



**Monitoring report form  
(Version 04.0)**

*Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.*

**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>	01
<b>Completion date of the monitoring report</b>	10/09/2014
<b>Registration date of the project activity</b>	27/04/2007
<b>Monitoring period number and duration of this monitoring period</b>	5 <sup>th</sup> Periodic Verification 01/01/2013 – 31/07/2014 (first and last day included)
<b>Project participant(s)</b>	EnviroServ Waste Management (Pty) Ltd
<b>Host Party(ies)</b>	South Africa
<b>Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)</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>	478 848 tCO <sub>2</sub> e
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period</b>	223 612 tCO <sub>2</sub> e
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)</b>	NA
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).</b>	223 612 tCO <sub>2</sub> e

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

&gt;&gt;

- (a) Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks:

The purpose of the project is to extract landfill gas at the EnviroServ Chloorkop 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.

- (b) Brief description of the installed technology and equipment:

The installed technology consists of wells in the landfill, a gas collection system connecting the wells and two flare installations connected to the gas collection system. Each flare installation consists of a blower that draws the gas from the wells and the gas collection system, and the flare itself.

- (c) Relevant dates for the project activity

The EnviroServ Chloorkop Landfill Site consists of six waste disposal cells. Construction of the wellfield was done in a phased manner. The first vertical wells were installed in cells 1, 2 and 3 in 2005 as a pilot trial. These were followed by additional vertical wells in cells 1, 2 and 3, and horizontal collectors 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 19/01/2008 (the start date of the project activity). 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.

- (d) Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period

The total GHG emission reductions achieved in this monitoring period was 223 612 t CO<sub>2</sub>e.

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

&gt;&gt;

- (a) Host Party(ies)

The host party is South Africa

- (b) Region/ State/ Province

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

- (c) City/ Town / Community

Ekurhuleni Metropolitan Municipality

- (d) Physical/ Geographical location

The GPS coordinates are: 26° 02' 30.35" S, 28° 10' 04.58" E or latitude -26.0417, longitude 28.1679

**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 Waste Management (Pty) Ltd - Private	No

**A.4. Reference of applied methodology and standardized baseline**

&gt;&gt;

(a) Applied methodology

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.

(b) Tools and other methodologies applied

The tool applied is Methodological “Tool to determine project emissions from flaring gases containing methane”. Reference: EB28, Annex 13.

(c) The applied standardized baseline(s), where applicable

No standardized baseline(s) were applied.

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

&gt;&gt;

The first renewable crediting period for the project, as given in the PDD and project view page, was from 01/07/2007 to 30/06/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/01/2008, 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 19/01/2008 to 18/01/2015.

**A.6. Contact information of responsible persons/ entities**

&gt;&gt;

See Appendix 1

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

&gt;&gt;

Status of the project activity during this monitoring period.

During this monitoring period, both flares were in operation, with flare 1 operating at 66% of its design capacity and flare 2 at 58% 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. The construction of cell 6 was completed in this monitoring period.

Significant events that caused downtime of the flares and the total hours of downtime during the months in which there was downtime, were the following:

Month	Significant Events	Downtime (hours)
January 2013	Control system fault (flare 2)	3.5

Month	Significant Events	Downtime (hours)
February 2013	Flare schedule maintenance, control system fault (flare 1). Control system fault. Replaced methane analyser card (flare 2)	5.0
March 2013	Power failures (flares 1 and 2)	27.5
April 2013	Power failures (flares 1 and 2). Blower overhaul (flare 2)	378
May 2013	Blower overhaul, gas analyser cleaning (flare 2)	40.5
June 2013	Control system faults (flares 1 and 2)	2.5
July 2013	Power failure, control system faults, high level in knock-out pot (flares 1 and 2)	21.5
August 2013	Power failure, control system faults, high level in knock-out pot, compressor failure (flares 1 and 2). Replaced carbon dioxide analyser card (flare 2)	112.5
September 2013	Power failures (flares 1 and 2). Control system fault (flare 2)	19.0
October 2013	Power failures, control system faults (flares 1 and 2)	20.5
November 2013	Power failures, control system faults, schedule maintenance (flares 1 and 2). Knock-out pot repairs (flare 2)	23.5
December 2013	Power failure (flares 1 and 2). Replace carbon dioxide analyser card (flare 2)	4.5
January 2014	Replaced total gas flowmeter for calibration (flares 1 and 2)	1.5
February 2014	Control system fault (flares 1 and 2). Replaced carbon dioxide analyser card (flare 1)	9.0
March 2014	Routine service. Power failures. Control system faults (flares 1 and 2)	22.0
April 2014	Power failures. Control system faults (flares 1 and 2)	13.5
May 2014	Power failures. Compressor failure (flares 1 and 2)	58.0
June 2014	Routine maintenance. Power failures (flares 1 and 2). Replaced methane, carbon dioxide and oxygen analyser cards (flare 2)	18.5
July 2014	Power failure. (flares 1 and 2). Blower failure (flare 2)	93.5

