



**Monitoring report form  
(Version 03.1)**

**Monitoring report**

<b>Title of the project activity</b>	EnviroServ Chloorkop Landfill Gas Recovery Project
<b>Reference number of the project activity</b>	0925
<b>Version number of the monitoring report</b>	02
<b>Completion date of the monitoring report</b>	31/01/2013
<b>Registration date of the project activity</b>	27/04/2007
<b>Monitoring period number and duration of this monitoring period</b>	4 01/04/2012 – 31/12/2012
<b>Project participant(s)</b>	EnviroServ (Pty) Ltd Japan Carbon Finance Ltd
<b>Host Party(ies)</b>	South Africa
<b>Sectoral scope(s) and applied methodology(ies)</b>	Sectoral scope: 13 Waste handling and disposal Applied methodology: AM0011 version 02
<b>Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD</b>	242,520
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period</b>	124,306

**SECTION A. Description of project activity****A.1. Purpose and general description of project activity**

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## 1. Purpose of the project activity:

The purpose of the project is to extract landfill gas at the EnviroServ Chlookop Landfill Site and to combust the landfill gas by flaring. Landfill gas consists of approximately 50% methane, which has a global warming potential 21 times greater than CO<sub>2</sub>. Through the destruction of methane, the emissions of greenhouse gas are reduced.

## 2. General description of the project activity:

## Landfill site

The EnviroServ Chlookop Landfill Site has been used for the disposal of municipal solid waste since 1997, receiving approximately 396 000 tons of waste per annum. The waste accepted includes general (or domestic) waste, garden waste, soil and builder's rubble. To date, six cells have been constructed.

## Landfill Gas Collection System

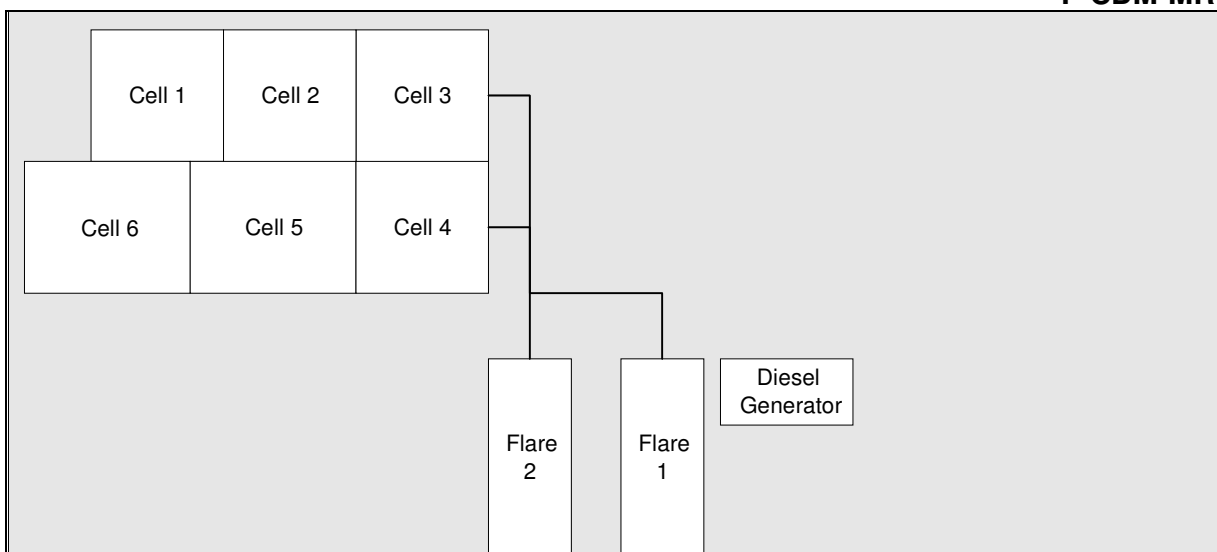
Vertical wells were installed in cells 1 to 3 by augering into the existing waste body once the cell reached final grade. Horizontal collectors were installed in cells 4, 5 and 6 and involved the excavation of trenches into the waste at intermediate intervals before a cell reached final grade. In both cases, perforated piping was installed in gravel backfill for collection of the landfill gas under a vacuum. The vertical wells and horizontal piping were connected to a number headers leading to the flare installations.

## Flare System

There are two flare installations. The flares used are high temperature enclosed flares.

The two flare installations are situated alongside each other. An emergency diesel fueled electricity generator supplies emergency power to the flare installations in the event of a failure of the power from the electricity grid.

A diagram of the landfill cells, flare installations and diesel generator are given below:



**A.2. Location of project activity**

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The project activity is located at the EnviroServ Chloorkop landfill site, Ekurhuleni Metropolitan Municipality, Gauteng Province, South Africa.

GPS coordinates: 26° 02' 30.35" S, 28° 10' 04.58" E

**A.3. Parties and project participant(s)**

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	EnviroServ (Pty) Ltd – Private	Yes
Japan	Japan Carbon Finance Ltd – Private	Yes

**A.4. Reference of applied methodology**

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The methodology utilised for the project is AM0011 version 02 – landfill gas recovery with electricity generation and no capture or destruction of methane in the baseline scenario.

**A.5. Crediting period of project activity**

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The first renewable crediting period for the project, as given in the PDD and project view page, was from 1/7/2007 to 30/6/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/1/2008, which was the date on which operation of the project started. A reply to this request was received and the crediting period was changed to 19/1/2008 to 18/1/2015.

**SECTION B. Implementation of project activity****B.1. Description of implemented registered project activity**

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## 1. Starting date of operation and phased implementation.

