CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

González Catán and Ensenada Landfill Gas Project.

Document version number: 1.

30 September 2005.

A.2. Description of the project activity:

The project will be developed by Conestoga-Rovers & Associates Capital Limited at both González Catán and Ensenada landfills (Sites). The González Catán and Ensenada landfills received non-hazardous solid municipal, industrial, commercial, institutional and some agricultural wastes for over 20 years. The landfills normally emit carbon dioxide (CO_2) and methane (CH_4) into the atmosphere, with these compounds being generated by the anaerobic decomposition of the above-noted wastes placed at the Sites.

The project will involve construction of landfill gas collection systems consisting of a grid of horizontal trenches and vertical gas extraction wells, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to collect the LFG.

To combust the LFG collected from the Sites, enclosed LFG flares with full process controls and instrumentation will also be constructed and operated. This will be state-of-the-art flare technology capable of providing sufficient temperature and retention time of the extracted landfill gas for complete destruction of hydrocarbons. Specifically, the retention time of the landfill gas within the enclosed flares will be 0.5 seconds at a temperature of 875^{o}C.

Purpose of the Project Activity:

The purpose of the proposed project is to collect landfill gas at both González Catán and Ensenada landfill sites and combust the extracted LFG over a ten-year period utilizing high-efficiency enclosed flares, thereby reducing greenhouse gas emissions (GHGs) and generating approximately 7,698,095 Certified Emission Reductions (CERs). The González Catán landfill will generate 5,117,995 CERs and the Ensenada landfill will generate 2,580,100 CERs.

Contribution of the Project Activity to Sustainable Development:

The project will make a strong contribution to sustainable development in Argentina. Over and above reducing emissions of GHGs, there are other benefits related to sustainable development as follows:

a) **Contribution to human health and the environment:**

With the flaring of landfill gas, the population living around the landfills will have an environment that is cleaner and healthier, with improved air quality and reduced risk due to landfill gas subsurface migration.

Further, potential for fires resulting from uncontrolled landfill gas will be minimized, as will potential for groundwater contamination.

b) Contribution to the improvement of working conditions and employment creation:

Starting with the construction phase, local manpower will be used during the implementation of the project. Local employment will be directly created during the construction phase of the project, which entails installation of vertical wells and assembly and operation of equipment such as blowers and flares. All these jobs will be created fully obeying the current Argentinean employment legislation. During the operational phase, which will take place 24 hours/day, 7 days/week, there will be new jobs created locally for duties related to operations and maintenance, landscaping, plumbing, monitoring and security personnel. These people will be fully trained on their new duties and tasks.

c) Contribution to income generation:

As one of the early projects in Argentina, the flaring of landfill gas at the González Catán and Ensenada landfills will generate royalty revenue for local governmental entities throughout the ten-year crediting period of the project.

d) Contribution to technological capacity building:

Conestoga-Rovers & Associated Capital Limited will make available on a Web site all information pertaining to the project activity and it is also ready to answer any questions regarding the project to whoever might be interested (municipalities, universities, and the general public) through the e-mail address BuenosAires@CRAworld.com.

e) Contribution to regional integration and cooperation with other sectors:

The González Catán and Ensenada landfill gas project activity will serve as a reference for other municipalities that are willing to implement similar projects at their landfill sites. Other sectors of the economy will be stimulated by the innovative nature of the project and the prospect of investing royalty monies to bring about social and environmental benefits.

A.3. Project participants:

A list of the involved parties is indicated below.

Name of Party Involved (host indicates a host party)	Private and/or public entity(ies) project participants	The party involved wishes to be considered as project participant (Yes/No)*
Argentina (Host Country)	Coordinación Ecológica Área Metropolitana Sociedad del Estado – CEAMSE, Buenos Aires	No
Canada	Conestoga-Rovers & Associates Capital Limited (Project Sponsor)	No

* indicates project participant status of the party listed in first column of table.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The project activities will take place at González Catán and Ensenada landfill sites in the province of Buenos Aires, Argentina.

A.4.1.1. Host Party(ies):

The host country is Argentina.

A.4.1.2. Region/State/Province etc.:

Both Sites are located within the Province of Buenos Aires.

A.4.1.3. City/Town/Community etc:

González Catán landfill: The Site is located within the County of González Catán, Municipality of Matanza.

Ensenada landfill: The Site is located within the Municipality of Ensenada.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

González Catán Landfill:

The González Catán landfill site is located in the outskirts of the Town of González Catán, in the Municipality of Matanza, Province of Buenos Aires; specifically the Site is located at the intersection of Domingo Scarlatti and Manuel Gallardo streets.

The González Catán landfill site has been in operation since 1981 and currently receives approximately 2,500 tonnes per day of MSW from the neighboring municipalities. The Site is composed of four modules in total. Modules I, II, III, are currently closed, with Module IV currently in operation and receiving wastes. The overall Site footage is approximately 100 hectares. The Site is equipped with a leachate treatment plant and a leachate collection system. The current tonnage of waste disposed at the Site is approximately 11 million tonnes.

Ensenada Landfill:

The Ensenada landfill site is located in the outskirts of the City of Ensenada, in the Province of Buenos Aires; specifically the Site is located at the intersection of Diagonal 74 Road and Arroyo El Gato.

The Ensenada landfill site has been in operation since 1982 and currently receives approximately 1,300 tonnes per day of MSW from the neighboring municipalities. The Site is composed of six modules in total. Modules A2, A3, B2 and C are currently closed, with Modules A1 and B1 currently in operation and receiving wastes. The current overall Site footage is approximately 70 hectares. The Site is equipped with a leachate treatment plant and a leachate collection system. The current tonnage of waste disposed at the Site is over 4 million tonnes.

A.4.2. Category(ies) of project activity:

The project activity will be a landfill gas emission reduction project under sectoral scope 13: waste handling and disposal.

A.4.3. Technology to be employed by the project activity:

The technology used to gather the LFG is a grid of trenches and wells within the landfills, connected to centralized blower systems used to induce vacuum. Upon gathering the LFG, the methane component of the LFG is combusted in state-of-the-art, high-efficiency enclosed flares. The Global Warming Potential (GWP) of the LFG will thus be reduced by the destruction of the methane portion of the LFG.

At each landfill, vertical gas extraction wells will be established in the waste material and will be connected to the blower system through a network of underground piping installed on and around the perimeter of the landfill. The extraction wells will be connected to the subheader or directly to the header through smaller diameter laterals. As the blowers are operated, a vacuum is applied through the piping network, which in turn applies a vacuum to each well and extracts LFG out of the waste. The flow of gas can be controlled at each of the individual vertical extraction wells through the use of a valve located at the top of the well piping. Each well will be individually controlled to ensure that the collection systems can be effectively set up and balanced. The systems will be manually monitored and controlled and each wellhead will be equipped with a secure monitoring chamber and monitoring ports for gas composition, pressure, and temperature readings.

Horizontal collection trenches will be installed by excavating into the refuse at each Site. Horizontal collection trenching will be installed in an excavated trench lined with clear stone. Collection pipe within the trench will be perforated so that a vacuum can be applied and LFG drawn from the waste. Horizontal collection trenches operate in a similar manner to vertical wells, with the main difference that the zone of influence for trenches is typically oval in shape in the vertical plane due to the higher horizontal permeability of the refuse compared to the vertical permeability. For horizontal collection trenches, the complete length of the trench will be monitored and adjusted at a single location at the connection point along a sub-header piping section. Individual trenches will be manually monitored and controlled to help with set-up and balancing of the LFG collection field. Controls for each trench will be located in a valve chamber installed in line with the trench which will include a secure monitoring chamber and monitoring ports for gas composition, pressure, and temperature readings.