## Description of the installed technology, technical process and equipment

### Landfill site

The EnviroServ Chloorkop Landfill Site has been used for the disposal of municipal solid waste since 1997, receiving 396,000 to 448,000 tons of waste per annum. The waste accepted includes general (or domestic) waste, garden waste, soil and builder's rubble. To date, 5 cells have been constructed and are now full. Cell 6 started receiving waste in May 2010 and is still in operation.

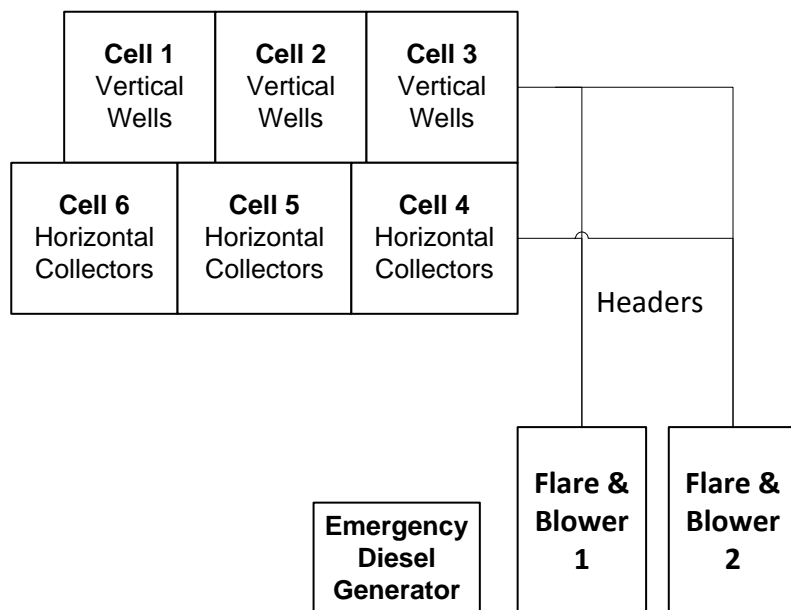
### Landfill Gas Collection System

Vertical wells were installed in cells 1 to 3 by auguring 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. The vertical wells and the horizontal collectors 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 fuelled 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:



## B.2. Post registration changes

### B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

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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, applied methodology or applied standardized baseline

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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 LFGapp i,y, TLFG, PLFG) 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 01/07/2007 to 30/06/2014 (i.e. for 7 years). A request was submitted to the Executive Board that the start of the crediting period be changed to 19/01/2008, 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 19/01/2008 to 18/01/2015.