The EnviroServ Chlookop Landfill Site consists of six waste disposal cells. Construction of the wellfield was done in a phased manner. The first six vertical wells were installed in cells 1, 2 and 3 in 2005 as a pilot trial. These were followed by 23 additional vertical wells in cells 1, 2 and 3, and 5 horizontal collectors in two layers in cell 4, and the first flare in 2007. Commissioning of this initial phase took place in late 2007 with the first gas being flared on 19/1/2008 (the start date of the project activity). Eight additional vertical wells were installed in 2008 with additional horizontal collectors being installed in cells 5 and 6 from 2008. Installation of the second flare was completed in December 2008 and started operation in January 2009.

## 2. Actual operation of the project activity during this monitoring period.

During this monitoring period, both flares were in operation, with flare 1 operating at about 65% of its design capacity and flare 2 at about 72% of its design capacity. The design capacity of each flare is 2,000 Nm<sup>3</sup>/h. The throughput of the flares was dictated by the amount of landfill gas available from the wellfield.

Significant events that caused downtime of the flares and the total hours of downtime, were the following:

Month	Significant Events	Downtime (hours)
April 2012	Scheduled maintenance. Flame failure (flare 1). Thermocouple failure (flare 2)	4
May 2012	Control system failure and maintenance.	6
June 2012	Faulty sump pump (flare 1). Flowmeter for total flow replaced. Control system data loss.	4
July 2012	Air compressor failure. Blower failure (flare 1). Power failure.	268
August 2012	Blower repairs (flare 1). Air compressor failure. Control system data loss.	396.5
September 2012	Control system data loss.	12
October 2012	Control system data loss. On-line analyser fault.	53
November 2012	Control system data loss. Replace flowmeter for routine calibration. (flare 1). Thermocouple failure.	62.5
December 2012		0

The following measuring equipment was replaced during this monitoring period:

Equipment tag number	Equipment Description	Date replaced	Reason for replacement
3449-E-189	Thermocouple, flare 2	30/4/2012	Thermocouple failure
3449-E-172	Carbon dioxide analyser card, flare 2	11/10/2012	Faulty card
3449-E-189	Thermocouple, flare 2	22/10/2012	Thermocouple failure
3092-FM-118	Gas flowmeter flare 1	22/11/2012	Routine calibration
3092-E-151	Thermocouple, flare 1	29/11/2012	Thermocouple failure

**B.2. Post registration changes****B.2.1. Temporary deviations from registered monitoring plan or applied methodology**

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There were no temporary deviations from the registered monitoring plan or applied methodology during this monitoring period.

**B.2.2. Corrections**

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There were no corrections during this monitoring period.

**B.2.3. Permanent changes from registered monitoring plan or applied methodology**

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A request was made to revise the monitoring plan in August 2010. During the first verification, SGS United Kingdom Ltd, raised one FAR that required a revision to the monitoring plan. The revisions included the exclusion of three parameters (namely  $LFG_{add i,v}$ ,  $T_{LFG}$ ,  $P_{LFG}$ ) required to close out the FAR from the first verification, a change in data units (from cubic meters to Normal cubic meters), a change in units from %,g/m<sup>3</sup> to % for the methane fraction in landfill gas, details on the calibration procedures and accuracies of the monitoring equipment, and updating the Monitoring Information in Annex 4 to be consistent with corrections made in the revised monitoring plan and to include the monitoring parameters for 'Amount of Landfill gas used for electricity generation' and 'Amount of electricity generated'. The revised monitoring plan was approved by the CDM Executive Board on 20/12/2010.

There were no permanent changes from the applied methodology.

**B.2.4. Changes to project design of registered project activity**

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There were not changes to the project design of the registered project activity.

**B.2.5. Changes to start date of crediting period**

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The first renewable crediting period for the project, as given in the PDD and project view page, was from 1/7/2007 to 30/6/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/1/2008, which was the date on which operation of the project started. A reply to this request was received and the crediting period was changed to 19/1/2008 to 18/1/2015.

**B.2.6. Types of changes specific to afforestation or reforestation project activity**

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Not applicable.

**SECTION C. Description of monitoring system**

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Data collection, recording, aggregation and reporting

To ensure the integrity of all the monitoring information generated by the project, two independent streams of data are received for the flares; telemetry data (primary) and check sheet data (secondary).

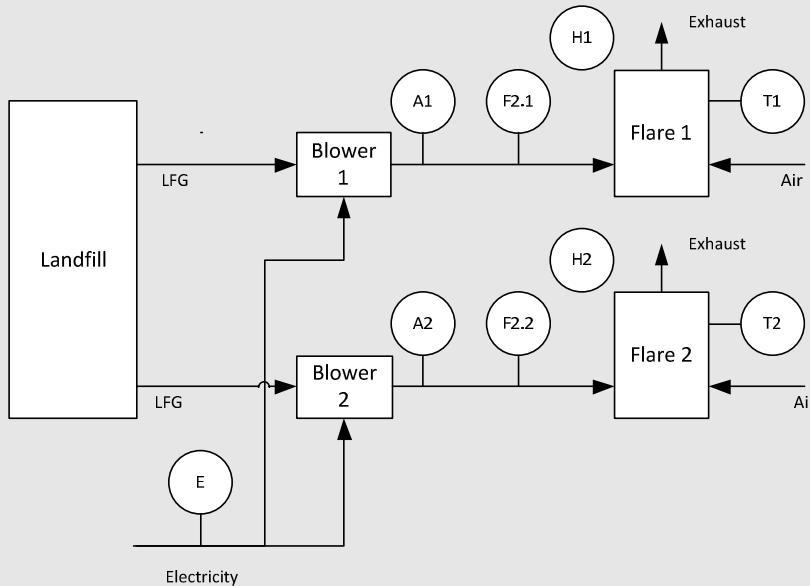
Primary data is defined as the data representing the main variables for the calculation of the emission reductions. This data is captured from the various sensors by a data acquisition system and is then sent from the site through a telemetry system to a website managed by Netrix, which then provides access to the data to Biogas Technology Ltd (Biogas). Netrix through Biogas were subcontracted by ENER-G Systems (Pty) Ltd (Ener-G), the company that manages the wellfield and the flare for EnviroServ. The information is received by Biogas via a website, and is downloaded weekly.