Non-perforated LFG collection piping will be utilized to convey the LFG from the extraction wells and horizontal collection trenches to the gas control plant at each Site. The LFG collection piping consists of a perimeter header, sub-headers, and laterals. Header piping conveys the LFG collected from sub-header and horizontal collection trenching to the gas control plant. Sub-header piping conveys LFG from lateral piping to header piping, and lateral piping conveys LFG collected primarily at vertical extraction wells to sub-header piping.

At the gas control plant of each Site, the blower system will be equipped at all times to allow for regular down time for maintenance and to provide backup in the event of a component failure. The blower system will exert vacuum through the piping system to the system of vertical wells and horizontal trenches. Extracted LFG will be sent to high-efficiency state-of-the-art enclosed flares for destruction of the methane component of the extracted landfill gas. The stack height of the flares will be specified to provide sufficient residence time for destruction of compounds in the gas at high temperature and in a controlled environment to destroy extracted methane. Flame temperature will be controlled by means of a system of automatically and manually controlled air inlet dampers and thermocouples located in the stack of each Site. Retention time of the landfill gas within the enclosed flares will be 0.5 seconds at a temperature of 875^{o}C.

Flaring is a proven technology for the combustion of landfill gas and has been demonstrated to be reliable and environmentally safe. The industry standard destruction efficiencies for enclosed flares are upwards of 99.99% for hydrocarbons.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

Anthropogenic emissions of GHG's occur at González Catán and Ensenada landfill when methane produced at these landfills is not destroyed.

The collection and destruction of the methane in the project activity will reduce GHG emissions from the "business as usual case" currently employed by the González Catán and Ensenada landfill sites. The current practice at these landfills is to allow the uncontrolled release of LFG into the atmosphere. The LFG generated at the Sites consists approximately of 50% methane and 50% carbon dioxide, both known GHGs with Global Warming Potentials (GWP) values of 21 and 1, respectively. However, the carbon dioxide portion of landfill gas is considered to be biogenic in origin and part of the natural carbon cycle, and thus not considered an anthropogenic source of greenhouse gas.

Currently, there are no national or sector policies or regulations governing the release of LFG into the atmosphere. The proposed CDM project activity will establish landfill gas collection and flaring systems at González Catán and Ensenada landfills, thus generating emission reductions that satisfy all of the tests for creation of CERs over the extended life of the project.

It is important to note that the abovementioned GHGs emission reductions are additional to the current Sites conditions and current practices, and would have not occurred in the absence of the project; thus, the project complies with the concept of additionality defined under Kyoto's Clean Development Mechanism.

Over the 10-year period of credit certification, the anticipated total reductions for both Sites combined in tonnes of CO_2 is estimated as 7,698,095 tonnes of CO_2 equivalent.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

By direct flaring of the LFG generated at the Sites, the proposed project is expected to generate 7,698,095 tonnes of emission reductions expressed as tonnes of CO_2e over the crediting period.

The annual expected amount of emission reductions generated over the entire project lifespan is indicated below for each landfill site:

González Catán Landfill Site:

Year	Annual estimation of emission reductions in tonnes of CO2e
2006	570,753
2007	612,014
2008	582,155
2009	553,766
2010	526,763
2011	501,061
2012	476,620
2013	453,375
2014	431,264
2015	410,224
Total estimated reductions (tonnes of CO_2e)	5,117,995
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	511,800

Ensenada Landfill Site:

Year	Annual estimation of emission reductions in tonnes of CO2e
2006	233,123
2007	256,305
2008	278,353
2009	299,309
2010	284,715
2011	270,815
2012	257,607
2013	245,050
2014	233,102
2015	221,721
Total estimated reductions (tonnes of CO_2e)	2,580,100
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	258,010

Both Landfill Sites Combined:

Year	Annual estimation of emission reductions in tonnes of CO2e
2006	803,876

2007	868,319
2008	860,508
2009	853,075
2010	811,478
2011	771,876
2012	734,226
2013	698,425
2014	664,366
2015	631,946
Total estimated reductions (tonnes of CO_2e)	7,698,095
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	769,810

A.4.5. Public funding of the project activity:

No public funding of any kind has been provided for this project.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

The approved baseline methodology applied to this project is the approved ACM0001 – Consolidated Baseline Methodology for Landfill Gas Project Activities.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

ACM0001 was developed as a consolidated document that incorporates all previously-approved methodologies applicable to landfill gas project activities where the baseline scenario is the partial or total atmospheric release of landfill gas. This methodology is applicable to "landfill gas capture project activities where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as: the captured gas is flared". For the proposed project activity, the baseline scenario is the total atmospheric release of the gas, and the project activity is the flaring/destruction of captured gas; as a result, ACM0001 is applicable to the project activity.

The CERs exchange mechanism provided under the CDM is considered a real and concrete incentive in the decision to proceed with the project activity and the project activity will not be initiated without registration as a CDM project.

B.2. Description of how the methodology is applied in the context of the project activity:

As mentioned above, based on the current LFG management practices at the Site and the current environmental regulations in Argentina, the GHG emission reductions generated by the implementation of the project activity are considered fully additional.

There are no existing or pending regulatory requirements requiring the landfill site to implement any form of LFG emission reductions program. There is also no current system in place for landfill gas recovery and combustion at the Sites. Therefore, the project baseline is the uncontrolled release of the landfill gas into the atmosphere at each Site.

The greenhouse gas emissions reductions achieved by the project activity during a given period is the difference between the amount of methane actually destroyed/combusted and the amount of methane that would have been destroyed/combusted in the absence of the project activity, times the GWP of methane. For this project, the baseline is the total release of landfill gas into the atmosphere.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

The ACM0001 methodology requires the use of the "Tool for the demonstration and assessment of additionality" to demonstrate and assess additionality, which is a step-wise approach that includes:

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive (in the absence of the CDM incentive);
- Barriers analysis;
- Common practice analysis; and
- Impact of registration of the proposed project activity as a CDM project activity.

The "Tool for the demonstration and assessment of additionality" (UNFCCC, 22 October 2004) is applied as follows.

Step 0. Preliminary screening based on the starting date of the project activity

The actual methane destruction crediting period is expected to start on August 10, 2006; by then, all necessary local and UNFCCC approvals are expected to be in place, ie. the crediting period will commence subsequent to registration of the project activity. As a result, Step 0 is not applicable.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Alternatives to the project activity consistent with current laws and regulations are defined through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:
The below table presents an analysis of different alternatives to the project activity along with a discussion of probable outcome.

Alternatives to Project Activity	Probability of Scenario
Landfill gas recovery not implemented (continuation of the current situation)	Most probable: there are no regulations requiring the capture and destruction of landfill gas at the site. Additionally, the

	technical expertise and financial investment to engage in the project is not available in Argentina.
Project undertaken as a non-CDM project activity	Not probable: The project activity requires funds for both construction of the required facilities and to maintain operations. There are no known or available funding sources available to support this project and there are no known or proposed regulatory requirements that would require the emissions to be controlled. The project activity will not be initiated without registration as a CDM project.
Electricity generation from the methane component of the extracted landfill gas	Not probable: the technical expertise and financial resources in Argentina are not available to initiate electrical generation. Utilization systems are more capitally-intensive than landfill gas capture and flaring systems, requiring significantly more investment.

The above analysis shows that the only reasonable alternative to the project activity is the continued uncontrolled release of landfill gas to the atmosphere as part of the "business-as-usual" scenario at both Sites. As a result, the project activity is the only viable alternative to address the reduction of greenhouse gas emissions at the Sites.

Sub-step 1b. Enforcement of applicable laws and regulations:

Each of the above alternatives complies with the applicable laws and regulations in Argentina. In terms of the project activity, the active collection and flaring of LFG is not mandatory at the González Catán and Ensenada landfills, and as such, the Sites are currently in compliance with all local environmental regulations with respect to air emissions.