#### **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).

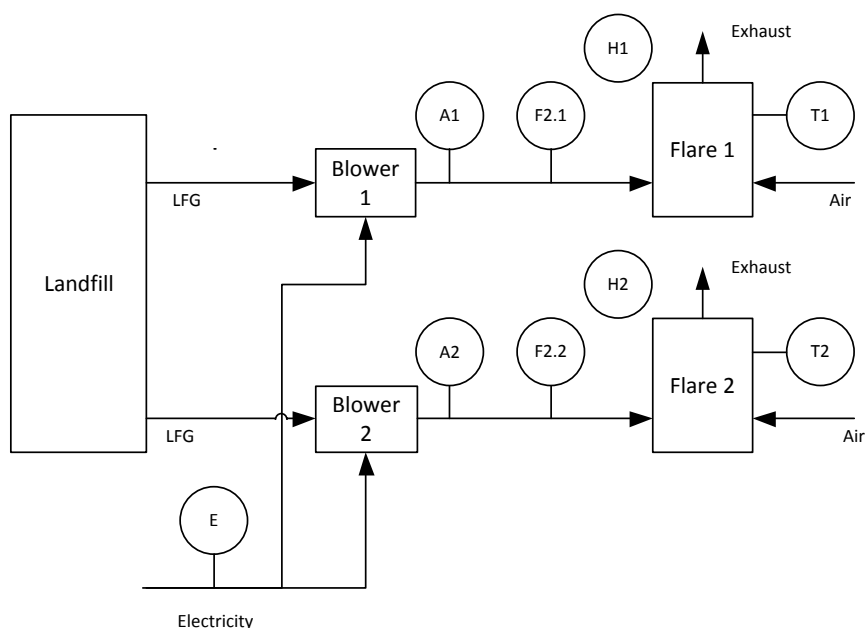
Primary data is defined as the data representing the main variables for the calculation of the emission reductions. This data is captured from the various sensors by a data acquisition system and is then sent from the site through a telemetry system to a website managed by Netrix, which then provides access to the data to Dexdyne Limited (Dexdyne). Netrix through Dexdyne 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 Dexdyne 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, Dexdyne 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 has to approve access to this group by signing off the application form.
- The signed form is either scanned and e-mailed or faxed to the IT department.

- A call is logged with the service desk to request access to this group.
- One of the System Administrators then grants access to this group.
- For the access to take affect the user needs to log off and log back onto the system.

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

- Currently the 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 backup starts at 5:00pm in the afternoons
  - Backup Media is LTO4
  - Retention is 5 weeks off-site at MetroFile
  - Backup Schedule is Monday to Friday unless the daily backup falls within a monthly or yearly schedule
- Monthly backup 5:00pm in the afternoons
  - Backup Media is LTO4
  - Retention is 1 Year off-site at MetroFile
  - Backup Schedule is the last day of the month unless this day falls on a weekend or public holiday in which case it is 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 backup 5:00pm in the afternoons
  - Backup Media is LTO 4
  - Retention is Infinite off-site at MetroFile and is 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 is the day before the start of that weekend or public holiday.

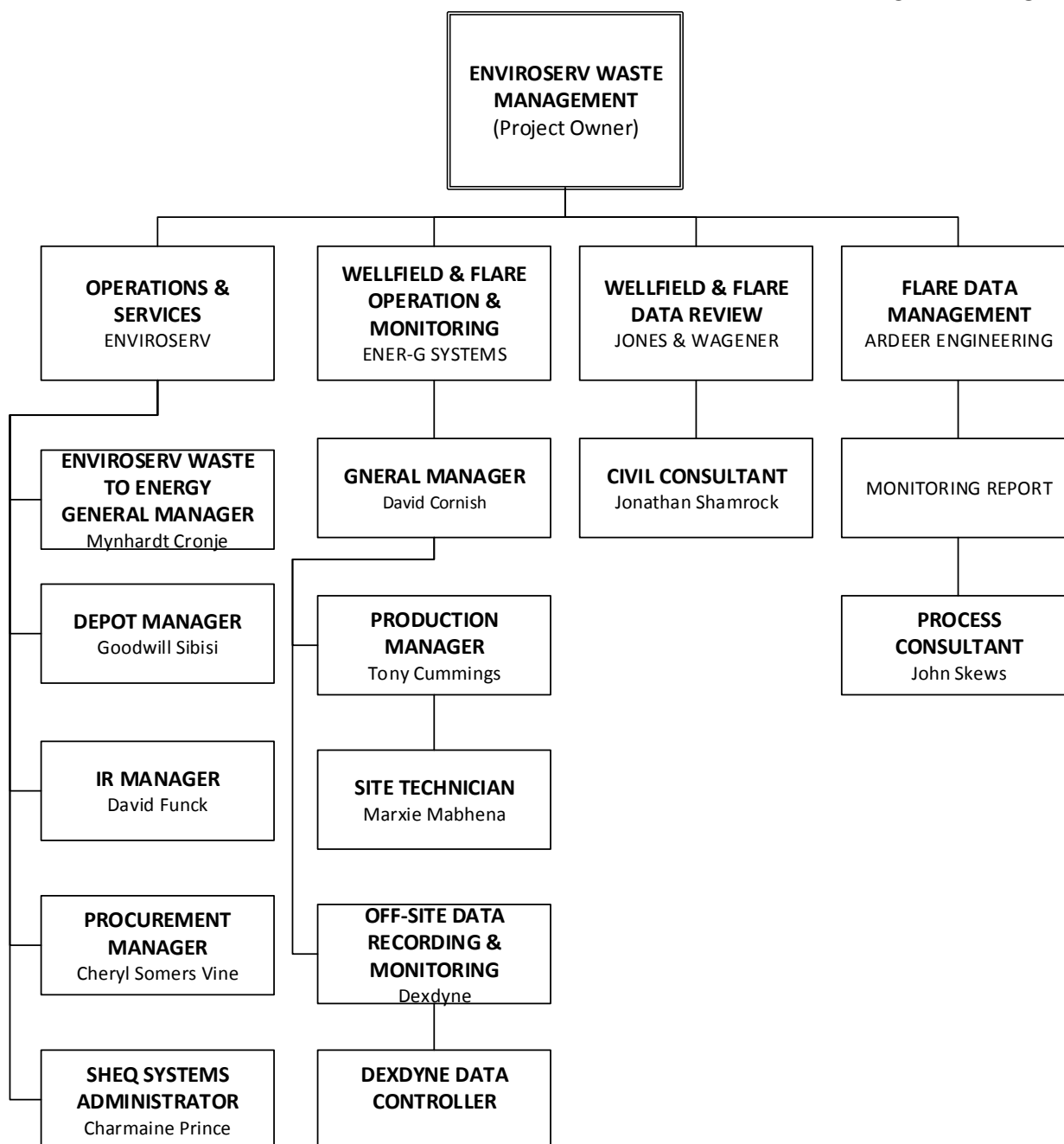
#### Emergency procedures for the monitoring system