Secondary data is defined as variables measured visually on site and includes the primary data variables. These variables are recorded twice a day during day-shift. This data is recorded on the daily check sheet and filed at the ENER-G Systems offices.

The primary data from the Netrix website for the month is saved in comma separated value (CSV) format and pasted into an Excel spreadsheet workbook. This workbook calculates the number of emission reductions, transfers the results to an operations report and produces a graph and a data table. The primary data is the only data used in the calculation of emission reductions. This information is then used to create monthly report on the emission reductions. There is a separate monthly workbook for each flare.

The monthly information is copied into the summary workbook which gives the total values for the monitoring period.

A line diagram showing the relevant measuring points is given below.



	Parameter	Description	Instrument tag number
F2.1	LFG <sub>flared,y</sub>	Total amount of landfill gas flared in flare 1	3092-FM-118
F2.2		Total amount of landfill gas flared in flare 2	3449-FM-118
A1	W <sub>CH4</sub>	Methane fraction of landfill gas to flare 1	3092-E-172
A2		Methane fraction of landfill gas to flare 2	3449-E-172
H1	Flare hours	Working hours for flare 1	N/A
H2		Working hours for flare 2	N/A
T1	Flare temperature	Flare temperature flare 1	3092-E-151
T2		Flare temperature flare 2	3449-E-151
E	EL <sub>IMP</sub>	Electricity consumed by project	-

Data security and archiving

All data and information obtained over the crediting period of the project is stored and archived in an ISO 9001 approved filing system and kept for the life of the project, plus a further 2 years.

The data system uses 128 bit SSL Encryption for security. The system is further protected by user names and passwords to restrict access.

Data is generated from the monitoring equipment and passed to the Netrix system in an electronic format, which can't be tampered with. Once the information is sent via a GPRS SIM card to the Netrix website, it is held securely. Access to the gathered data is only possible via a username and password, which is provided by Netrix.

With regards to workbook, Biogas does not password protect workbooks for any of its sites as the workbooks are in Microsoft excel format, and passwords in excel can easily be deactivated or by-passed.

All the data is transferred via email and CD from Ener-G to EnviroServ on a monthly basis. The data is received and archived in a folder on the EnviroServ access controlled server. The CD's are archived in a secure locked cupboard. Access to the server is controlled by the EnviroServ IT department using the

following process:

- The user needs to fill in a user application form requesting access to this folder.
- The Process Operations Manager would need to approve access to this group by signing the application form off.
- The signed form will need to be either scanned and e-mailed or faxed to IT.
- A call needs to be logged with service desk to request access to this group.
- One of the System Administrators will then grant access to this group.
- For the access to take affect the user will need to log off and log back onto the system.

The folder is backed up as described in the process below:

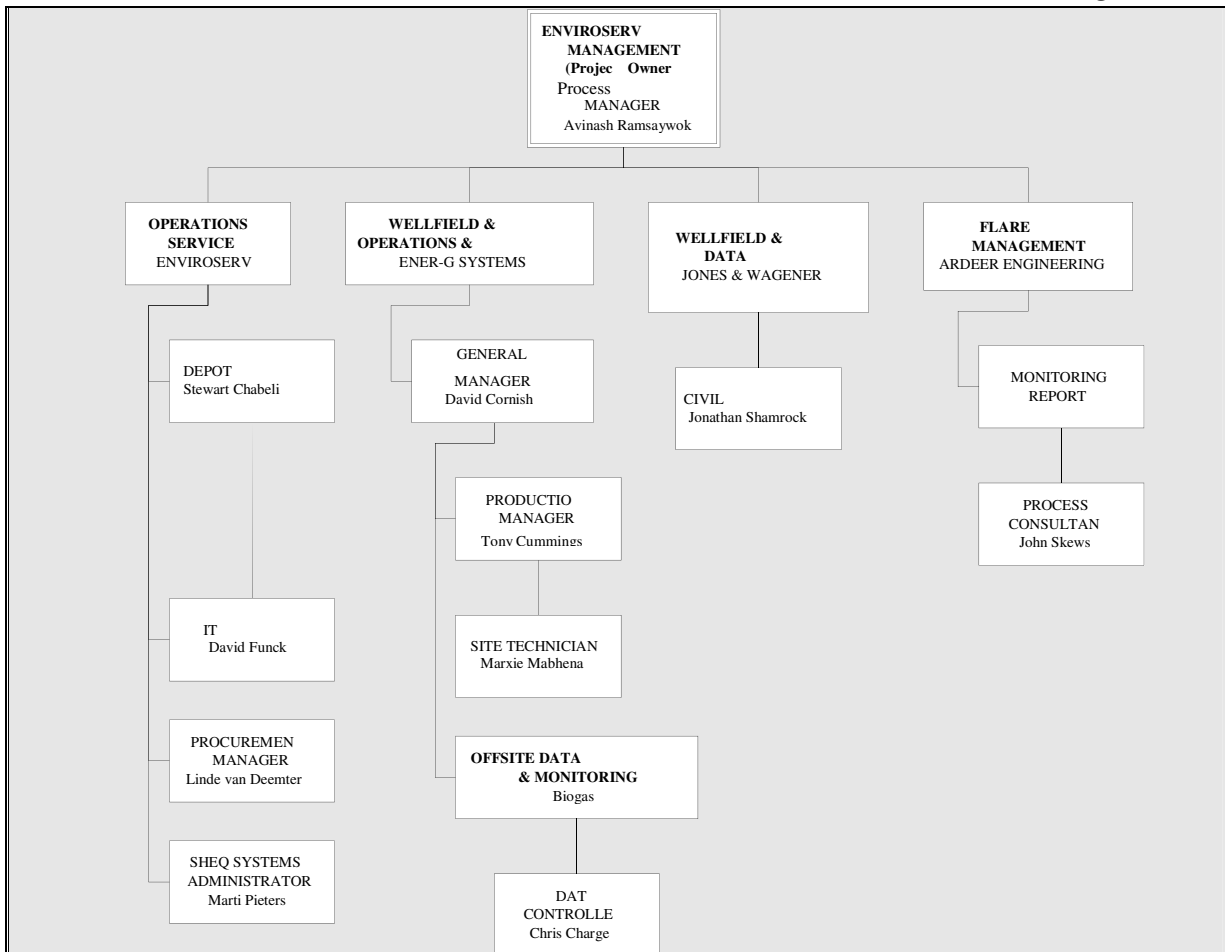
- Currently this folder resides on a server's RAID5 Array drive which is located on a fibre attached SAN which provides additional redundancy.
- This drive is backed up using Backup Exec 12.5 using the following schedules
- Daily starts at 5:00pm in the afternoons
  - Backup Media is LTO4
  - Retention is 5 weeks off-site at MetroFile
  - Backup Schedule Monday to Friday unless the daily falls within a monthly or yearly schedule
- Monthly 5:00pm in the afternoons
  - Backup Media is LTO4
  - Retention is 1 Year off-site at MetroFile
  - Backup Schedule is Last day of the month unless this day falls on a weekend or public holiday in which case it will be the day before the start of that weekend or public holiday. Monthly schedule do not apply if it falls within a yearly backup schedule
- Yearly 5:00pm in the afternoons
  - Backup Media is LTO 4
  - Retention is infinite off-site at MetroFile and are only recalled on request.
  - Backup Schedule is Last day of the Year unless this day falls on a weekend or public holiday in which case it will be the day before the start of that weekend or public holiday.