Step 2. Investment analysis

According to the "Tool for the demonstration and assessment of additionality" (UNFCCC, 22 October 2004), an investment analysis or barrier analysis is required. For the investment analysis, "if the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I)". Option 1 of Sub-step 2b is thus applied.

The project activity involves the implementation of a landfill gas collection and flaring systems to combust the methane component of landfill gas. This will require capital expenditures for the gas collection wells and piping, the mechanical instrumentation required to induce vacuum, the analytical instrumentation necessary to monitor landfill gas composition, and the enclosed drum flare to be used in destruction of the methane component of the landfill gas at each Site. Additionally, on-going expenses will be incurred to operate the facilities and to maintain the systems components.

The destruction of methane via the project activity would not result in any income other than that derived through revenues generated from the CER exchange mechanism under the CDM. The project activity is not financially attractive under any scenario except through registration as a CDM project.

Step 3. Barrier analysis

The goal of step 3 is to determine whether the proposed project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity in the absence of the CDM incentive; and
(b) Do not prevent the implementation of at least one of the identified alternatives.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

The implementation of landfill gas collection systems at González Catán and Ensenada landfill sites faces a number of investment and technologic barriers in the absence of the CDM incentive. These barriers are briefly discussed below.

- *Investment Barriers*

Currently, the availability of debt funding or access to international capital markets for this type of project is restricted in Argentina, as is the availability of government subsidies.

- *Technologic Barriers*

Today, Argentina lacks the necessary technical knowledge to implement LFG Management projects. Although the main infrastructure for the implementation of this type of project is readily available, the technical and engineering expertise, and the main components of the LFG management systems, are not available in Argentina and therefore need to be provided by sources outside the country.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

Alternative #1: Landfill gas recovery not implemented (continuation of the current situation)

The identified barriers would not affect the current “business-as-usual” scenario of emitting the landfill gas into the atmosphere. The “business-as-usual” scenario does not require any investments or technological improvements and is fully compatible with regulatory requirements.

Alternative #2: Project undertaken as a non-CDM project activity

Implementation of a landfill gas capture and flaring systems without registration as a CDM project will not proceed as a result of the significant investments required to initiate the project. Investment barriers prevent the implementation of this alternative.

Alternative #3: Electricity generation from the methane component of the extracted landfill gas

The technical expertise resources in Argentina are not available to initiate electrical generation and as a result, this alternative presents a technological barrier. Further, as capital expenditures for landfill gas utilization systems are significantly higher than for landfill gas capture and flaring systems, there is an additional investment barrier associated with this alternative.

As a result of the above analysis, the only plausible scenario is the continuation of the current scenario ie. landfill gas recovery not implemented. The project activity overcomes the stated barriers by utilizing revenues from the generation of CERs to undertake a project that would otherwise be unattractive and which has no regulatory driver for implementation.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

With the exception of small demonstration pilot-scale undertakings, there are currently no LFG management projects operating in Argentina. There are, however, several LFG management projects being filed under CDM with the local DNA, and this demonstrates the necessity of CER revenue for the implementation of this type of project.

Sub-step 4b. Discuss any similar options that are occurring:

Implementation of landfill gas capture and flaring systems in Argentina currently under development are reliant on revenues generated from the CER exchange mechanism under the CDM. Thus, these projects face similar barriers to implementation as the project activity.

Step 5. Impact of CDM registration

Once the proposed project activity is registered under CDM, the project will be entitled to proceed with the trade and/or exchange of the generated Certified Emission Reductions (CERs) in the open market. The sale of CERs to interested parties will generate a revenue source that will leverage the project Internal Rate of Return (IRR) to a point considered to be attractive by its investors in a way that the project will become economically feasible. Therefore, the CDM registration will facilitate and allow the implementation of the proposed project activity and ensure its financial viability. As a consequence of this, real reductions in anthropogenic greenhouse gas emissions will be realized.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The project boundary as related to the baseline methodology is delineated by the area of the González Catán and Ensenada landfill sites. The project boundary as related to the project activity will constitute the same area and will include the gas extraction and combustion facilities, where the landfill gas is destroyed.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Date of Completion: The baseline study was completed on 09/06/2005. Detailed baseline information is included as Annex 3 of this document.

Name of Entities Determining the Baseline: The baseline was determined by Conestoga Rovers & Associates Ltd. Contact information is presented below:

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SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The project is expected to be commissioned in August 2006.

C.1.2. Expected operational lifetime of the project activity:

The current duration of the present project under the framework outlined herein with the identified project participants is for a period of 10 years and zero months from the date that the completed system is commissioned and begins operation. There will be additional operational life for the system beyond that time but the future agreements and status of CERs or any other related designation is not known at this time. Based on present knowledge and information, the facility operation may be terminated at the end of the period noted above. This will need to be verified in future and will be a function of both the current status of the Sites and the market conditions related to CERs or their equivalent.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

10/08/2006.

C.2.2.2. Length:

10 years and 0 months.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

The approved monitoring methodology applied to this project activity is the ACM0001 – Consolidated Monitoring Methodology for Landfill Gas Project Activities.

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

ACM0001 was developed as a consolidated document that incorporates all previously-approved methodologies applicable to landfill gas activities where the baseline scenario is the partial or total atmospheric release of landfill gas. Scenarios contemplated by the methodology ACM0001 include the case where the management of the LFG collected at the Site includes direct flaring for emission reductions, which forms the basis of the project activity.

This monitoring methodology is based on the direct measurement of the quantity of LFG captured, collected and destroyed by the LFG management system. The actual tonnage of methane emissions reduced by the project is calculated based on flow rate of the landfill gas, methane concentration, and destruction/conversion efficiency of the combustion equipment. The monitoring plan provides for the continuous measurement of both LFG quantity and quality using a continuous flow meter and on-line LFG analyzer. The methane emissions reduced by the flares are determined based on the operating hours measured by a run-time meter. The destruction efficiency of the flare is directly correlated to the internal combustion temperature and the retention time in the unit.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

The section was left blank on purpose. Option 2 was selected.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The section was left blank on purpose. Option 2 was selected.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The section was left blank on purpose. Option 2 was selected.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The section was left blank on purpose. Option 2 was selected.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
2. $LFG_{flare,y}$	Total amount of landfill gas flared	On-Line LFG flow meter	m^3	m	Continuous	100%	Daily: electronic Monthly: paper	Measured by a flow meter
5. FE	Flare/combustion efficiency	Thermistors, Samples	%	m/c	(1) periodically; (2) continuously	100%	Daily: electronic Monthly: Paper	(1) Periodic measurement of methane content of flare exhaust gas (2) Continuous measurement of operation time of flare (with temperature)
6. $w_{CH4,y}$	Methane fraction in the landfill gas	On-Line LFG analyzer	m^3 CH_4/ m^3 LFG	m	Continuous	100%	Daily: electronic Monthly: Paper	Measured by continuous gas quality analyser
7. T	Temperature of the landfill gas	Temperature probe	^oC	m	Continuous	100%	Daily: electronic Monthly: paper	
8.	Pressure of	Pressure gauge	Pa	m	Continuous	100%	Daily:	

p	the landfill gas						electronic Monthly: paper	
9.	Total amount of electricity and/or other energy carriers used in the project for gas pumping	Electricity meter	MWh	m	Continuous	100%	Daily: electronic Monthly: paper	Required to determine CO_2 emissions from use of electricity
10.	CO_2 emission intensity of the electricity and/or other energy carriers in ID9	Calculated	tCO_2/ MWh	c	Annually	100%	Daily: electronic Monthly: paper	Required to determine CO_2 emissions from use of electricity
11.	Regulatory requirements relating to landfill gas projects	Local regulatory framework	Test	n/a	Annually	100%	Periodically	Required for any changes to the adjustment factor (AF) or directly $MD_{reg, y}$

It is noted that items related to electricity or thermal energy output in approved consolidated monitoring methodology ACM0001 are not components of the proposed project activity. Additionally, all data will be archived during the crediting period and for two years after.

