ y} + ET_{LFG,y} * CEF_{ther,BL,y} \quad (1)$$

Where:

BE_y	= Baseline emission in year y (tCO_2e)
$MD_{project,\ y}$	= The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario
$MD_{BL,y}$	= The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirements, in tonnes of methane (tCH_4)
GWP_{CH4}	= Global Warming Potential value for methane for the first commitment period is 21 tCO_2e / tCH_4
$EL_{LFG,y}$	= Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site /off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh)
$CEF_{elec,\ BL,\ y}$	= CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh. This is estimated as per equation (9) below
$ET_{LFG,y}$	= The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler, during the year y in TJ
$CEF_{ther,BL,y}$	= CO_2 emissions intensity of the fuel used by boiler to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO_2e/TJ.

No emission reductions are claimed for grid-connected electricity generation that is offset by electricity produced from landfill gas destructed at the Ingenco facility, as these environmental attributes are not owned by Henrico. Further no thermal energy is produced using the landfill gas therefore equation (1) is reduced to:

$$BE_y = (MD_{project,\ y} – MD_{BL,y}) * GWP_{CH4} \quad (1)$$

According to ACM0001 in the case where the $MD_{BL,y}$ is given/defined in the regulation and/or contract as a quantity that quantity will be used. In situations where in the baseline LFG captured and destroyed, for reasons other than regulation and/or contract, historic data on actual amount captured shall be used as $MD_{BL,y}$. Otherwise, ACM0001 states that historic data on the actual amount of methane captured should be used.

As such, historic data will be used to quantify $MD_{BL,y,}$. As a result equations (2) through (7) are not applicable to the project and they are omitted.

<u>Calculation of Methane Destroyed by the Project Activity</u>

The methane destroyed by the project activity ($MD_{project,y}$) is then calculated based on monitoring the quantity of methane actually flared, used to generate electricity, thermal energy or natural gas and the total quantity of methane captured for entry into equation (1) as follows:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \quad (8)$$

Where:

$MD_{flared,y}$ = Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$ = Quantity of methane destroyed by generation of electricity (tCH_4)
$MD_{thermal,y}$ = Quantity of methane destroyed for the generation of thermal energy (tCH_4)
$MD_{PL,y}$ = Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)

No thermal energy or natural gas for pipeline distribution is produced by the project however electricity was produced from landfill gas during the Reporting Period therefore equation (8) is reduced to:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} \quad (8)$$

Calculation of the quantity of methane destroyed by flaring ($MD_{flared,y}$) and electricity generation ($MD_{electricity,y}$)for entry into equation (8) is outlined below:

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4}) \quad (9)$$

Where:

$LFG_{flare,y}$ = Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)
$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4 / m^3 LFG)
D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4 / m^3CH_4)
$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO_2e) determined following the procedure described in the "Tool to determine project emissions from flaring gases containing Methane", for which the involved equations are listed below.

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4} \quad (10)$$

Where:
MDelectricity,y = Quantity of methane destroyed by generation of electricity
LFGelectricity,y = Quantity of landfill gas fed into electricity generator

<u>Project Emissions from Flaring</u>

Project emissions from flaring ($PE_{flare,y}$) are calculated following the methodology outlined in the CDM Annex 13 "Tool to determine project emissions from flaring gases containing methane".

Flare Efficiency
Following the options outlined in the CDM tool, a default flare efficiency is used. The CDM "Tool to determine project emissions from flaring gases containing methane" specifies a default flare efficiency of 50% for open flares.

Since methane composition is metered on a continuous basis, a flare efficiency of 98% will be applied. This represents the flare efficiencies typically achieved in the United States for flares designed in accordance with 40 CFR 60.18. This standard specifies requirements for flare operating variables (i.e. Btu content, exit velocity) that must be met in order to achieve 98% or higher flare destruction efficiencies, and are applicable if the flare is operated in accordance with design limits.

The flare's design limits specify that landfill gas must have a composition of at least 30% methane to maintain a stable flame and a 98% destruction efficiency. The flow range must be between 135 scfm and 1350 scfm.

To ensure the flare is operated within these limits, the average monthly methane content and the average monthly flow of landfill gas to the flare will be monitored to ensure they are within design limits. This will

ensure that the flare is operated according to the specifications required to ensure a destruction efficiency of 98%.

Landfill Gas Composition
The CDM tool requires that the volumetric fraction of each component in the landfill gas ($fv_{i,h}$) be measured continuously, which has happened during this monitoring period and will continue on a go forward basis.