Emergency procedures for the monitoring system

The calculation carried out in the Biogas workbook includes a validation check on the methane concentration, combustion temperature and flow of gas to the flare (see step 2 in the data calculation description in Section E1 below). If any of these parameters are outside the defined limits, the emission reduction value is set to zero i.e. no emission reductions are claimed for the period in which any of these parameters are outside the defined limits.

Roles and responsibilities

An organogram of the Chloorkop Gas Project Team is given below:



The responsibilities and authorities of those in the various positions are as follows:

Position	Responsibilities	Authorities
EnviroServ Process Operations Manager	Overall responsibility for the landfill gas system. Overall responsibility for the Quality Management System for the landfill gas system. Reviews performance data on landfill gas system and submits comments to Ener-G Chairs monthly review meetings between EnviroServ and Ener-G on the operation of the landfill gas system Stores and archives data received from Ener-G on the EnviroServ Chlookop CDM folder on the server. Compiles monthly report and submits to the JCF.	Provides and manages resources for operation of the landfill gas system
EnviroServ Depot Manager	Liaison between Ener-G and rest of landfill site. Advises Ener-G of aspects of landfill operation that may impact on operation of the landfill gas	



	system.	
EnviroServ IT Manager	Manages the IT system in EnviroServ. Provides data storage and archiving (backup) of data for the landfill gas system.	Provides resources for data storage and backup.
EnviroServ Procurement Manager	Manages procurement in EnviroServ. Manages the procurement of spares and services for the landfill gas system.	Manages resources and systems for procurement.
Ener-G General Manager	Overall responsibility for managing the landfill gas system.	Manages resources for the landfill gas system.
Ener-G Production Manager	Operation of the landfill gas system. Reviews workbook data from Biogas, comments if necessary. Advises Biogas of any comments on the workbook data. Approves monthly report Compiles monthly reports and together with workbooks from Biogas submits to EnviroServ via email and cd. Attends monthly meetings with EnviroServ to discuss operations and maintenance of the plant. Draws up purchase requisitions to purchase items for the plant and submits to EnviroServ for approval.	Controls the landfill gas system
Ener-G Site Technician	Day-to-day operation of the landfill gas system	Controls the landfill gas system
Biogas Data Controller	Reviews and compares primary and secondary data from flare system. Prepares monthly workbook and submits to Ener-G General Manager. Reviews comments from Ener-G and EnviroServ and makes changes as necessary.	Selects primary or secondary data that goes into the monthly workbook.
Jones & Wagener Civil Consultant	Reviews data on well field and flare performance on an ad-hoc basis when required by EnviroServ to do so. Submits comments to Ener-G General Manager & EnviroServ Process Operations Manager Provides technical support to Ener-G and EnviroServ	Recommends changes to operation of landfill gas system to Ener-G and EnviroServ. .
Ardeer Engineering Process Consultant	Assists in compiling draft monitoring report (report required for verification of emission	-

	reductions by DOE). Submits draft monitoring report to EnviroServ Process Operations Manager for approval and issue. Provides Process and technical support to Ener-G and EnviroServ.	
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**SECTION D. Data and parameters**

**D.1. Data and parameters fixed ex ante or at renewal of crediting period**

<b>Data / Parameter:</b>	<b>GWP<sub>CH4</sub></b>
Unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Global Warming Potential of methane
Source of data:	Methodology AM0011 version 2
Value(s) applied):	21
Purpose of data:	Baseline emission calculations
Additional comment:	

<b>Data / Parameter:</b>	<b>D<sub>CH4</sub></b>
Unit:	tCH <sub>4</sub> /Nm <sup>3</sup> CH <sub>4</sub>
Description:	Density of methane at 0 degree Celsius and 1,013 bar
Source of data:	Methodology ACM0001 version 1
Value(s) applied):	0.0007168
Purpose of data:	Baseline emission calculations
Additional comment:	