The calculation carried out in the Dexdyne 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 Waste to Energy General Manager	<p>Overall responsibility for the landfill gas system.</p> <p>Overall responsibility for the Quality Management System for the landfill gas system.</p> <p>Reviews performance data on landfill gas system and submits comments to Ener-G</p> <p>Chairs monthly review meetings between EnviroServ and Ener-G on the operation of the landfill gas system</p> <p>Stores and archives data received from Ener-G on the EnviroServ</p>	<p>Provides and manages resources for operation of the landfill gas system</p>

Position	Responsibilities	Authorities
	Chloorkop CDM folder on the server.	
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 Dexdyne and comments if necessary. Advises Dexdyne of any comments on the workbook data. Approves monthly report	Controls the landfill gas system
Ener-G Site Technician	Day-to-day operation of the landfill gas system	Controls the landfill gas system
Dexdyne Data Controller	Reviews data from the flare system. Prepares monthly workbook and submits to Ener-G General Manager and Production Manager. Reviews comments from Ener-G and EnviroServ and makes changes as necessary.	Selects data that goes into the monthly workbook.
Jones & Wagener Civil Consultant	Reviews data on well field and flare performance. Submits comments to Ener-G General Manager & EnviroServ Waste to Energy General 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 the monitoring report (report required for verification of emission reductions by DOE). Submits the monitoring report to EnviroServ Waste to Energy	-

Position	Responsibilities	Authorities
	General Manager for approval and issue. Provides process and technical support to Ener-G and EnviroServ.	

## Regulatory Framework

The regulatory framework is monitored on an annual basis. In case upcoming regulations in South Africa mandate methane capture and destruction during the crediting period, the baseline scenario and emissions shall be adapted accordingly.

There were no changes to the regulatory framework during this monitoring period.