To calculate project emissions from flaring, the mass flow rate in the residual gas on a wet basis is calculated as follows:

$$TM_{RG} = FV_{RG} * fv_{CH4,RG} * \rho_{CH4,n} \text{ (13 flaring tool)}$$

Where:

TM_{RG}	= Mass flow rate of methane in the residual gas
FV_{RG}	= Volumetric flow rate of the residual gas in wet basis at normal conditions
$fv_{CH4,RG}$	= Volumetric fraction of methane in the residual gas on wet basis (NB: this corresponds to $fv_{i,.RG,h}$ where i refers to methane).
$\rho_{CH4,n}$	= Density of methane at normal conditions

Emissions are then calculated as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG} * (1 - \eta_{flare}) * GWP_{CH4} / 1000 \text{ (15 flaring tool)}$$

Where:

$PE_{flare,y}$	= Project emissions from flaring of the residual gas stream in year y
TM_{RG}	= Mass flow rate of methane in the residual gas
η_{flare}	= Flare efficiency
GWP_{CH4}	= Global Warming Potential of methane valid for the commitment period

4.2 Project Emissions

According to ACM0001 project emissions are defined by the following equation:

$$PE_y = PE_{Grid,y} + PE_{FC,Propane,y} \text{ (16)}$$

Where:

$PE_{EC,y}$	= Emissions from consumption of electricity in the project case. The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".
$PE_{FC,Propane,y}$	= Emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

The project emissions from electricity consumption ($PE_{EC,y}$) for input into equation (16) are calculated following the methodology outlined in the the CDM Annex 7 "Tool to calculate baseline, project or leakage emissions from electricity consumption" Version, 01.

During Phase one (1) of the Project, electricity is consumed to operate the blowers used to transport gas to the flare. Each blower is equipped with a 40 hp motor. Electricity will also be used under Phase two (2) of the Project to transport gas to the Ingenco facility and further process gas.

For determination of the emission factor for electricity generation ($EF_{EL,j,y}$) the methodology presents a number of options. In this case the electricity consumed is purchased from the regional grid and the applicable options are Option A1 and Option A2.

Option A1 is the calculation of a grid emission intensity factor following the methodology outlined in the CDM Annex 12 "Tool to calculate the emission factor for an electricity system" Version 01.1 (Option A1). However, calculation of an emission factor is data intensive and not administratively simple. Given that the project does not consume or generate a significant quantity of electricity and electricity consumption does not represent a large emission source for the project, this approach is not reasonable.

Under Option A2 a conservative default value may be used instead. Following ACM001 only project emissions from electricity consumption are calculated, therefore a default value of 0.8 tonnes CO_2 per MWh would be applied. However given the generation mix and emission intensity of electricity generation from the applicable regional grid, this value is not representative of the emissions associated with electricity generation for the Landfill. A deviation from the methodology is proposed and the emission factor for electricity generation ($EF_{EL,j,y}$) is determined as outlined below:

> The grid average emission intensity of electricity generation in the region was examined to define a value to the CO_2 emissions intensity of the project source of grid-connected electricity.
>
> The electricity grid from which the Landfill draws electricity is part of the SRVC region. The emission rate of electricity generation from this eGRID2012 for 2009 was 0.47 tonnes CO_2 per MWh. The emission factor for electricity generation ($EF_{EL,j,y}$) is therefore assigned this value.

Emissions are then calculated as follows:

$$PE_{Grid,y} = \sum_{j} EC_{PJ,Grid,y} * FE_{EL,Grid,y} * (1 + TDL_{Grid,y}) \text{ (1 electricity tool)}$$

Where:

$PE_{EC,y}$ = Project emissions from electricity consumption in year y (tCO2/yr)
$EC_{PJ,Grid,y}$ = Quantity of electricity consumed by the project from the regional grid in year y (MWh/yr)
$EF_{ELGridj,y}$ = Emission factor for electricity generation from the regional grid in year y (tCO2/MWh)
$TDL_{Grid,y}$ = Average technical transmission and distribution losses for the regional grid in year y

Equations (2) and (3) of the electricity tool are omitted as calculation of the baseline and leakage electricity consumption are not required by ACM0001.

Equations (4), (5), (6), (7) and (8) of the CDM tool are omitted as these are not relevant to the project.