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Landfill gas not captured by the landfill gas collection and flaring systems at each Site cannot be monitored, as this emission is diffused over the landfill. The amount of landfill gas collected and destroyed by combustion can be monitored at a centralised location using a flow meter. Project emissions are thus comprised of the quantity of methane collected and not flared due to flaring inefficiency, and this amount is subtracted from the measured amount of collected methane. The overall flaring efficiency for an enclosed flare is upwards of 99.99%.

The total amount of methane destroyed by the flare in a given hour is calculated as:

$MD_{project} = [LFG_{flare} (2.) \times w_{CH4} (6.) \times DCF_{CH4} \times FE (5.)]$

Where:

$MD_{project,y}$ = methane destroyed during a specified monitoring period (tonnes of CH_4)
LFG_{flare} = average flow of LFG collected during specified monitoring period in m^3/t
w_{CH4}= percentage by volume of CH_4 in LFG ($m^3 CH_4/m^3$ LFG)
DCF_{CH4} =methane density at standard pressure (1 atm) and temperature (0°C) conditions, 0.0007168 tonnes/m^3, as per consolidated methodology ACM0001
FE = destruction efficiency of the flare (%)

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

No leakage effects need to be accounted under methodology ACM0001.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No leakage effects need to be accounted under methodology ACM0001.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The following formulae will be used to estimate emission reductions for the project activity.

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EG_y * CEF_{electricity,y} + ET * CEF_{thermal,y}$

Where:

- ER_y are the emission reductions, measured in tCO_2e;
- $MD_{project,y}$ is the amount of methane actually destroyed/combusted during the year, measured in tCH_4;
- $MD_{reg,y}$ is the amount of methane that would have been destroyed/combusted during time period t in the absence of the project activity, measured in tCH_4;
- GWP_{CH4} is the approved Global Warming Potential value for methane, 21 tCO_2e/tCH_4;
- EG_y is net quantity of electricity displaced during a given period t, measured in MWh;
- $CEF_{electricity,y}$ is the CO_2 emissions intensity of the electricity displaced, measured in tCO2e/MWh;
- ET is the quantity of thermal energy displaced, measured in TeraJoules (TJ);
- $CEF_{thermal,y}$ is the CO_2 emissions intensity of the thermal energy displaced, measured in tCO2e/TJ.

It is noted that while the terms for electricity and thermal energy have been included to be consistent with the overall formulation stated in ACM0001, energy displacement is not a component of the proposed project activity. As a result, the above equation reduces to the following form for the project activity:

$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$

Considering that there is no regulatory or contractual requirement determining MD_{reg}, an adjustment factor (AF) is used:

$MD_{reg} = MD_{project} * AF$

The methane destroyed by the project activity during a given time period can be determined by the following: monitoring the quantity of methane actually flared and LFG used to generate electricity and to produce thermal energy, and is given by:

$MD_{project} = MD_{flared} + MD_{electricity} + MD_{thermal}$

For the proposed project activity, $MD_{electricity}$ = $MD_{thermal}$ =0, as there is no energy displacement component of the project. As a result, the total actual quantity of methane captured and destroyed will be metered *ex post* once the project activity is operational, and:

$MD_{project} = MD_{flared}$

And,

$MD_{flared,y} = LFG_{flare,y} * w_{CH4,y} * D_{CH4} * FE$

Where:

- $MD_{flared,y}$ is the quantity of methane destroyed by flaring in a given time period t, measured in tCH_4;
- LFG_{flare} is the quantity of landfill gas flared during the time period t, measured in cubic meters (m^3);
- w_{CH4} is the average methane fraction of the landfill gas as measured during the given time period t and expressed as a fraction of CH_4 volume per LFG volume (m^3 CH_4 / m^3 of LFG);
- FE is the flare efficiency (the fraction of the methane destroyed);
- D_{CH4} is the methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP (0 degree Celsius and 1.013 bar), which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001).

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2. (Table D2.2.1)	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
5.(Table D 2.2.1)	Medium	Regular maintenance to ensure optimal operation of controlled combustion environment
6. (Table D2.2.1)	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
7. (Table D2.2.1)	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
8. (Table D2.2.1)	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
9. (Table D2.2.1)	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured
10. (Table D2.2.1)	Low	Not applicable.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

All continuously measured parameters (LFG flow, CH_4 concentration, flare temperature, and flare operating hours), will be recorded electronically via a datalogger, which will have the capability to aggregate and print the collected data at the frequencies as specified above.

Before commencement of the O&M phase, a training and quality control program will be enacted to ensure that good management practices are ensured and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action. An operations manual will be developed for the operating personnel. The procedures for filing data and calculations to be performed by the LFG management operator will be included in a daily log to be placed in the main control room.

D.5 Name of person/entity determining the monitoring methodology:

The monitoring methodology for the project is determined by Conestoga-Rovers & Associates Ltd. The details of the monitoring plan are provided in Annex 4 and contact information is presented below:

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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

A total of 10,535,477 tonnes of Municipal Solid Waste (MSW) was collected at the González Catán landfill from 1981 to 2004 and a total of 3,953,662 tonnes of MSW was collected at the Ensenada landfill from 1982 to 2004. Module II of González Catán and Modules A1 and B1 of Ensenada are still accepting MSW. The total methane generation at the Site has been estimated based on the waste tonnage of the landfill using a United States Environmental Protection Agency (USEPA) first-order kinetic model for landfill gas:

$G_I = (M_i) \times (k) \times (L_o) \exp^{-(k \times t)}$

Where

G_i = emission rate from the ith section of waste (m^3 CH_4/year);
k = CH_4 generation rate (1/year);
L_o = CH_4 generation potential (m^3 CH_4/tonne of refuse);
M_i = mass of refuse in the ith section (tonnes); and
t_i = age of the ith section of waste (years).

The following input parameters and assumptions were used to represent González Catán and Ensenada landfills:

k = 0.05 $year^{-1}$;
L_o = 170 m^3/tonne;
Lag phase of methane production = 1 year;
Methane content in LFG = 50%;
LFG collection efficiency = 60%; and
Density of methane = 0.0007168 tonnes/m^3 (as per consolidated methodology ACM0001).

<u>González Catán Landfill:</u>

A sensitivity analysis was conducted on methane emissions to establish high, mid and low-range estimates for González Catán. It is estimated based on the above data that methane emissions will be in the range of 28,746 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) to 68,121 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2006, decreasing to between 22,398 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) and 41,697 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2015. Mid-range parameters (Lo=170 $m^3_{methane}$/tonne; k=0.05/year) were applied in the modelling to introduce conservativeness to the methane emission data, and estimate methane emissions as 45,305 tonnes in 2006, declining to 32,564 tonnes in 2015.

Table 1 (below) presents the waste tonnage accepted at González Catán landfill and the methane emission estimates based on the USEPA model. It is noted that the values presented in Table 1 represent modelled quantities of methane generation for the stated time period. The actual amount of GHGs reduced will be calculated based on the actual quantities of LFG collected and flared.

