MONITORING REPORT FORM (CDM-MR)
Version 01 - in effect as of: 28/09/2010

CONTENTS

MONITORING REPORT
Version number 03, 10/10/2011

EnviroServ Chloorkop Landfill Gas Recovery Project
CDM Ref. no. 0925
Monitoring period no. 3: 01/01/2010 – 31/12/2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity

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1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions;

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_2. Through the destruction of methane, the emissions of greenhouse gas are reduced.

2. Brief description of the installed technology and equipments;

The project involved the installation of vertical wells and horizontal collectors in the waste body for the extraction of the landfill gas. The wells and collectors were connected to headers, which in turn were used to feed two flare installations. Each flare installation consisted of a blower to create the vacuum in the well field, and a flare.

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).

Construction of the wellfield was done in a phased manner. The first vertical wells were installed in 2005 as a pilot trial. These were followed by additional vertical wells 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. Additional vertical wells were installed in 2008 and 2009 and horizontal collectors from 2008 onwards. The second flare was commissioned in December 2008 and started operation in January 2009.

4. Total emission reductions achieved in this monitoring period.

The total emission reductions achieved in this the second monitoring period were 161,663 tCO_2e

A.2. Project Participants

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Name of Party involved	Private and/or public entity(ies) project participants
South Africa (host)	EnviroServ (Pty) Ltd – Private
Japan	Japan Carbon Finance Ltd – Private

A.3. Location of the 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.4. Technical description of the project

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Description of the technology applied in the project activity and detailed technical process, including diagrams.

Landfill site

The EnviroServ Chloorkop 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, five cells have been constructed and the construction of the sixth cell is in progress.

Landfill Gas Collection System

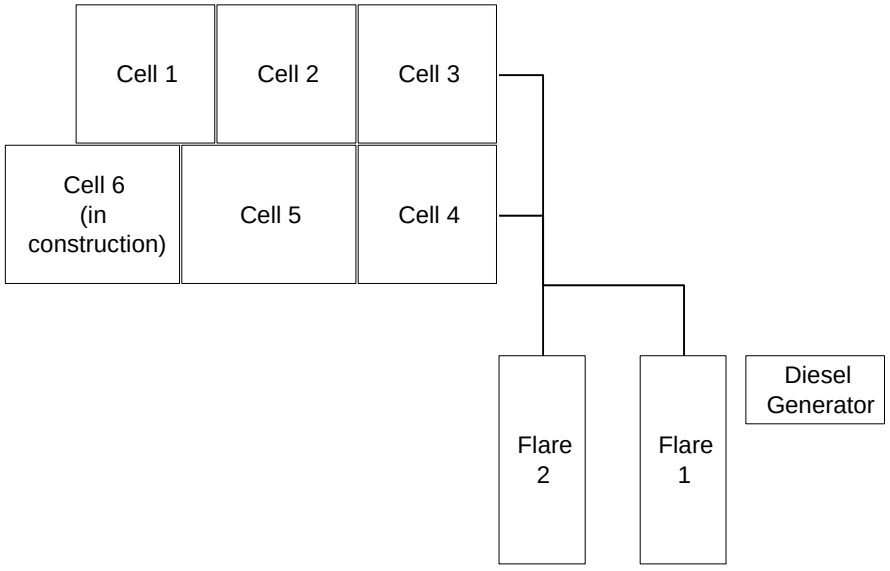
Vertical wells were installed in cells 1 to 3 by augering into the existing waste body once the cell reached final grade. Horizontal collectors were installed in cells 4 and 5 and involved the excavation of trenches into the waste at intermediate intervals before a cell reached final grade. In both cases, 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 of 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.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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

A.6. Registration date of the project activity:

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The project was registered with the UNFCCC on 27/04/2007

A.7. Crediting period of the project activity and related information (start date and choice 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.

A.8. Name of responsible person(s)/entity(ies):

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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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1. Starting date of operation and phased implementation.

The EnviroServ Chloorkop Landfill Site consisted of five waste disposal cells with a sixth cell in construction. 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 9 additional horizontal collectors being installed in cell 5 from 2008. The second flare was commissioned 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 76% of its design capacity and flare 2 at about 66% of its design capacity. The throughput of the flares was dictated by the amount of landfill gas available from the wellfield.