**D.2. Data and parameters monitored**

<b>Data / Parameter:</b>	<b>Q</b>		
Unit:	Nm <sup>3</sup>		
Description:	Total amount of landfill gas collected at Normal Temperature and Pressure		
Measured/ Calculated / Default:	Measured value		
Source of data:	Flowmeter		
Value(s) of monitored parameter:	Flare 1	Flare 2	Total
	7,753,753	9,423,438	17,177,191

Monitoring equipment:	Thermal mass flowmeter. The typical accuracy of the thermal mass flowmeters is ±1.5% of reading, +0.5 % of full scale. Calibration frequency is 3 years. Validity of calibration is 3 years from time the flowmeter is taken into service after calibration. The flowmeter on flare 1 was replaced on 22/11/2012 for routine calibration.			
		Flare 1	Flare 2	
	Equipment number	3092-FM-118	3449-FM-118	
		Up to 22/11/2012	After 22/11/2012	After 6/10/2011
	Serial number	99047602000	A309FA02000	99047702000
	Last calibration	24/10/2008	26/07/2012	10/03/11
	Taken into service	23/11/2009	22/11/2012	6/10/2011
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly			
Calculation method (if applicable):	NA			
QA/QC procedures:	The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards.			
Purpose of data:	Baseline emission calculation			
Additional comment:	The flowmeters used are thermal mass flowmeters. These flowmeters express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of the LFG is necessary. The flow measurement for Q is the same as that for $LFG_{\text{flared,y}}$ , as there was no electricity generation in this monitoring period and hence $Q = LFG_{\text{flared,y}}$			
<b>Data / Parameter:</b>	<b><math>LFG_{\text{flared,y}}</math></b>			
Unit:	$Nm^3$			
Description:	Total amount of landfill gas flared			
Measured/ Calculated / Default:	Measured value			
Source of data:	Flowmeter			
Value(s) of monitored parameter:	Flare 1	Flare 2	Total	
	7,753,753	9,423,438	17,177,191	

Monitoring equipment:	Thermal mass flowmeter. The typical accuracy of the thermal mass flowmeters is ±1.5% of reading, +0.5 % of full scale. Calibration frequency is 3 years. Validity of calibration is 3 years from time the flowmeter is taken into service after calibration. The flowmeter on flare 1 was replaced on 22/11/2012 for routine calibration.			
		Flare 1	Flare 2	
	Equipment number	3092-FM-118	3449-FM-118	
		Up to 22/11/2012	After 22/11/2012	After 6/10/2011
	Serial number	99047602000	A309FA02000	99047702000
	Last calibration	24/10/2008	26/07/2012	10/03/11
	Taken into service	23/11/2009	22/11/2012	6/10/2011
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly			
Calculation method (if applicable):	Correction factor applied for methane concentration			
QA/QC procedures:	The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards.			
Purpose of data:	Baseline emission calculation			
Additional comment:	The flowmeters used are thermal mass flowmeters. These flowmeters express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of the LFG is necessary. The values used in the emission calculations are the 30-minute quantities given in the monthly emission reduction workbooks.			
<b>Data / Parameter:</b>	<b>LFG<sub>leachate,y</sub></b>			
Unit:	Nm <sup>3</sup>			
Description:	Total amount of landfill gas used for leachate evaporation			
Measured/ Calculated / Default:	Measured value			
Source of data:	NA			
Value(s) of monitored parameter:	NA			
Monitoring equipment:	NA			
Measuring/ Reading/ Recording frequency:	NA			

Calculation method (if applicable):	NA		
QA/QC procedures:	NA		
Purpose of data:	NA		
Additional comment:	No facilities installed for the evaporation of leachate using LFG. No LFG used for leachate evaporation.		
<b>Data / Parameter:</b> LFG <sub>electricity, v</sub>			
Unit:	Nm <sup>3</sup>		
Description:	Total amount of landfill gas used for electricity generation		
Measured/ Calculated / Default:	Measured value		
Source of data:	NA		
Value(s) of monitored parameter:	NA		
Monitoring equipment:	NA		
Measuring/ Reading/ Recording frequency:	NA		
Calculation method (if applicable):	NA		
QA/QC procedures:	NA		
Purpose of data:	NA		
Additional comment:	No facilities installed for the generation of electricity from LFG. No LFG used for electricity generation.		
<b>Data / Parameter:</b> W <sub>CH4</sub>			
Unit:	%		
Description:	Methane fraction in landfill gas		
Measured/ Calculated / Default:	Measured value		
Source of data:	Fixed Gas Analyser		
Value(s) of monitored parameter:	Flare 1	Flare 2	Weighted average
	47.2%	52.5%	49.9%