Table 1: Methane Emissions Estimate for the González Catán Landfill

Waste		*Upper*	*Mid-Range*	*Lower*
Quantity		tonnes CH_4/year	tonnes CH_4/year	tonnes CH_4/year
Year	*(tonnes)*			
1981	331,495	0	0	0
1982	266,381	3,493	2,020	1,188
1983	251,096	6,064	3,544	2,096
1984	262,257	8,299	4,901	2,914
1985	285,638	10,502	6,260	3,740
1986	326,860	12,802	7,695	4,617
1987	331,089	15,380	9,311	5,607
1988	310,814	17,829	10,874	6,574
1989	223,397	19,899	12,238	7,430
1990	244,544	20,907	13,002	7,939
1991	306,371	22,071	13,858	8,505
1992	446,031	23,807	15,049	9,269
1993	515,388	26,897	17,032	10,504
1994	504,903	30,509	19,342	11,940
1995	503,294	33,767	21,475	13,281
1996	472,925	36,787	23,494	14,564
1997	510,630	39,283	25,230	15,688
1998	593,552	42,008	27,110	16,903
1999	633,027	45,422	29,404	18,367
2000	700,615	49,022	31,827	19,916
2001	722,440	53,090	34,544	21,646
2002	560,987	57,113	37,261	23,387
2003	552,243	59,163	38,862	24,480
2004	679,500	60,982	40,331	25,499
2005	800,000	64,019	42,504	26,935
2006	900,000	**68,121**	**45,305**	**28,746**
2007	0	**72,998**	**48,579**	**30,844**
2008	0	**68,063**	**46,210**	**29,635**
2009	0	**63,462**	**43,956**	**28,473**
2010	0	**59,171**	**41,813**	**27,357**
2011	0	**55,171**	**39,773**	**26,284**
2012	0	**51,441**	**37,834**	**25,253**
2013	0	**47,963**	**35,988**	**24,263**
2014	0	**44,721**	**34,233**	**23,312**
2015	0	**41,697**	**32,564**	**22,398**
2016	0	38,878	30,976	21,519
2017	0	36,250	29,465	20,676
2018	0	33,799	28,028	19,865
2019	0	31,514	26,661	19,086
2020	0	29,384	25,361	18,338

Ensenada Landfill:

A sensitivity analysis was conducted on methane emissions to establish high, mid and low-range estimates for Ensenada landfill. It is estimated based on the above data that methane emissions will be in the range of 11,635 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) to 28,303 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2006, decreasing to between 11,776 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) and 23,803 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2015. Mid-range parameters (Lo=170 $m^3_{methane}$/tonne; k=0.05/year) were applied in the modelling to introduce conservativeness to the methane emission data, and estimate methane emissions as 18,505 tonnes in 2006, declining to 17,601 tonnes in 2015.

Table 2 (below) presents the waste tonnage accepted at Ensenada landfill and the methane emission estimates based on the USEPA model. It is noted that the values presented in Table 2 represent modelled quantities of methane generation for the stated time period. The actual amount of GHGs reduced will be calculated based on the actual quantities of LFG collected and flared.

Table 2: Methane Emissions Estimate for the Ensenada Landfill

Waste		***Upper***	***Mid-Range***	***Lower***
Quantity		tonnes CH_4/year	tonnes CH_4/year	tonnes CH_4/year
Year	***(tonnes)***			
1981	0	0	0	0
1982	83,662	0	0	0
1983	95,429	882	510	300
1984	94,489	1,827	1,066	630
1985	101,461	2,700	1,590	944
1986	111,082	3,586	2,131	1,271
1987	120,155	4,514	2,704	1,619
1988	107,821	5,475	3,304	1,986
1989	97,765	6,241	3,800	2,295
1990	100,792	6,849	4,210	2,555
1991	112,519	7,448	4,619	2,816
1992	148,428	8,130	5,079	3,109
1993	170,362	9,145	5,736	3,519
1994	186,412	10,321	6,494	3,992
1995	196,182	11,588	7,313	4,503
1996	192,122	12,872	8,152	5,030
1997	203,908	14,026	8,925	5,521
1998	244,665	15,226	9,732	6,035
1999	258,840	16,775	10,748	6,676
2000	260,594	18,368	11,801	7,342
2001	260,084	19,872	12,813	7,988
2002	228,111	21,269	13,773	8,607
2003	223,204	22,235	14,491	9,087
2004	355,575	23,084	15,144	9,530
2005	450,000	25,270	16,572	10,431
2006	450,000	**28,303**	**18,505**	**11,635**
2007	450,000	**31,131**	**20,345**	**12,791**
2008	450,000	**33,768**	**22,094**	**13,903**
2009	0	**36,227**	**23,758**	**14,970**
2010	0	**33,778**	**22,600**	**14,383**

2011	0	**31,494**	**21,497**	**13,819**
2012	0	**29,365**	**20,449**	**13,278**
2013	0	**27,380**	**19,452**	**12,757**
2014	0	**25,529**	**18,503**	**12,257**
2015	0	**23,803**	**17,601**	**11,776**
2016	0	22,193	16,742	11,314
2017	0	20,693	15,926	10,871
2018	0	19,294	15,149	10,444
2019	0	17,990	14,410	10,035
2020	0	16,773	13,707	9,641

González Catán and Ensenada Landfill Sites Combined:

Based on the above data, combined project activity methane emissions are estimated to be in the range of 40,381 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) to 96,424 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2006, decreasing to between 34,174 tonnes (Lo=125 $m^3_{methane}$/tonne; k=0.04/year) and 65,500 tonnes (Lo=210 $m^3_{methane}$/tonne; k=0.07/year) in 2015. Mid-range parameters (Lo=170 $m^3_{methane}$/tonne; k=0.05/year) were applied in the modelling to introduce conservativeness to the methane emission data, and estimate methane emissions as 63,810 tonnes in 2006, declining to 50,165 tonnes in 2015.

Table 3 (below) presents the waste tonnage accepted at both Sites combined and the methane emission estimates based on the USEPA model. It is noted that the values presented in Table 3 represent modelled quantities of methane generation for the stated time period. The actual amount of GHGs reduced will be calculated based on the actual quantities of LFG collected and flared.

Table 3: Methane Emissions Estimate for Both Sites Combined

Year	***Upper***	***Mid-Range***	***Lower***
	tonnes CH_4/year	tonnes CH_4/year	tonnes CH_4/year
1981	0	0	0
1982	3,493	2,020	1,188
1983	6,946	4,054	2,396
1984	10,126	5,967	3,544
1985	13,202	7,850	4,684
1986	16,388	9,826	5,888
1987	19,894	12,015	7,226
1988	23,304	14,178	8,560
1989	26,140	16,038	9,725
1990	27,756	17,212	10,494
1991	29,519	18,477	11,321
1992	31,937	20,128	12,378
1993	36,042	22,768	14,023
1994	40,830	25,836	15,932
1995	45,355	28,788	17,784
1996	49,659	31,646	19,594
1997	53,309	34,155	21,209
1998	57,234	36,842	22,938
1999	62,197	40,152	25,043
2000	67,390	43,628	27,258

2001	72,962	47,357	29,634
2002	78,382	51,034	31,994
2003	81,398	53,353	33,567
2004	84,066	55,475	35,029
2005	89,289	59,076	37,366
2006	**96,424**	**63,810**	**40,381**
2007	**104,129**	**68,924**	**43,635**
2008	**101,831**	**68,304**	**43,538**
2009	**99,689**	**67,714**	**43,443**
2010	**92,949**	**64,413**	**41,740**
2011	**86,665**	**61,270**	**40,103**
2012	**80,806**	**58,283**	**38,531**
2013	**75,343**	**55,440**	**37,020**
2014	**70,250**	**52,736**	**35,569**
2015	**65,500**	**50,165**	**34,174**
2016	61,071	47,718	32,833
2017	56,943	45,391	31,547
2018	53,093	43,177	30,309
2019	49,504	41,071	29,121
2020	46,157	39,068	27,979

Based on the mid-range estimates, the total methane emissions in the absence of the project activity during the crediting period are calculated as 406,255 tonnes of methane for González Catán, 204,804 tonnes of methane for Ensenada, and 611,059 tonnes of methane for both Sites combined. The landfill gas collection and flaring systems will capture only a portion of the generated landfill gas. Thus, a conservative estimate of 60% LFG collection was applied to the midrange estimate of LFG produced. Under assumption that generated LFG is composed of 50% methane, Tables 4, 5 and 6 illustrate the quantities of methane collected by the project activity during the crediting period.