Events that caused downtime of the flares and the total hours of downtime for both flares were the following:

Month	Significant Events	Downtime (hours)
January 2010	Power failures, scheduled maintenance.	14
February 2010	Control system problems, power failures, manual valve replacement.	30
March 2010	Power cable failure.	2
April 2010	Power failures, scheduled maintenance, high level in knock-out pot.	15
May 2010	Gas analyser problems. Installation of common metering manifold. Gas flowmeter erroneous readings.	164
June 2010	Thermocouple failures. High level in knock-out pot. Flowmeter signal error.	45
July 2010	Thermocouple failure, high temperature. High level in knock-out pot. Maintenance.	72
August 2010	High level in knock-out port. Power failures. Thermocouple failures. Blower maintenance.	152
September 2010	Power failures. Faulty thermocouple readings.	111
October 2010	Power failures. Knock-out pot repairs. Scheduled maintenance. Faulty thermocouple readings.	51
November 2010	Power failures, thermocouple failures. Repairs to gas main. Air compressor maintenance.	261
December 2010	Power failures. Moisture in gas sample line. High level in knock-out pot.	22

There were no significant exchanges of equipment during this monitoring equipment.

3. Events affecting the applicability of the methodology

There were no events or situations that occurred during this monitoring period that impacted on the applicability of the methodology.

B.2. Revision of the monitoring plan

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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 $LFG_{app\ i,y}$, 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/m3 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.

B.3. Request for deviation applied to this monitoring period

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No deviations were requested or applied during the monitoring period.

B.4. Notification or request of approval of changes

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No notifications or requests for approval of changes from the project activity were received or made during the monitoring period.

SECTION C. Description of the 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).

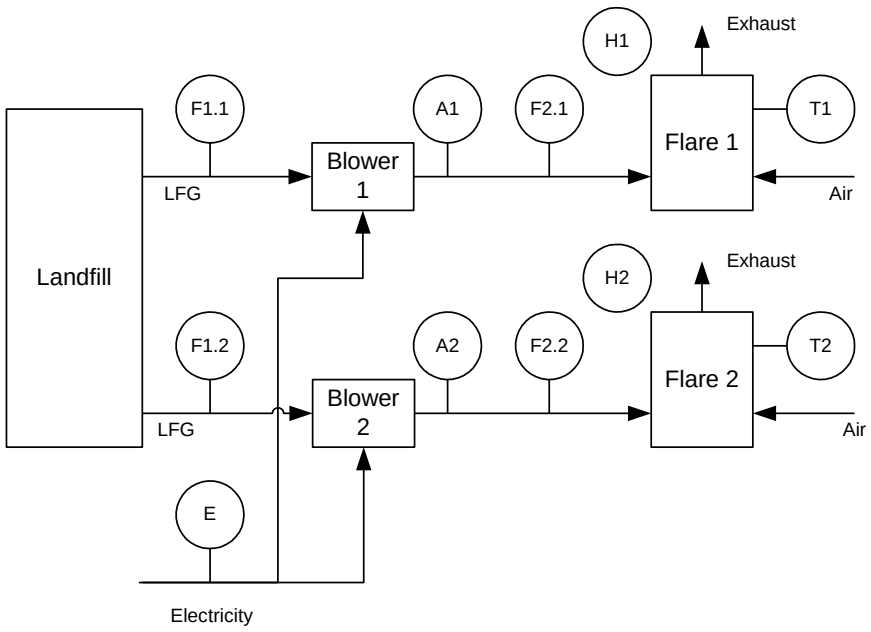
Primary data is defined as the data representing the main variables for the calculation of the emission reductions. This data is captured from the various sensors by a data acquisition system and is then sent from the site through a telemetry system to a website managed by Netrix, which then provides 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 then 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 daily values from the monthly reports of the two flares are then copied into the annual workbook, which calculates the overall emission reductions for the year.

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



	Parameter	Description	Instrument tag number
F1.1	Q	Total amount of landfill gas collected to flare 1	3092-FM-176
F1.2		Total amount of landfill gas collected to flare 2	3449-FM-176
F2.1	$LFG_{flared,y}$	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_{CH4}	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_{IMP}	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 control system in an electronic format, which cannot be tampered with. Once the information is sent via a GPRS SIM card to the Biogas website, it is held securely. Access to the gathered data is only possible via a username and password.

With regards to the workbooks, Biogas does not password protect workbooks for any of its sites as the workbooks are in Microsoft Excel format, and passwords in Excel can 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 the IT Department.
- 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.

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 that 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
    - Retension is 5 weeks off-site at MetroFile
    - The backup schedule is Monday to Friday unless the daily backup falls within a monthly or yearly schedule
- Monthly 5:00pm in the afternoons
    - Backup Media is LTO4
    - Retension is 1 Year off-site at MetroFile.