## 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:	tCO <sub>2</sub> e/Nm <sup>3</sup> CH <sub>4</sub>
Description:	Density of methane at 0 degree Celsius and 1.013 bar
Source of data:	Tool for flaring
Value(s) applied:	0.0007168
Purpose of data:	Baseline emission calculations
Additional comment:	

<b>Data / Parameter:</b>	<b>Lo</b>
Unit:	Nm <sup>3</sup> landfill gas / kg organic C
Description:	Theoretical landfill gas generation potential based on the biodegradable organic carbon content of specific waste fractions.
Source of data:	Van Zanten, B., and Scheepers, M., 1994, Modelling of Landfill Gas Potentials, Report prepared for International Energy Agency (IEA) Expert Working Group on Landfill Gas, published by Technical University of Lulea, Sweden.
Value(s) applied:	1.87
Purpose of data:	Used for the theoretical baseline emission calculations in the PDD
Additional comment:	

<b>Data / Parameter:</b>	<b>K</b>
Unit:	1 / year
Description:	Kinetic constant
Source of data:	Pipatti, R., and Vieira, S., 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste, EXCEL spreadsheet IPCC_Waste_Model_sb24.PDD for this project
Value(s) applied:	0.07 for "rapidly" biodegradable putrescible fraction of landfilled waste, or 0.04 for "slowly" biodegradable paper fraction of landfilled waste.
Purpose of data:	Used for the theoretical baseline emission calculations in the PDD
Additional comment:	

## D.2. Data and parameters monitored

Data / Parameter:	Q		
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
	17 990 478	15 113 005	33 103 483
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. There were no replacements of the flowmeters during this monitoring period.		
		Flare 1	Flare 2
	Instrument tag number	3092-FM-118	3449-FM-118
	Change in monitoring equipment	NA	NA
	Serial number	A309FA02000	99047702000
	Last calibration	26/07/2012	10/03/11
	Taken into service	22/11/2012	06/10/2011
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 by an external laboratory. The standard is for the “General requirements for the competence of testing and calibration laboratories”		
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 <sub>flared,y</sub> , as there was no electricity generation and no leachate evaporation in this monitoring period and hence Q = LFG <sub>flared,y</sub>		

<b>Data / Parameter:</b>	<b>LFG<sub>flared,y</sub></b>																		
Unit:	Nm <sup>3</sup>																		
Description:	Total amount of landfill gas flared																		
Measured/ Calculated / Default:	Measured value																		
Source of data:	Flowmeter																		
Value(s) of monitored parameter:	<table border="1"> <tr> <td>Flare 1</td><td>Flare 2</td><td>Total</td></tr> <tr> <td>17 990 478</td><td>15 113 005</td><td>33 103 483</td></tr> </table>	Flare 1	Flare 2	Total	17 990 478	15 113 005	33 103 483												
Flare 1	Flare 2	Total																	
17 990 478	15 113 005	33 103 483																	
Monitoring equipment:	<p>Thermal mass flowmeter. The typical accuracy of the thermal mass flowmeters is <math>\pm 1.5\%</math> of reading, <math>\pm 0.5\%</math> of full scale. Calibration frequency is 3 years. Validity of calibration is 3 years from time the flowmeter is taken into service after calibration. There were no replacements of the flowmeters during this monitoring period.</p> <table border="1"> <tr> <td></td><td>Flare 1</td><td>Flare 2</td></tr> <tr> <td>Instrument tag number</td><td>3092-FM-118</td><td>3449-FM-118</td></tr> <tr> <td>Change in monitoring equipment</td><td>NA</td><td>NA</td></tr> <tr> <td>Serial number</td><td>A309FA02000</td><td>99047702000</td></tr> <tr> <td>Last calibration</td><td>26/07/2012</td><td>10/03/11</td></tr> <tr> <td>Taken into service</td><td>22/11/2012</td><td>06/10/2011</td></tr> </table>		Flare 1	Flare 2	Instrument tag number	3092-FM-118	3449-FM-118	Change in monitoring equipment	NA	NA	Serial number	A309FA02000	99047702000	Last calibration	26/07/2012	10/03/11	Taken into service	22/11/2012	06/10/2011
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Instrument tag number	3092-FM-118	3449-FM-118																	
Change in monitoring equipment	NA	NA																	
Serial number	A309FA02000	99047702000																	
Last calibration	26/07/2012	10/03/11																	
Taken into service	22/11/2012	06/10/2011																	
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 by an external laboratory. The standard is for the "General requirements for the competence of testing and calibration laboratories"																		
Purpose of data:	Baseline emission calculation																		
Additional comment:	<p>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<sub>flared,y</sub>, as there was no electricity generation and no leachate evaporation in this monitoring period and hence <math>Q = \text{LFG}_{\text{flared,y}}</math></p>																		

<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 are installed for the evaporation of leachate using LFG. No LFG was used for leachate evaporation.