Table 4: Quantity of Methane Captured by the Project Activity for the González Catán Landfill

Year	*Percentage of Methane Captured*	*Amount of Methane Captured by Project Activity* (tonnes CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tonnes CH_4/year)
2006	60%	27,183	18,122
2007	60%	29,148	19,431
2008	60%	27,726	18,484
2009	60%	26,374	17,582
2010	60%	25,088	16,725
2011	60%	23,864	15,909
2012	60%	22,700	15,134
2013	60%	21,593	14,395
2014	60%	20,540	13,693
2015	60%	19,538	13,026

Table 5: Quantity of Methane Captured by the Project Activity for the Ensenada Landfill

Year	*Percentage of Methane Captured*	*Amount of Methane Captured by Project Activity* (tonnes CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tonnes CH_4/year)
2006	60%	11,103	7,402

2007	60%	12,207	8,138
2008	60%	13,257	8,837
2009	60%	14,255	9,503
2010	60%	13,560	9,040
2011	60%	12,898	8,599
2012	60%	12,269	8,180
2013	60%	11,671	7,781
2014	60%	11,102	7,401
2015	60%	10,560	7,041

Table 6: Quantity of Methane Captured by the Project Activity for Both Sites Combined

Year	*Percentage of Methane Captured*	*Amount of Methane Captured by Project Activity* (tonnes CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tonnes CH_4/year)
2006	60%	38,286	25,524
2007	60%	41,355	27,569
2008	60%	40,983	27,321
2009	60%	40,629	27,085
2010	60%	38,648	25,765
2011	60%	36,762	24,508
2012	60%	34,969	23,314
2013	60%	33,264	22,176
2014	60%	31,642	21,094
2015	60%	30,098	20,067

The total methane captured by the project activity during the crediting period is estimated as 243,754 tonnes of methane for González Catán, 122,882 tonnes of methane for Ensenada, and 366,636 tonnes of methane for both Sites combined.

Emissions from the project activity are expected to be negligible. The use of high-efficiency enclosed drum flares has demonstrated capability to destroy in excess of 99.99% of hydrocarbons in the controlled combustion environment. As required, uncombusted methane will be measured and accounted for according to the requirements set forth in methodology ACM0001, but quantities of uncombusted methane are expected to be negligible. For the purpose of estimating project activity emissions, a destruction efficiency of 99.99% was applied to the quantities of methane captured (Tables 4, 5 and 6). Project activity emissions are summarized in Tables 7, 8 and 9.

Table 7: Emissions Resulting from Uncombusted Methane in the Project Activity for the González Catán Landfill

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tonnes CH_4/year)	*Project Activity Emissions (tonnes CO_2e/year)*
2006	99.99%	2.72	57.1
2007	99.99%	2.91	61.2
2008	99.99%	2.77	58.2
2009	99.99%	2.64	55.4
2010	99.99%	2.51	52.7
2011	99.99%	2.39	50.1
2012	99.99%	2.27	47.7

2013	99.99%	2.16	45.3
2014	99.99%	2.05	43.1
2015	99.99%	1.95	41.0

Table 8: Emissions Resulting from Uncombusted Methane in the Project Activity for the Ensenada Landfill

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tonnes CH_4/year)	*Project Activity Emissions (tonnes CO_2e/year)*
2006	99.99%	1.11	23.3
2007	99.99%	1.22	25.6
2008	99.99%	1.33	27.8
2009	99.99%	1.43	29.9
2010	99.99%	1.36	28.5
2011	99.99%	1.29	27.1
2012	99.99%	1.23	25.8
2013	99.99%	1.17	24.5
2014	99.99%	1.11	23.3
2015	99.99%	1.06	22.2

Table 9: Emissions Resulting from Uncombusted Methane in the Project Activity for Both Sites Combined

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tonnes CH_4/year)	*Project Activity Emissions (tonnes CO_2e/year)*
2006	99.99%	3.83	80.4
2007	99.99%	4.14	86.8
2008	99.99%	4.10	86.1
2009	99.99%	4.06	85.3
2010	99.99%	3.86	81.2
2011	99.99%	3.68	77.2
2012	99.99%	3.50	73.4
2013	99.99%	3.33	69.9
2014	99.99%	3.16	66.4
2015	99.99%	3.01	63.2

The only source of project activity emission is uncombusted methane. As a result, the total emissions attributed to the project activity are estimated as 512 tonnes CO_2e for González Catán, 258 tonnes CO_2e for Ensenada and 770 tonnes CO_2e for both Sites combined over the duration of the crediting period. Therefore, E.1=770 tonnes CO_2e.

E.2. Estimated leakage:

No leakage effects need to be accounted under methodology ACM0001 (E.2=0).

However, methodology ACM0001 clearly states that the CO_2 emission intensity of the electricity consumed by the project activity must be taken into account. In the project activity, electrical consumption is associated with the blower systems used to draw landfill gas to the enclosed drum flares, and the total electrical requirement of these blower systems is 55.5 kW (37 kW for González Catán landfill and 18.5 kW for Ensenada landfill). This corresponds to electrical consumption of 486 MWh/year (324 MWh/year for González Catán landfill and 162 MWh/year for Ensenada landfill).

Electricity in Argentina is produced from natural gas (50%), hydroelectric (40%) and nuclear (10%). According to the IPCC, the specific emission factors for hydroelectric and nuclear power is 0 kg CO_2/MWh and for natural gas the emission factor is 15.3 tonnes C/TJ, or 202 kg CO_2/MWh. An estimate of the grid emission factor for Argentina is thus calculated as 101 kg CO_2/MWh. Tables 10, 11 and 12 illustrate the total emissions resulting from electrical consumption in the project activity during the crediting period.

Table 10: Emissions Resulting from Electrical Consumption in the Project Activity for the González Catán Landfill

Year	*Electrical Consumption in Project Activity (MWh/year)*	*Emissions Resulting from Electrical Consumption (tonnes of CO_2/year)*
2006	324	32.7
2007	324	32.7
2008	324	32.7
2009	324	32.7
2010	324	32.7
2011	324	32.7
2012	324	32.7
2013	324	32.7
2014	324	32.7
2015	324	32.7

Table 11: Emissions Resulting from Electrical Consumption in the Project Activity for the Ensenada Landfill

Year	*Electrical Consumption in Project Activity (MWh/year)*	*Emissions Resulting from Electrical Consumption (tonnes of CO_2/year)*
2006	162	16.4
2007	162	16.4
2008	162	16.4
2009	162	16.4
2010	162	16.4
2011	162	16.4
2012	162	16.4
2013	162	16.4
2014	162	16.4
2015	162	16.4

Table 12: Emissions Resulting from Electrical Consumption in the Project Activity for Both Sites Combined

Year	*Electrical Consumption in Project Activity (MWh/year)*	*Emissions Resulting from Electrical Consumption (tonnes of CO_2/year)*
2006	486	49.1
2007	486	49.1
2008	486	49.1
2009	486	49.1
2010	486	49.1
2011	486	49.1
2012	486	49.1
2013	486	49.1
2014	486	49.1
2015	486	49.1

Therefore total emissions resulting from electrical consumption in the project activity is estimated as 491 tonnes CO_{2e} for both Sites combined (327 tonnes CO_{2e} for González Catán landfill and 164 tonnes CO_{2e} for Ensenada landfill) over the crediting period, and E.2=491 tonnes CO_{2e}.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Tables 13, 14 and 15 presents the total project activity emissions, attributable to uncombusted methane release and emissions associated with electrical consumption during the crediting period.