<p>Monitoring equipment:</p>	<p>Infrared continuous analyser The typical accuracy of the analyzer is 2% full scale per month. Calibration frequency is once per week using a supply of span gas. The span gas has a methane concentration of 40%v/v.</p> <table border="1" data-bbox="527 321 1344 422"> <tr> <td></td> <td>Flare 1</td> <td>Flare 2</td> </tr> <tr> <td>Equipment number</td> <td>3092-E-172</td> <td>3449-E-172</td> </tr> <tr> <td>Serial number</td> <td>I-02177</td> <td>I-04311</td> </tr> </table> <p>There were 2 instances for flare 1 where the calibration of the analyser using the span gas gave values greater than the stated accuracy of the instrument. The values used to calculate the emission reductions were reduced by the amount the calibration check exceeded the methane concentration of the span gas (40.0 %v/v). This was applied to the period from the previous calibration to the current calibration. This was to ensure a conservative approach to the calculation of the emission reductions.</p> <p>The dates of calibration, the calibration check results and the periods affected are given in the table below.</p> <table border="1" data-bbox="527 831 1344 1024"> <thead> <tr> <th>Flare</th> <th>Date of calibration</th> <th>Calibration check results %v/v</th> <th>Period affected</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>20/4/12</td> <td>42.0</td> <td>13/04/12 to 20/4/12</td> </tr> <tr> <td>1</td> <td>8/6/12</td> <td>42.1</td> <td>1/6/12 to 8/6/12</td> </tr> </tbody> </table>		Flare 1	Flare 2	Equipment number	3092-E-172	3449-E-172	Serial number	I-02177	I-04311	Flare	Date of calibration	Calibration check results %v/v	Period affected	1	20/4/12	42.0	13/04/12 to 20/4/12	1	8/6/12	42.1	1/6/12 to 8/6/12
	Flare 1	Flare 2																				
Equipment number	3092-E-172	3449-E-172																				
Serial number	I-02177	I-04311																				
Flare	Date of calibration	Calibration check results %v/v	Period affected																			
1	20/4/12	42.0	13/04/12 to 20/4/12																			
1	8/6/12	42.1	1/6/12 to 8/6/12																			
<p>Measuring/ Reading/ Recording frequency:</p>	<p>Measured by continuous gas quality analyser.</p>																					
<p>Calculation method (if applicable):</p>	<p>NA</p>																					
<p>QA/QC procedures:</p>	<p>The gas analyser is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards.</p>																					
<p>Purpose of data:</p>	<p>Baseline emission calculations</p>																					
<p>Additional comment:</p>	<p>The values used for the emission reduction calculations are the 30-minute values given in the monthly emission reduction workbooks.</p>																					
<p><b>Data / Parameter:</b></p>	<p><b>FE</b></p>																					
<p>Unit:</p>	<p>%</p>																					
<p>Description:</p>	<p>Flare efficiency (combustion efficiency)</p>																					
<p>Measured/ Calculated / Default:</p>	<p>Default and measured</p>																					
<p>Source of data:</p>	<p>Default value: revised and approved monitoring plan. Measured values: laboratory analysis/gas analyser</p>																					

<p>Value(s) of monitored parameter:</p>	<p>The dates and measured flare efficiencies were:</p> <table border="1" data-bbox="532 226 1159 422"> <thead> <tr> <th>Date of measurement</th> <th>Flare 1 Measured flare efficiency</th> <th>Flare 2 Measured flare efficiency</th> </tr> </thead> <tbody> <tr> <td>22/3/12</td> <td>99.41%</td> <td>98.76%</td> </tr> <tr> <td>22/8/12</td> <td>99.99%</td> <td>99.96%</td> </tr> </tbody> </table> <p>The flare efficiency values used in the calculation of the emission reductions are as follows:</p> <table border="1" data-bbox="532 548 1344 898"> <thead> <tr> <th>Period</th> <th>Flare 1 Flare efficiency used</th> <th>Flare 2 Flare efficiency used</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>1/4/12 to 22/6/12</td> <td>99.41%</td> <td>98.76%</td> <td>Measured value</td> </tr> <tr> <td>23/6/12 to 22/8/12</td> <td>90%</td> <td>90%</td> <td>Default value</td> </tr> <tr> <td>23/8/12 to 22/11/12</td> <td>99.99%</td> <td>99.96%</td> <td>Measured value</td> </tr> <tr> <td>23/11/12 to 31/12/12</td> <td>90%</td> <td>90%</td> <td>Default value</td> </tr> </tbody> </table>	Date of measurement	Flare 1 Measured flare efficiency	Flare 2 Measured flare efficiency	22/3/12	99.41%	98.76%	22/8/12	99.99%	99.96%	Period	Flare 1 Flare efficiency used	Flare 2 Flare efficiency used	Comment	1/4/12 to 22/6/12	99.41%	98.76%	Measured value	23/6/12 to 22/8/12	90%	90%	Default value	23/8/12 to 22/11/12	99.99%	99.96%	Measured value	23/11/12 to 31/12/12	90%	90%	Default value
Date of measurement	Flare 1 Measured flare efficiency	Flare 2 Measured flare efficiency																												
22/3/12	99.41%	98.76%																												
22/8/12	99.99%	99.96%																												
Period	Flare 1 Flare efficiency used	Flare 2 Flare efficiency used	Comment																											
1/4/12 to 22/6/12	99.41%	98.76%	Measured value																											
23/6/12 to 22/8/12	90%	90%	Default value																											
23/8/12 to 22/11/12	99.99%	99.96%	Measured value																											
23/11/12 to 31/12/12	90%	90%	Default value																											
<p>Monitoring equipment:</p>	<p>Fixed gas analyser for inlet gas concentrations. Laboratory analysis of exhaust gas concentrations.</p>																													
<p>Measuring/ Reading/ Recording frequency:</p>	<p>Quarterly</p>																													
<p>Calculation method (if applicable):</p>	<p>EB28, Annex 13. Methodological "Tool to determine project emissions from flaring gases containing methane"</p>																													
<p>QA/QC procedures:</p>	<p>The gas analyser is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards. Laboratory analysis by ISO 9001:2008 certified laboratory.</p>																													
<p>Purpose of data:</p>	<p>Baseline emission calculations</p>																													
<p>Additional comment:</p>	<p>Flare efficiency testing is to be done on a quarterly basis i.e. every 3 months. Measured flare efficiency values are used for 3 months from the date of the flare efficiency measurement. If no flare efficiency test is done within 3 months after the previous test, the default value of 90% is used for the calculation of the emission reductions until the next test is done.</p>																													
<table border="1"> <tr> <td><b>Data / Parameter:</b></td> <td><b>Flare hours</b></td> </tr> <tr> <td>Unit:</td> <td>Hours</td> </tr> <tr> <td>Description:</td> <td>Flare working hours</td> </tr> <tr> <td>Measured/ Calculated / Default:</td> <td>Measured</td> </tr> <tr> <td>Source of data:</td> <td>Control system clock</td> </tr> </table>	<b>Data / Parameter:</b>	<b>Flare hours</b>	Unit:	Hours	Description:	Flare working hours	Measured/ Calculated / Default:	Measured	Source of data:	Control system clock																				
<b>Data / Parameter:</b>	<b>Flare hours</b>																													
Unit:	Hours																													
Description:	Flare working hours																													
Measured/ Calculated / Default:	Measured																													
Source of data:	Control system clock																													