<b>Data / Parameter:</b>	<b>LFG<sub>electricity,y</sub></b>
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 are installed for electricity generation. No LFG was used for electricity generation.

Data / Parameter:	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
	48.9%	50.9%	49.9%

Monitoring equipment:	<p>Infrared continuous analyser</p> <p>The typical accuracy of the analyser is 2% full scale per month. Calibration frequency is at least once a week using a supply of span gas. The span gas has a methane concentration of 40%v/v.</p> <table border="1" data-bbox="528 342 1406 441"> <tr> <th></th><th>Flare 1</th><th>Flare 2</th></tr> <tr> <td>Instrument tag 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 was 1 instance for flare 1 where the calibration of the analyser using the span gas gave values greater than or equal to 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 date of the previous calibration to the date of the current calibration. This was to ensure a conservative approach to the calculation of the emission reductions.</p> <p>The date of calibration, the calibration check results and the period affected are given in the table below.</p> <table border="1" data-bbox="528 869 1406 1025"> <tr> <th>Flare</th><th>Date of calibration</th><th>Calibration check results %v/v</th><th>Period affected</th></tr> <tr> <td>1</td><td>14/03/2014</td><td>42.0</td><td>07/03/2014 to 14/03/2014</td></tr> </table> <p>There were no instances for flare 2 where the calibration using the span gas gave values greater than or equal to the stated accuracy of the instrument.</p> <p>The analyser card on flare 2 was replaced on 08/02/2013 because the card had failed.</p> <table border="1" data-bbox="528 1240 1406 1431"> <tr> <th></th><th colspan="2">Flare 2</th></tr> <tr> <td>Instrument tag number</td><td colspan="2">3449-E-172</td></tr> <tr> <td>Change in monitoring equipment</td><td>Up to 08/02/2013</td><td>After 08/02/2013</td></tr> <tr> <td>Serial number</td><td>29564</td><td>31393</td></tr> </table> <p>The analyser card on flare 2 was replaced on 11/06/2014 because the card was giving erroneous readings</p> <table border="1" data-bbox="528 1523 1406 1713"> <tr> <th></th><th colspan="2">Flare 2</th></tr> <tr> <td>Instrument tag number</td><td colspan="2">3449-E-172</td></tr> <tr> <td>Change in monitoring equipment</td><td>Up to 11/06/2014</td><td>After 11/06/2014</td></tr> <tr> <td>Serial number</td><td>31393</td><td>31761</td></tr> </table>		Flare 1	Flare 2	Instrument tag 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	14/03/2014	42.0	07/03/2014 to 14/03/2014		Flare 2		Instrument tag number	3449-E-172		Change in monitoring equipment	Up to 08/02/2013	After 08/02/2013	Serial number	29564	31393		Flare 2		Instrument tag number	3449-E-172		Change in monitoring equipment	Up to 11/06/2014	After 11/06/2014	Serial number	31393	31761
	Flare 1	Flare 2																																								
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Instrument tag number	3449-E-172																																									
Change in monitoring equipment	Up to 11/06/2014	After 11/06/2014																																								
Serial number	31393	31761																																								
Measuring/ Reading/ Recording frequency:	Measured by continuous gas quality analyser.																																									
Calculation method (if applicable):	NA																																									
QA/QC procedures:	The gas analyser is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards by an external laboratory. The standard is for the "General requirements for the competence of testing and calibration laboratories".																																									

Purpose of data:	Baseline emission calculations
Additional comment:	

<b>Data / Parameter:</b>	<b>FE</b>
Unit:	%
Description:	Flare efficiency (combustion efficiency)
Measured/ Calculated / Default:	Default value
Source of data:	Revised and approved monitoring plan
Value(s) of monitored parameter:	90%
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	Not measured
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Baseline emission calculations
Additional comment:	No flare testing was done in this monitoring period. The value of 90% is used for the calculation of the emission reductions as this is the default value in the case where no flare efficiency testing is done.