Table 13: Total Project Activity Emissions for González Catán Landfill

Year	*Project Activity Emissions from Uncombusted Methane (tonnes CO_2e/year)*	*Project Activity Emissions from Electrical Consumption (tonnes of CO_2/year)*	*Total Emissions Resulting from the Project Activity (tonnes of CO_2/year)*
2006	57.1	32.7	89.8
2007	61.2	32.7	93.9
2008	58.2	32.7	90.9
2009	55.4	32.7	88.1
2010	52.7	32.7	85.4
2011	50.1	32.7	82.8
2012	47.7	32.7	80.4
2013	45.3	32.7	78.0
2014	43.1	32.7	75.8
2015	41.0	32.7	73.7

Table 14: Total Project Activity Emissions for Ensenada Landfill

Year	*Project Activity Emissions from Uncombusted Methane (tonnes CO_2e/year)*	*Project Activity Emissions from Electrical Consumption (tonnes of CO_2/year)*	*Total Emissions Resulting from the Project Activity (tonnes of CO_2/year)*

2006	23.3	16.4	39.7
2007	25.6	16.4	42.0
2008	27.8	16.4	44.2
2009	29.9	16.4	46.3
2010	28.5	16.4	44.9
2011	27.1	16.4	43.5
2012	25.8	16.4	42.2
2013	24.5	16.4	40.9
2014	23.3	16.4	39.7
2015	22.2	16.4	38.6

Table 13: Total Project Activity Emissions for Both Sites Combined

Year	*Project Activity Emissions from Uncombusted Methane (tonnes CO_2e/year)*	*Project Activity Emissions from Electrical Consumption (tonnes of CO_2/year)*	*Total Emissions Resulting from the Project Activity (tonnes of CO_2/year)*
2006	80.4	49.1	129.5
2007	86.8	49.1	135.9
2008	86.1	49.1	135.2
2009	85.3	49.1	134.4
2010	81.2	49.1	130.3
2011	77.2	49.1	126.3
2012	73.4	49.1	122.5
2013	69.9	49.1	119.0
2014	66.4	49.1	115.5
2015	63.2	49.1	112.3

The sum of project activity emissions during the crediting period is estimated as 1,261 tonnes CO_2e (839 tonnes CO_2e for González Catán landfill and 422 tonnes CO_2e for Ensenada landfill), and E.3=1,261 tonnes CO_2e.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Based on the model projections of total emissions illustrated in E.1, the total methane emission in the baseline scenario (no collection or destruction of methane at the Site) for the crediting period is 8,531,376 tonnes of CO_{2e} for González Catán landfill and 4,300,860 tonnes of CO_{2e} for Ensenada landfill. The combined total emissions value for both Sites are 12,832,236 tonnes of CO_{2e}.

Multiplied by an estimated collection efficiency of 60%, this results in emission reductions of 5,118,834 tonnes of CO_{2e} for the González Catán landfill and 2,580,522 tonnes of CO_{2e} for the Ensenada landfill. The combined emission reductions for both Sites is 7,699,356 tonnes of CO_{2e}, and E.4=7,699,356.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

The total emission reduction of the project activity is the difference between E.4 and E.3 and results in an estimated emission reduction of 7,698,095 tonnes of CO_{2e} between 2006 and 2015 for both Sites combined.

E.6. Table providing values obtained when applying formulae above:

Tables 16, 17 and 18 summarize the net emission reduction associated with the project activity.

Table 16: Total Project Activity Emissions for the González Catán Landfill Site:

Year	Estimation of project activity Emission Reductions (tonnes of CO_2e)	Estimation of baseline Emission Reductions (tonnes of CO_2e)	Estimation of leakage and project activity emissions (tonnes of CO_2e)	Estimation of Net Emission Reductions (tonnes of CO_2e)
2006	570,843	0	89.8	570,753
2007	612,108	0	93.9	612,014
2008	582,246	0	90.9	582,155
2009	553,854	0	88.1	553,766
2010	526,848	0	85.4	526,763
2011	501,144	0	82.8	501,061
2012	476,700	0	80.4	476,620
2013	453,453	0	78.0	453,375
2014	431,340	0	75.8	431,264
2015	410,298	0	73.7	410,224
Total (tonnes of CO_2e)	5,118,834	0	839	5,117,995

Table 17: Total Project Activity Emissions for the Ensenada Landfill Site:

Year	Estimation of project activity Emission Reductions (tonnes of CO_2e)	Estimation of baseline Emission Reductions (tonnes of CO_2e)	Estimation of leakage and project activity emissions (tonnes of CO_2e)	Estimation of Net Emission Reductions (tonnes of CO_2e)
2006	233,163	0	39.7	233,123
2007	256,347	0	42.0	256,305
2008	278,397	0	44.2	278,353
2009	299,355	0	46.3	299,309
2010	284,760	0	44.9	284,715
2011	270,858	0	43.5	270,815
2012	257,649	0	42.2	257,607
2013	245,091	0	40.9	245,050
2014	233,142	0	39.7	233,102
2015	221,760	0	38.6	221,721
Total (tonnes of CO_2e)	2,580,522	0	422	2,580,100

Table 18: Total Project Activity Emissions for Both Sites Sites Combined:

Year	Estimation of project activity Emission Reductions (tonnes of CO_2e)	Estimation of baseline Emission Reductions (tonnes of CO_2e)	Estimation of leakage and project activity emissions (tonnes of CO_2e)	Estimation of Net Emission Reductions (tonnes of CO_2e)
2006	804,006	0	129.5	803,876
2007	868,455	0	135.9	868,319
2008	860,643	0	135.2	860,508
2009	853,209	0	134.4	853,075
2010	811,608	0	130.3	811,478
2011	772,002	0	126.3	771,876
2012	734,349	0	122.5	734,226
2013	698,544	0	119.0	698,425
2014	664,482	0	115.5	664,366
2015	632,058	0	112.3	631,946
Total (tonnes of CO_2e)	7,699,356	0	1,261	7,698,095

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

There are expected to be no significant impacts due to the project activity. Emissions from the flare include the carbon dioxide component of landfill gas, but this carbon dioxide is considered to be a natural product of the carbon cycle. In the combustion of landfill gas, carbon dioxide is additionally produced, but this is also considered to be part of the natural carbon cycle and not of anthropogenic origin. There is minimal visual impact from the flare, and noise and vibration will be limited to the localized site.

Overall, implementation of the project activity will have a beneficial environmental impact on the site, reducing emissions of methane and other trace gases.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

There are no significant environmental impacts resulting from the project activity.

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

The guidelines issued by the Argentina DNA (Designated National Authority) do not specify particular project stakeholders. Therefore, local project stakeholders were identified and invited by letter to attend a series of public information sessions and to provide their comments on the proposed undertaking.

A public meeting with local stakeholders was held in Buenos Aires on 13 July 2005 to present the project to the public as well as to official authorities. The following are selected photographs from the public meeting.