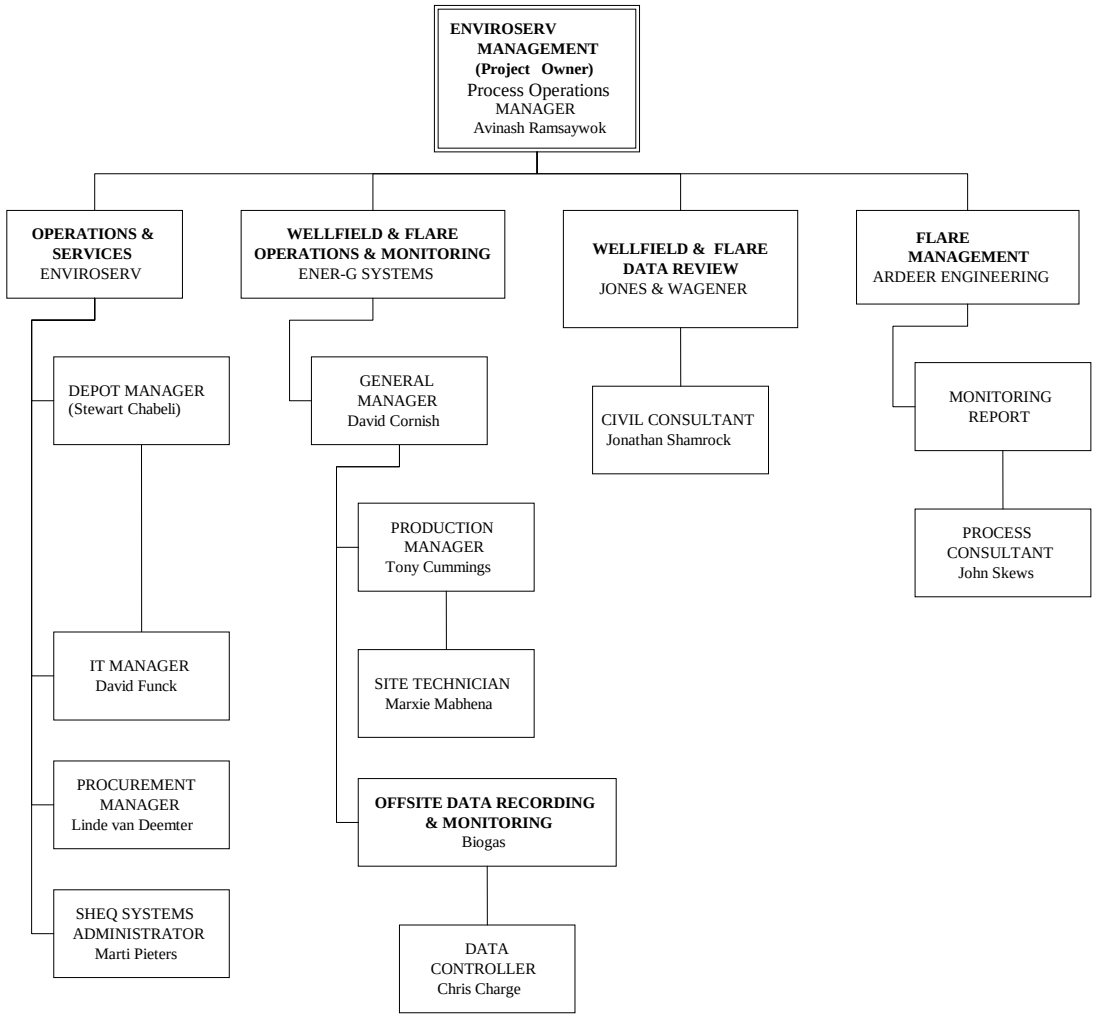
        - The backup schedule is the last day of the month unless this day falls on a weekend or public holiday in which case it will be the day before the start of that weekend or public holiday. Monthly schedule do not apply if it falls within a yearly backup schedule.
- Yearly 5:00pm in the afternoons
    - Backup Media is LTO 4
    - Retension is infinate off-site at MetroFile and the backups are only recalled on request.
    - The 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 the those in the various positions is 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 Chloorkop CDM folder on the server. Compiles monthly report and submits to the JCF.	Provides and manages resources for operation of the landfill gas system

Position	Responsibilities	Authorities
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 a 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	Recommends changes to operation of landfill gas system to Ener-G and EnviroServ. .