Data / Parameter:	Flare hours		
Unit:	hours		
Description:	Flare working hours		
Measured/ Calculated / Default:	Measured value		
Source of data:	Control system clock		
Value(s) of monitored parameter:	Flare 1	Flare 2	Total
	13 677	13 121	26 798
Monitoring equipment:	Control system clock		
Measuring/ Reading/ Recording frequency:	Data is monitored continuously		
Calculation method (if applicable):	NA		
QA/QC procedures:	The clock is calibrated on a regular basis to ensure accuracy		
Purpose of data:	Baseline emission calculations		
Additional comment:	The flare working hours are calculated from the control system clock, only taking into account those periods when the flare is operating within the manufacturer's limits. (The concentration of methane in the gas is greater than 25% v/v; the combustion temperature in the flare is greater than 700 °C and the flow of gas to the flare is greater than 200 Nm3/h). (See also point 2 in section E.1. below)		



<b>Data / Parameter:</b>	<b>Flare temperature</b>												
Unit:	°C												
Description:	Temperature of the flare												
Measured/ Calculated / Default:	Measured value												
Source of data:	Thermocouple												
Value(s) of monitored parameter:	<table border="1"> <tr> <td>Flare 1</td><td>Flare 2</td><td>Weighted Average</td></tr> <tr> <td>991</td><td>953</td><td>973</td></tr> </table>	Flare 1	Flare 2	Weighted Average	991	953	973						
Flare 1	Flare 2	Weighted Average											
991	953	973											
Monitoring equipment:	<p>The thermocouple on flare 1 was replaced on 15/06/2014 as it had failed.</p> <table border="1"> <tr> <td></td><td colspan="2">Flare 1</td></tr> <tr> <td>Instrument tag number</td><td colspan="2">3092-E-151 (T<sub>Combust</sub>)</td></tr> <tr> <td></td><td>Up to 15/06/2014</td><td>After 15/06/2014</td></tr> <tr> <td>Serial number</td><td>NA</td><td>NA</td></tr> </table> <p>Type: N type thermocouple  The typical accuracy of this type of thermocouple is <math>\pm 5</math> °C.  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.</p>		Flare 1		Instrument tag number	3092-E-151 (T <sub>Combust</sub> )			Up to 15/06/2014	After 15/06/2014	Serial number	NA	NA
	Flare 1												
Instrument tag number	3092-E-151 (T <sub>Combust</sub> )												
	Up to 15/06/2014	After 15/06/2014											
Serial number	NA	NA											
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Date 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:	The measured values were not used in the emission reduction calculations. The temperature is measured every 30 minutes and emission reductions are not claimed when the temperature is below a threshold value of 700 °C.												

<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 are installed for electricity generation. No LFG was used for electricity generation.

<b>Data / Parameter:</b>	<b>EL<sub>IMP</sub></b>
Unit:	kWh
Description:	Electricity consumed by the project (blowers)
Measured/ Calculated / Default:	Measured and calculated value
Source of data:	kWh meter
Value(s) of monitored parameter:	731 790 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:	NA
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

&gt;&gt;

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

&gt;&gt;

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

$$BE_y = MD_{projecty} * GWP_{CH_4}$$

Symbol	Description	Units
$BE_y$	Emission reductions in the year	tCO <sub>2</sub> e
$MD_{projecty}$	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 ( $MD_{projecty}$ ) 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

$$MD_{project,y} = CH_{4flared,y}$$

where:

$$CH_{4flared,y} = LFG_{flared,y} * W_{CH_4} * D_{CH_4} * FE$$

Symbol	Description	Units
$CH_{4flared,y}$	Amount of methane destroyed by the flare in the year	t CH <sub>4</sub>
$LFG_{flared,y}$	Amount of landfill gas flared in the year	Nm <sup>3</sup>
$W_{CH_4}$	Methane fraction in the landfill gas	%
$D_{CH_4}$	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. ( $LFG_{flared,y}$ ).
  - 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. (TCombust)
  - 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. ( $W_{CH_4}$ )
  - 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 ( $MD_{flare,y}$ ) is then calculated by multiplying the quantity of landfill gas from step 7 by the methane concentration ( $W_{CH_4}$ ), the density of methane ( $D_{CH_4} = 0.0007168$ ) 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. ( $GW_{PCH_4} = 21 \text{ tCO}_2\text{e/tCH}_4$ )
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 landfill gas quantity, the average flare temperature, the average methane concentration and downtime hours are copied from the monthly emission reduction workbooks for each of the two flares into the summary emission reduction workbook. Values for any analyser calibration adjustment and flare efficiency values are then added. The summary emission reduction workbook 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. It is the values from this summary emission reduction workbook that are reported on in the monitoring report.