Pilot fuel used in the flares represents another fossil fuel emission from the project activity. The project emissions from fuel consumption ($PE_{FC,j,y}$) for input into equation (16) are calculated following the methodology outlined in the the CDM Annex 19 "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 01 using Option B as follows:

$$PE_{FC,j,y} = \sum_{i} FC_{Propane,y} * COEF_{Propane,y} \text{ (1 fuel tool)}$$

Where:

$PE_{FC,Propane,y}$ = are the CO_2 emissions from propane combustion during the year y (tCO_2/yr)
$FC_{Propane,y}$ = quantity of propane used in the flare as pilot fuel during the year y (gallons/yr)
$COEF_{Propane,y}$ = CO_2 emission coefficient of propane in the year y (tCO_2/gallon)

Note that the CDM "Tool to Calculate Project or Leakage CO_2 Emissions from Fossil Fuel Combustion recommends calculating emission coefficients based on IPCC factors; however, no such IPCC factors

exist for propane. As such, U.S. EPA factors are used instead[3]. It is possible to use the IPCC factors for Liquefied Petroleum Gas, a mixture of Propane and Butane, but the EPA factor used is higher and therefore more conservative.

The CO_2 emission coefficient $COEF_{i,y}$ is then calculated based on the net calorific value and CO_2 emission factor of the fuel type i (Option B), as follows:

$$COEF_{Propane,y} = NCV_{Propane,y} * EF_{CO2,Propane,y} \text{ (4 fuel tool)}$$

Where:
$COEF_{Propane,y}$ = the CO_2 emission coefficient of propane used (tCO_2/gallon);
$NCV_{Propane,y}$ = the weighted average net calorific value of propane (MMBtu/gallon)
$EF_{CO2,Propane,y}$ = the weighted average CO_2 emission factor of propane (tCO_2/MMBtu)

The CO_2 emission coefficient $COEF_{Diesel}$ will also be calculated based on the net calorific value and CO_2 emission factor (Option B), as follows:

$$COEF_{Diesel} = NCV_{Diesel} * EF_{CO2,\ Diesel} \text{ (4 fuel tool)}$$

Where:
$COEF_{Diesel}$ = the CO_2 emission coefficient of diesel (tCO_2/gallon);
NCV_{Diesel} = the weighted average net calorific value of diesel (MMBtu/gallon)
$EF_{CO2,\ Diesel}$ = the weighted average CO_2 emission factor of diesel (tCO_2/MMBtu)

4.3 Leakage

The project activity does not anticipate any leakage emissions.

4.4 Summary of GHG Emission Reductions and Removals

Ex Ante Estimate of Emission Reductions

Following ACM0001 project proponents must provide an ex ante estimate of emission reductions by projecting the future GHG emissions of the landfill.

Instead of estimating baseline methane emissions using the CDM "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", the US EPA LandGEM Landfill Gas Emissions model is used. This is the accepted standard for developing landfill gas curves in the United States. Equation (13) of ACM0001 is therefore not required.

Instead, the LandGEM model requires the user to input the following variables to determine the emissions associated with disposal of waste at the solid waste disposal site:

$$MD_{project,\ y} = f\ (W, F, k, Lo)$$

Where:
$MD_{project,\ y}$ = Methane emissions generated during the year y from waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
F = Fraction of methane in the landfill gas (volume fraction) (0.5)
W_x = Amount of waste disposed in the landfill in each year x from the year the landfill / landfill cell began accepting waste to present (tons)

[3] U.S. EPA, Inventory of Greenhouse Gas Emissions and Sinks: 1990 – 2009 (20011), Annex 2, Table A-46

k = Decay constant (1/yr)
Lo = Methane potential generation capacity (m^3/Mg)

Following ACM0001 the sum of the quantities fed to the flare and to the Ingenco genset will be compared annually with the total quantity of methane generated. The lowest value of the two will be adopted as $MD_{project,y}$. The table below shows this comparison from the project for 2013.

Table 1. Ex Methane Generated vs Sum quantities destroyed for Oct-Dec 2013

Year	Potential Emission Reductions (tCH4)
$MG_{PR,2013}$	3,854.04
Sum 2013	3,328

Emission reductions are calculated as the difference between the baseline methane emissions and project emissions from electricity and fuel consumption at the site as follows:

$$ER_y = BE_y - PE_y \quad (17)$$

Where:
ER_y = Emission reductions in year y (tCO_2e)
PE_y = Project emissions in year y (tCO_2e)
BE_y = Baseline emissions in year y (tCO_2e)

Table 2 provides a summary of the quantification of emission reductions generated by the project activity from October 1- December 31, 2013.

Table 2: Summary of Emission Reductions (tonnes CO_2e)

	Previous Verification Jan. – Sept 2013	Current Verification Oct- Dec 2013 Total	2013 Total
Baseline Emissions	46,518	15,487	62,005
Project Emissions	190	36	226
Total Emission Reductions	**46,328 (tCO2E)**	**15,451 (tCO2E)**	**61,779 (tCO2E)**

5 ADDITIONAL INFORMATION

There is no additional information.