Position	Responsibilities	Authorities
	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.	-

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of methane
Source of data used:	PDD for the project
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Additional comment:	

Data / Parameter:	**D_{CH4}**
Data unit:	tCH_4/Nm^3CH_4
Description:	Denisty of methane at 0 degree Celsium and 1,013 bar
Source of data used:	Methodology AM0011 ver. 2
Value(s) :	0.0007168
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	**Q**
Data unit:	Nm^3
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: 12,586,073 | Flare 2: 11,056,335 | Total: 23,642,408
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: 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. Equipment number: Flare 1 3092-FM-118, Flare 2 3449-FM-118 Serial number: Flare 1 99047602000, Flare 2 A309F902000 Last calibration: Flare 1 24/10/2008, Flare 2 1/4/2008
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	The flowmeters are calibrated according to the ISO/IEC 17025:2005 standards.
Comments:	The flowmeters used are thermal mass flowmeters. The flowmeters express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of the LFG is necessary.

Data / Parameter:	**$LFG_{flared,y}$**
Data 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: 12,586,073 | Flare 2: 11,056,335 | Total: 23,642,408
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: 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. Equipment number: Flare 1 3092-FM-118, Flare 2 3449-FM-118 Serial number: Flare 1 99047602000, Flare 2 A309F902000 Last calibration: Flare 1 24/10/2008, Flare 2 1/4/2008
Measuring/ Reading/ Recording frequency:	Data is measured continuously. Data to be aggregated monthly and yearly,
Calculation method (if applicable):	Correction factor applied for methane concentration

QA/QC procedures to be applied:	The flowmeter is calibrated according to the ISO/IEC 17025:2005 standards.
Comments:	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 LFG is necessary. The values used in the emission calculations are the 30-minute quantities given in the Biogas workbooks.

Data / Parameter:	**$LFG_{leachate,y}$**
Data unit:	Nm^3
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
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	NA
Comments:	No facilities are installed for the evaporation of leachate using LFG. No LFG was used for leachate evaporation.

Data / Parameter:	**$LFG_{electricity,\ y}$**
Data unit:	Nm^3
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
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA

Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	NA
Comments:	No facilities are installed for the generation of electricity from LFG. No LFG was used for electricity generation.

Data / Parameter:	**W_{CH4}**
Data 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: 50.5; Flare 2: 50.2%; Weighted average: 50.4%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Infrared continuous analyser The typical accuracy of the analyzer is 2% full scale per month. Calibration frequency is once per month using a supply of span gas. Equipment number: Flare 1 3092-E-172, Flare 2 3449-E-172 Serial number: Flare 1 I-02177, Flare 2 I-04311
Measuring/ Reading/ Recording frequency:	Measured by continuous gas quality analyser.
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	The gas analyzer is calibrated using a span gas that has been calibrated according to ISO/IEC 17025 standards.
Comments:	The values used for the emission reduction calculations are the 30-minute values given in the Biogas workbooks.

Data / Parameter:	**FE**
Data unit:	%
Description:	Flare efficiency (combustion efficiency)
Measured /Calculated /Default:	Default
Source of data:	NA
Value(s) of monitored parameter:	90%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Monitoring equipment (type, accuracy class,	NA

serial number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Not measured.
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	NA
Comments:	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 given in the PDD in the case where no flare efficiency testing is done.

Data / Parameter:	**Flare hours**		
Data unit:	Hours		
Description:	Flare working hours		
Measured /Calculated /Default:	Calculated. The flare working hours are calculated by the Biogas workbook for the periods when the flares were operating within the manufacturer's limits.		
Source of data:	Control system clock		
Value(s) of monitored parameter:	Flare 1	Flare 2	Total
	8,248	8,337	16,585
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA		
Measuring/ Reading/ Recording frequency:	Data is monitored continuously		
Calculation method (if applicable):	NA		
QA/QC procedures to be applied:	NA		
Comments:	The flare working hours are calculated by the Biogas workbook for the periods when the flare is operating within the manufacturer's limits.		

Data / Parameter:	**Flare temperature**		
Data 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
	990	956	973
Indicate what the data are used for (Baseline/	NA. See comment below.		

Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: K 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 to be applied:	See monitoring equipment above.
Comments:	The combustion temperature is measured by this thermocouple. A second thermocouple higher up in the flare exhaust stack is used as a check on the combustion temperature. 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.

Data / Parameter:	**EL**
Data unit:	kWh
Description:	Electricity generated
Measured /Calculated /Default:	Measured value
Source of data:	NA
Value(s) of monitored parameter:	NA
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	NA
Comments:	No facilities installed for the generation of electricity. No electricity was generated during this monitoring period.