Figure 1: Public meeting in Buenos Aires

Figure 2: Mr. Omar Scatassa, Engineer from CEAMSE, addressing site-specific questions

Figure 3: Edward del Rosso, P.Eng., presenting the project and addressing public questions

The following tables illustrate the list of participants in the meeting:

CEAMSE	
Gustavo Dalesio	Doctor
Fernando Dufour	Engineer
Graciela Gerola	Engineer
Carlos Hurst	President
Aldo Rivas	Engineer
Marcelo Eduardo Rosso	Engineer
Omar Scatassa	Senior Engineer

Conestoga-Rovers & Associates	
Frederick (Rick) A. Mosher, P. Eng.	Vice-President
Edward del Rosso, P.Eng.	Manager

CITY AND STATE OFFICIALS	
Marcelo Calviño	Ensenada Municipality
Carlos Iurada	Ensenada Municipality
Raúl Panetieri	Ensenada Municipality
Maria Carlos Secco	Ensenada Municipality
César Ortiz Araya	Secretariat of Environment and Suatainable Development
Carmen Vicién	Buenos Aires Province

NGOs	
Mariela Pugliese	El Armadero – Matilde Vara Association

PRIVATE SECTOR	
Alberto Di Bacco	Industrias Di Bacco

UNIVERSITIES	
Marcela Vitale	I-Salud

G.2. Summary of the comments received:

A questionnaire was distributed to the public meeting participants for feedback, with questions relating to how the project activity would relate to sustainable development in Argentina, technology transfer, and improvement in the socio-economic situation of the local region. The comments received concerning the project activity, as indicated on the questionnaires, were overwhelmingly positive. During the question and answer component of the public meeting, comments were also strongly positive and supportive of the project.

One of the participants showed interest in receiving further information about the project technology in general and specifically with respect to air emissions of the flaring technology. This issue is addressed in the subsequent section.

G.3. Report on how due account was taken of any comments received:

The received comment relating to further information of the project technology will be addressed and the following options will be contemplated:

- A pamphlet describing the project technology will be produced and distributed to interested stakeholders, including pertinent materials relating to air emissions from high-efficiency enclosed drum flares;
- An information package containing drawings and specifications detailing the project technology will be produced and kept at the Sites and be available for public information.

Progress with respect to increasing the awareness of the project technology will be monitored and strategies re-evaluated as necessary.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Coordinación Ecológica Área Metropolitana Sociedad del Estado (CEAMSE)
Street/P.O.Box:	Amancio Acorta, 3000
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State/Region:	Province of Buenos Aires
Postfix/ZIP:	1437
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Salutation:	Mr.
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Middle Name:	
First Name:	Carlos
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Represented by:	Frank Rovers
Title:	
Salutation:	Mr.
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Middle Name:	Anthony
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding.

Annex 3

BASELINE INFORMATION

The baseline scenario for the project activity is the uncontrolled release of landfill gas to the atmosphere. The total estimated emissions of landfill gas to the atmosphere in the baseline scenario are estimated as 12,832,236 tonnes of CO_2e during the crediting period for both Sites. There are presently no measures in place to reduce carbon dioxide emissions and there are no current or pending regulations that would require the specified Sites to reduce emissions.

Annex 4

MONITORING PLAN

1.0 Introduction and Objectives

The two primary purposes of a landfill gas monitoring plan are:

- To collect the necessary system data required for the determination and validation of certified emissions reductions (CERs); and
- To demonstrate successful compliance with established operating and performance criteria for the system, and to verify that the CERs have been generated.

The operational data that is collected for the system will be used to support the periodic report that will be required for the auditing and validation of CERs. The monitoring plan discussed herein is designed to meet or better the UNFCCC requirements.

The routine system monitoring program required for the determination and validation of CERs is discussed in Section 2, while the additional system data that is collected to ensure the safe, correct, and efficient operation of the landfill gas management system is discussed in Section 3.

Coupled with an operations and maintenance manual that is generally developed for a system, expected performance guidelines in accordance with the data collection procedures described below will be provided with trigger levels that would be indicative of a need for any follow-up assessment and possible remedial response measures.

2.0 Monitoring Work Program

The landfill gas monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system and for the verification of CERs. This data is collected in real time, and will provide a continuous record that is easy to monitor, review, and validate.

The following sections will outline and discuss the following key elements of the program:

- Flow measurement;
- Gas quality measurements;
- Data records; and
- Data assessment and reporting.

2.1 Flow Measurement

The flow of landfill gas collected by the system and subsequently flared or utilized is measured via a flow measuring device suitable for measuring the velocity and volumetric flow of a gas. Two such common examples are an annubar or an orifice plate. The flow measurements are taken within the piping itself, and the flow sensors are connected to a transmitter that is capable of collecting and sending continuous data to a recording device such as a datalogger.

The flow sensors are calibrated according to a specified temperature, pressure and composition of the gas, thus the flow actually measured must be corrected to according to actual temperature, pressure, and composition, thus density, of the gas measured. The equipment selected will allow dynamic compensation for these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are generally required to be normalized to 0°C and 1 atm at standard gas composition of 50% methane and carbon dioxide each by volume.

Specific calibration procedures are dependent on the actual equipment selected, however calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used, however equipment is available that will provide a minimum accuracy of +/- 2% by volume. Again dependent on the equipment selected, the measured flow is aggregated approximately once per second.

All data is that is collected will be recorded for the permanent record. Both electronic and hard copies of the data will be maintained for auditing purposes, and for use in the calculation of CERs.

2.2 Gas Quality

The two parameters that are most pertinent to the validation of CERs, as well as the safe and efficient operation of the system are the concentration of methane and oxygen in the gas stream. These two parameters are measured via a common sample line that is run to the main collection system piping, and measured in real time by two separate sensors, one each for methane and oxygen.

Although compensation for temperature and pressure is not required for the methane and oxygen sensors, the sensors are designed to operate within specified temperature and pressure conditions. Again, specific calibration procedures are dependent on the actual equipment selected, however calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected range of the gas stream to be measured. Equipment is readily available that will provide an accuracy of +/- 1% by volume. Dependent on the equipment selected compositions are aggregated approximately once per second.

2.3 Data Records

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the CER quantity calculations may be carried out, and a hard copy backup of the data may be printed. Backup of the data electronically may be conducted on a daily basis, and hard copy data may be printed weekly or monthly. As a back up would be produced separate from the main recording system, no more than one day of data at a time would ever be lost due to a system malfunction. Calibration records will be kept for all instrumentation.

2.4 Data Assessment and Reporting

Assessment of the flow and composition data described above coupled with the operating hours of the flare and flare destruction efficiency are used to determine the quantity of CERs generated. The destruction efficiency of the flare is a function of the internal combustion temperature and resident holding time, which are generally measured by the flare system controller, and recorded for auditing purposes. Extensive technical documentation is available that documents the destructive efficiency of the enclosed drum flares that will be used, subject to the flow rate and combustion temperature verification. Destruction efficiency will also be assessed periodically through measurement of uncombusted methane emissions.

As discussed in Section 2.1, flow data is normalized to standard temperature, pressure, and composition for reporting purposes. The data will be compiled and assessed to produce the required quantification and validation. The annual monitoring report will contain the data required for the validation of the CERs, and additionally may contain operational data from the collection system and flaring system described below to illustrate that the system is well maintained and operating at peak efficiency. Records of regular maintenance performed will also be a component of the annual report.

3.0 Related Monitoring

Additional operational monitoring of the landfill gas collection wellfield is conducted in order to optimize the system and ensure that it is operating both correctly and efficiently. Periodic adjustments to the extraction wells will be required to optimize the collection system effectiveness. Such collection field adjustments are undertaken made based upon a review of the well performance history considered within the context of the overall field operation in order to maximize the collection of methane balanced against the minimization of any oxygen in the system which could introduce unsafe operating conditions. Monitoring at each extraction well will consist of the following parameters: valve position, individual well flow, individual well vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

At such time as a landfill gas facility is designed and commissioned, a specific monitoring plan tailored to the actual utilization technology selected will be developed for this system.

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