For the summary emission reduction workbook see the file:

Chloorkop Workbook Summary Jan2013 – Jul2014 Rev0 Update 3Sep2014.xlsx

## 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)
Total	223 612	0	0	223 612

**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
Emission reductions or GHG removals by sinks (t CO <sub>2</sub> e)	478 848	223 612

The value for 2013 in the PDD was 303 437 but there is no data beyond 2013. In the light of this it was assumed that the value for 2014 was the same as 2013. The number of days for the period 01/01/14 to 31/07/2014 was 275 and therefore the emission reductions for the period 01/01/2013 to 31/07/2014 was  $303\,437 \times (1 + 211/365) = 478\,848$

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

>>

The actual emission reductions achieved were 53% less than those estimated ex-ante. The reasons were are follows:

- Downtime. This accounted for 3% 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. Also, the actual fraction of the total waste that was domestic waste was believed to be less than that assumed in the model. These factors would have reduced the quantity of landfill gas generated in this monitoring period compared to that estimated in the PDD.

**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
Emission reductions or GHG removals by sinks (t CO <sub>2</sub> e)	NA	223 612

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## Appendix 1. Contact information of project participants and responsible persons/ entities

<b>Project participant and/or responsible person/ entity</b>	<input type="checkbox"/> Project participant
<b>Organization name</b>	EnviroServ Waste Management (Pty) Ltd
<b>Street/P.O. Box</b>	P.O. Box 232
<b>Building</b>	
<b>City</b>	Bedfordview
<b>State/Region</b>	Gauteng
<b>Postcode</b>	
<b>Country</b>	South Africa
<b>Telephone</b>	+27 11 061 5104
<b>Fax</b>	+27 86 530 1180
<b>E-mail</b>	mynhardtc@enviroserv.co.za
<b>Website</b>	<a href="http://www.enviroserv.co.za">www.enviroserv.co.za</a>
<b>Contact person</b>	
<b>Title</b>	General Manager
<b>Salutation</b>	Mr
<b>Last name</b>	Cronje
<b>Middle name</b>	
<b>First name</b>	Mynhardt
<b>Department</b>	Waste to Energy
<b>Mobile</b>	+27 82 447 2321
<b>Direct fax</b>	
<b>Direct tel.</b>	+27 11 061 5104
<b>Personal e-mail</b>	

<b>Project participant and/or responsible person/ entity</b>	<input type="checkbox"/> Responsible person/ entity for completing the CDM-MR-FORM
<b>Organization name</b>	Ardeer Engineering (Pty) Ltd
<b>Street/P.O. Box</b>	P.O.Box 14
<b>Building</b>	
<b>City</b>	Modderfontein
<b>State/Region</b>	Gauteng
<b>Postcode</b>	1645
<b>Country</b>	South Africa
<b>Telephone</b>	+27 11 997 7942
<b>Fax</b>	+27 11 608 3314
<b>E-mail</b>	<a href="mailto:skewsj@ardeer.co.za">skewsj@ardeer.co.za</a>
<b>Website</b>	<a href="http://www.ardeer.co.za">www.ardeer.co.za</a>
<b>Contact person</b>	
<b>Title</b>	Process Engineer
<b>Salutation</b>	Mr
<b>Last name</b>	Skews

<b>Middle name</b>	
<b>First name</b>	John
<b>Department</b>	
<b>Mobile</b>	+27 83 408 2688
<b>Direct fax</b>	+27 11 608 3314
<b>Direct tel.</b>	+27 11 997 7942
<b>Personal e-mail</b>	<a href="mailto:skewsj@ardeer.co.za">skewsj@ardeer.co.za</a>

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### Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;</li> <li>• Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
03.2	5 November 2013	Editorial revision to correct table in page 1.
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.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		