Value(s) of monitored parameter:	Flare 1	Flare 2	Total	
	5,871	6,523	12,394	
Monitoring equipment:	NA			
Measuring/ Reading/ Recording frequency:	Data is monitored continuously			
Calculation method (if applicable):	NA			
QA/QC procedures:	NA			
Purpose of data:	Baseline emission calculations			
Additional comment:	The flare working hours are calculated by the Biogas monthly workbook for the periods when the flare is operating within the manufacturer's limits.			
<b>Data / Parameter:</b>	<b>Flare temperature</b>			
Unit:	°C			
Description:	Temperature of flare			
Measured/ Calculated / Default:	Measured value			
Source of data:	Thermocouple			
Value(s) of monitored parameter:	Flare 1	Flare 2	Average	
	999	997	998	
Monitoring equipment:		Flare 1	Flare 2	
	Equipment number	3092-E-151 (T <sub>Combust</sub> )	3449-E-151 (T <sub>Combust</sub> )	
	Equipment number	3092-E-188 (top thermocouple)	3449-E-188 (top thermocouple)	
	Type: N type thermocouple The typical accuracy of this type of thermocouple is ±0.75% of the measured temperature The thermocouples do not have serial numbers. The thermocouples are calibrated by means of a check done every 3 months using a portable temperature probe and monitor.			
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly.			
Calculation method (if applicable):	NA			
QA/QC procedures:	See monitoring equipment above			
Purpose of data:	Baseline emission calculations			



Additional comment:	<p>The combustion temperature is measured by thermocouple 3092-E-151 for flare 1 and thermocouple 3449-E-151 for flare 2. A second thermocouple higher up in the flare exhaust stack (3092-E-188 for flare 1 and 3449-E-188 for flare 2) is used as a check on the combustion temperature.</p> <p>These values were not used in the emission reduction calculations, but the temperature is measured every 30 minutes and emission reductions are not claimed when the temperature is below a threshold value of 700 °C.</p>
<b>Data / Parameter:</b>	<b>EL</b>
Unit:	kWh
Description:	Electricity generated
Measured/ Calculated / Default:	Measured value
Source of data:	NA
Value(s) of monitored parameter:	NA
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	NA
Additional comment:	No facilities installed for the generation of electricity. No electricity generated during this monitoring period.
<b>Data / Parameter:</b>	<b>EL<sub>IMP</sub></b>
Unit:	kWh
Description:	Electricity consumed by project (blowers)
Measured/ Calculated / Default:	Measured and calculated value
Source of data:	kWh meter
Value(s) of monitored parameter:	403,050 kWh
Monitoring equipment:	kWh meter.
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly.

Calculation method (if applicable):	NA
QA/QC procedures:	
Purpose of data:	Project
Additional comment:	Not required in terms of AM0011 and AM_CLA_0028. It is however monitored to assess the significance of emissions.

### D.3. Implementation of sampling plan

>>

Not applicable.

## SECTION E. Calculation of emission reductions or GHG removals by sinks

### E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

The formulae for calculating the baseline emission reductions are the following:

$$BE_y = MD_{project,y} * GWP_{CH_4}$$

Symbol	Description	Units
$BE_y$	Emission reductions in the year	tCO <sub>2</sub> e
$MD_{project,y}$	Amount of methane destroyed in the year	tCH <sub>4</sub>
$GWP_{CH_4}$	Global Warming Potential value for methane	tCO <sub>2</sub> e / tCH <sub>4</sub>

The methane destroyed by the project activity ( $MD_{project,y}$ ) during a year is the sum of the methane flared, that used to evaporate leachate, generate electricity and for other applications.

During this monitoring period, all the gas collected from the landfill was flared. No gas was used for leachate evaporation, electricity generation or in other applications.

This means that:

- Landfill gas used for leachate evaporation ( $LFG_{leachate,y} = 0$ )
- Landfill gas used for electricity generation ( $LFG_{electricity,y} = 0$ )
- Landfill gas used for other application ( $LFG_{app i,y} = 0$ )
- Electricity generated (EL) = 0

Therefore, the total methane destroyed is given by the formulae:

$$Q = LFG_{flared,y}$$

and

$$MD_{project,y} = CH_4_{flared,y}$$

where:

$$CH_4_{flared,y} = LFG_{flared,y} * W_{CH_4} * D_{CH_4} * FE$$

Symbol	Description	Units
$CH_4_{flared,y}$	Amount of methane destroyed by the flare in the year	t CH <sub>4</sub>

LFG <sub>flared,v</sub>	Amount of landfill gas flared in the year	Nm <sup>3</sup>
W <sub>CH4</sub>	Methane fraction in the landfill gas	%
D <sub>CH4</sub>	Density methane at normal conditions	tCH <sub>4</sub> / Nm <sup>3</sup> CH <sub>4</sub>
FE	Flare efficiency (combustion efficiency)	%

The calculation of the emission reductions that is carried out in the monthly emission reduction workbooks is summarised in the steps below:

1. The following raw data, recorded every 30 minutes, is incorporated into the monthly emission reduction workbooks:
  - The flow of landfill gas in Nm<sup>3</sup>/h as measured by flowmeter tag 3092-FM-118 for flare 1 and tag 3449-FM-118 for flare 2. (LFG<sub>flared,v</sub>).
  - The combustion temperature (°C) in the flare as measured by thermocouple tag 3092-E-151 for flare 1 and tag 3449-E-151 for flare 2. (T<sub>Combust</sub>)
  - The concentration (% v/v) of the methane in the landfill gas going to the flare as measured by the on-line analyser tag 3092-E-172 for flare 1 and tag 3449-E-172 for flare 2. (W<sub>CH4</sub>)
  - Whether the source of the data is primary (given a value of 1), secondary (given a value of 2) or a combination of the two (given a value of 3).
2. The following operational check is then done:
  - The concentration of methane in the gas is greater than 25% v/v;
  - The combustion temperature in the flare is greater than 700 °C;
  - The flow of gas to the flare is greater than 200 Nm<sup>3</sup>/h

If all parameters are Ok then this field is given a value of 1, which means that the emission reduction for the 30 minute time interval will be calculated. If any of the parameters are not Ok then this field will be given a value of 0 and the emission reduction for the time interval will be zero.
3. The frequency or time interval of the raw data is then determined by subtracting the date and time for the previous reading from that of the current reading.
4. This is then multiplied by the operational check value determined in step 2.
5. The quantity of gas (in Nm<sup>3</sup>) is then calculated by multiplying the flowrate as measured in step 1 by the time interval (in hours) times the operational check as determined in step 4.
6. A correction factor is calculated for the gas quantity based on the methane concentration. This is because the flowrate as measured by a thermal mass flow meter is dependent to a small extent on the methane concentration of the gas.
7. The corrected gas quantity is then calculated by multiplying the gas quantity from step 5 by the correction factor determined in step 6.
8. The mass of methane (MD<sub>flare,v</sub>) is then calculated by multiplying the quantity of landfill gas from step 7 by the methane concentration (W<sub>CH4</sub>), the density of methane (D<sub>CH4</sub> = 0.0007168) and the flare destruction efficiency (assumed to be 90%). The value of 90% of the destruction efficiency is the default value in the case when no flare efficiency testing has been done.
9. The quantity of emission reductions is then calculated by multiplying the methane determined in step 8 by the global warming potential for methane. (GWP<sub>CH4</sub> = 21 tCO<sub>2</sub>e/tCH<sub>4</sub>)
10. The emission reductions are then aggregated for each time period to give a total value for the month.
11. A monthly report is then produced as a sheet in the monthly emission reduction workbook giving the average landfill gas flowrate, the average methane concentration, the average combustion temperature, the downtime and average emission reductions for each day of the month. The quantity of landfill gas flared and the average flare temperature are calculated based on the measured data. Graphs of the methane flowrate and emission reductions for each day in the month are also produced.
12. The monthly report is then reviewed at the monthly management meeting to check that the emission reductions calculated in the workbook are correct.
13. The CD containing the workbooks and reports is given by Ener-G to EnviroServ who then archives the CD.
14. At the end of the monitoring period, the daily values for the average landfill gas flow, the average flare temperature, the average methane concentration, and the downtime hours are copied from the monthly emission reduction workbooks for each of the two flares into the annual emission reduction workbook. This workbook contains the daily landfill gas quantities, the total average monthly landfill gas flowrates, the average flare temperatures, the average methane concentrations and the total uptime and downtime hours, copied from the monthly emission reduction workbooks. It then calculates the total emission reductions for both flares. This annual workbook also reports the total electricity used by flares and reports it as tCO<sub>2</sub>e and as a percentage of the emission reductions.

For the summary workbook see the file:

Chlookop Workbook Summary Apr2012 – Dec2012 Rev1

## E.2. Calculation of project emissions or actual net GHG removals by sinks

>>

No project emissions are considered for this activity.

$$PE_y = 0$$

In response to a request for clarification (AM\_CLA\_0128), the answer from the Meth Panel was that project emissions (e.g. electricity from the grid or diesel generator set) would not have to be taken into account since no provisions for such emissions are included in the methodology AM0011 version 2.

## E.3. Calculation of leakage

>>

The methodology assumes no leakages from the project activity.

$$L_y = 0$$

## E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO <sub>2</sub> e)	Project emissions or actual net GHG removals by sinks (t CO <sub>2</sub> e)	Leakage (t CO <sub>2</sub> e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO <sub>2</sub> e)
<b>Total</b>	124,306	0	0	124,306

## E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
<b>Emission reductions or GHG removals by sinks (t CO<sub>2</sub>e)</b>	Apr-Dec2012 <sup>1</sup> 242 520	124,306

1. 75% of the value for 2012 of 323,360

## E.6. Remarks on difference from estimated value in registered PDD

>>

The actual emission reductions achieved were 34% less than those estimated ex-ante. The reasons were as follows:

- Downtime. This accounted for 6% of the discrepancy
- The ex-ante estimates of the landfill gas production were calculated using a multicomponent first order kinetic model based on the amount of biodegradable organic carbon in the landfill and the various waste fractions put to the landfill. This, in turn, was determined from the amount of domestic waste put to the landfill, and the fraction of this that was organic carbon. In the PDD, the volume of domestic waste for the years 2006 to 2012 was taken to be the same as that in 2005. The volume of

domestic waste actually put to the landfill was considerably less than this, particularly in the years from 2007 onwards because of the reduced economic activity in South Africa as well as other business reasons. This accounted for the balance of the discrepancy.

**E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards**

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
<b>Emission reductions or GHG removals by sinks (t CO<sub>2</sub>e)</b>	124,306	0

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**Document information**

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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