Data / Parameter:	**EL_{IMP}**
Data 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:	540,593
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	NA. See comment below.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	kWh meter.
Measuring/ Reading/ Recording frequency:	Data is monitored continuously. Data is aggregated monthly and yearly.
Calculation method (if applicable):	NA
QA/QC procedures to be applied:	
Comments:	Not required in terms of AM0011 and AM_CLA_0028. It is however monitored to assess the significance of emissions.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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

$BE_y = MDproject_y * GWP_{CH4}$

Symbol	Description	Units
BE_y	Emission reductions in the year	tCO_2e
$MDproject_y$	Amount of methane destroyed in the year	tCH_4
GWP_{CH4}	Global Warming Potential value for methane	tCO_2e / tCH_4

The methane destroyed by the project activity ($MDproject_y$) 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

$MDproject_y = CH_4flared_{,y}$

where:

$CH_4flared_{,y} = LFG_{flared,y} * W_{CH4} * D_{CH4} * FE$

Symbol	Description	Units
$CH_4flared_{,y}$	Amount of methane destroyed by the flare in the year	t CH_4
$LFG_{flared,y}$	Amount of landfill gas flared in the year	Nm^3
W_{CH4}	Methane fraction in the landfill gas	%
D_{CH4}	Density methane at normal conditions	tCH_4 / Nm^3CH_4
FE	Flare efficiency (combustion efficiency)	%

The emission reductions achieved per month during the monitoring period were as follows:

	Emission Reductions tCO2e		
Month	Flare 1	Flare 2	Total
Jan-10	7,289	8,888	16,177
Feb-10	6,519	7,791	14,310
Mar-10	7,646	8,481	16,127
Apr-10	6,982	7,499	14,480
May-10	5,820	7,298	13,118
Jun-10	6,624	7,072	13,697
Jul-10	8,052	5,969	14,021
Aug-10	6,368	4,927	11,295
Sep-10	6,853	4,936	11,789
Oct-10	7,899	4,625	12,523
Nov-10	7,962	2,836	10,798
Dec-10	8,174	5,153	13,327
TOTAL	**86,187**	**75,475**	**161,663**

The calculations of emission reductions are given in the monthly Biogas workbooks for each flare and are summarised in the steps below:

1. The following raw data, recorded every 30 minutes, is incorporated into the workbook:
   - The flow of landfill gas in Nm^3/h as measured by flowmeter tag 3092/3449-FM-118 ($LFG_{flared,y}$).
   - The combustion temperature (°C) in the flare as measured by thermocouple tag 3092/3449-E-151 ($T_{Combust}$)
   - The concentration (% v/v) of the methane in the landfill gas going to the flare as measured by the on-line analyser tag 3092/3449-E-172 (W_{CH4})
   - 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^3/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 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^3) 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 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_{CH4}), the density of methane ($D_{CH4} = 0.0007168$) 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. ($GWP_{CH4} = 21\ tCO_2e/tCH_4$)
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 workbook giving the average landfill gas flowrate, average methane concentration, downtime and average emission reductions for each day of the month. 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, average CH_4 concentration, downtime hours and calculated emission reductions are copied from monthly workbooks for each of the two flares into the annual emission reduction workbook. This workbook then calculates the total average monthly landfill gas flowrates, average CH_4 concentrations, total downtime and total emission reductions for both flares. This annual workbook also reports the total electricity used by flares and reports it as tCO_2e and as a percentage of the emission reductions.

For a summary of the calculations please see the annual workbook, file:
Chloorkop Workbook Summary 2010 Rev1 10Oct11.xls

E.2. Project emissions calculation

>>
No project emissions are considered for this activity.

$PE_y = 0$

E.3. Leakage calculation

>>
The methodology assumes no leakages from the project activity.

$L_y = 0$

E.4. Emission reductions calculation / table

>>
The emission reductions are calculated as given in the following formula:

$ER_y = BE_y – PE_y - L_y$

	Symbol	Units	Amount
Total baseline emissions	BE_y	tCO_2e	161,663
Total project emissions	PE_y	tCO_2e	0
Total leakage emissions	L_y	tCO_2e	0
Total emission reductions	**ER_y**	**tCO_2e**	**161,663**

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**187,615**	**161,663**

E.6. Remarks on difference from estimated value in the PDD

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The actual emission reductions achieved were 14% less than those estimated ex-ante. The reasons were as follows:

- Downtime. This accounted for 5% 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.