Revised Monitoring Plan

Project Title

Hiriya Landfill Project

CDM Project Number - 0147

Date: 6th Oct 2008

Version: 1

Implemented by:

Dan Region Associate of Town (DRAT)

SECTION 4. Application of a monitoring methodology and plan

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

The project will use the approved consolidated monitoring methodology ACM0001 "Consolidated monitoring methodology for landfill project activities"

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

The chosen methodology is to be used in conjunction with baseline methodology ACM0001. The proposed project activity meets all the applicability requirements requested for this methodology.

D.2.1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Not applicable.

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 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

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

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

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

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	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 (Data on recorded variables will be archived during the crediting period and two years after).
1. $LFG_{total,y}$	Total amount of landfill gas captured	Project developer	Nm^3	m	measured continuously, recorded weekly	100%	electronic	Measured by a flow meter that normalizes the reading to Nm^3 in a continuous manner. Data to be aggregated monthly and yearly.
2. $LFG_{flared,y}$	Amount of landfill gas Flared	Project developer	Nm^3	m	measured continuously, recorded weekly	100%	electronic	Measured by a flow meter that normalizes the reading to Nm^3 in a continuous manner. Data to be aggregated monthly and yearly.
3. $LFG_{thermal,y}$	Amount of landfill gas combusted in boiler	Project developer	Nm^3	m	measured continuously, recorded weekly	100%	electronic	If any landfill gas is supplied to boilers in the future, this will have to be monitored according to ACM0001. Data will be aggregated monthly and yearly
4. FE	Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)	Project developer	%	m/c	(1) continuously (2) quarterly, monthly if unstable	n/a	electronic	(1) Continuous measurement of operation time of flare (e.g. with temperature) (2) Periodic measurement of methane content of flare exhaust gas.
5. $w_{CH4,y}$	Methane fraction of the landfill gas	Project proponent data	Nm^3 CH_4/ Nm^3 LFG	m	Weekly	100%	Electronic	Measured by gas quality analyser
6. EG_y	Total amount of electricity and/or other energy carriers used in the project for gas pumping. (not derived from the gas)	Project developer	MWh	m	Continuously	100%	electronic	Only electricity will be used. Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity.

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7. $CEF_{electricity,y}$	CO_2 emissions intensity of the electricity displaced during year	National Electric Grid	tCO_2e/MWh	e	Annually	100%	electronic	For conservativeness, the grid CEF is based on assumption of 100% heavy coal (conservative). The make-up of the Israeli grid will be reassessed each year to ensure that the grid emissions factor does not exceed the highly conservative value chosen
8. legal	Regulatory requirements relating to landfill gas projects	Project developer	Text	n/a	Annually	100%	electronic	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$. Monitoring will be made through phone calls to the relevant authority.

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All data of the above table will be archived during the crediting period + two years.

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

Project emissions in tCO_2e during a given year 'y' (PE_y) are equal to the net amount of electricity used by the project (for the operation of pumps and flares) in the year in MWh (EG_y), multiplied by a carbon emissions factor (CEF electricity $_y$) for the grid from which electricity is taken (tCO_2e/MWh):

$$PE_y = EG_y * CEF_{electricity,y}$$

The CEF for this equation can be calculated using the equations for small-scale electricity projects (Type 1.D). For conservativeness, however, this project will use the highest (most conservative) CEF for a given country, which is 1.034 tCO_2e/MWh (Orot Rabin Plant), as if the country's energy matrix was entirely based on heavy coal. Using this CEF is in fact highly conservative, since most of the electricity used by the pumps and flares is in fact likely to be supplied by an off-site biodigester (that is not part of the project but which provides zero-emissions renewable electricity).

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	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

Not applicable.

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 have to be accounted for under 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 main formula, as described in section B.2 is:

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

Where:

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

$$PE_y = EG_y * CEF_{electricity,y} \quad \text{and} \quad BE_y = ET_y * CEF_{thermal,y}$$

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

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

$$MD_{thermal,y} = LFG_{thermal,y} * w_{CH4,}y * D_{CH4}$$

Where:

ER_y : greenhouse gas emission reduction achieved by the project activity during a given year *"y"* (tCO_2e).
$MD_{project,y}$: amount of methane actually destroyed/combusted during the year *"y"* (tCH_4).
MD_{flared} : quantity of methane destroyed by flaring in year *"y"* (tCH_4)
$MD_{thermal}$: quantity of methane destroyed by use in boilers for thermal energy in year *"y"* (tCH_4)
$MD_{electricity}$: quantity of methane destroyed by use for electricity generation in year *"y"* (tCH_4) (not applicable to this project)
AF : Adjustment Factor (%).
GWP_{CH4} : approved Global Warming Potential value for methane (21 tCO_2e / tCH_4).
PE_y : Project emissions of the landfill gas component from electricity consumed by the project during a given year *"y"* (t CO_2e).
BE_y : is the baseline emissions of thermal displacement (not applicable to this project) (tCO_2e).
EG_y : net quantity of electricity used during the year *"y"* (MWh).
$CEF_{electricity,y}$: CO_2 emissions intensity of the electricity used during year *"y"* (tCO_2e/MWh).
ET_y : quantity of thermal energy displaced during the year (not applicable to this project) (TJ).
$CEF_{thermal,y}$: CO_2 emissions intensity of the thermal energy displaced (not applicable to this project) (tCO2e/TJ).
$LFG_{thermal,y}$: is the quantity of landfill gas fed for the generation of thermal energy measured in normal cubic meters (Nm^3).
$LFG_{flared,y}$: the quantity of landfill gas flared during year *y* (Nm^3)
$w_{CH4,y}$: is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in Nm^3 CH_4 / Nm^3 LFG).
D_{CH4} : is the methane density expressed in tonnes of methane per cubic meter of methane (not applicable to this project)($tCH4/m^3CH_4$)
CV_{CH4} : is the calorific value of methane (not applicable to this project) (TJ/t CH_4).
CV_{fuel} : is the calorific value of the fuel (not applicable to this project) (TJ/t fuel).
EF_{fuel} : CO_2 emissions intensity of the fuel (not applicable to this project) (tC/TJ).
OF_{fuel} : Oxidizing fraction of the fuel (not applicable to this project) (%).

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As described in the formula for ER_y introduced in section B.2., the only project emissions associated with the landfill gas component are related to the electricity used for the operation of the flare pumps and other auxiliary equipment. The project will calculate project emissions based on the following equation:

$$PE_y = EG_y * CEF_{electricity,y}$$

Where:

PE_y : Project emissions from electricity consumed by the project during a given year *"y"* (t CO_2e).

EG_y : quantity of electricity consumed by the gas collecting system during the year *"y"* (MWh).
$CEF_{electricity,y}$: CO_2 emissions intensity of the electricity displaced during year *"y"* (tCO_2e/MWh).

The CEF for this equation could be calculated using the equations for small-scale electricity projects Type 1.D. For conservativeness and also to reduce the need of monitoring large amounts of data from the grid, this project will use the most conservative CEF for the country, which is 1.034 tCO_2e/MWh (Orot Rabin Plant), as if the country's energy matrix was entirely based on heavy coal.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:		
Data (Indicate table and ID number e.g. D.4-1; D.4-2.)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table .2.2.1; (1) $LFG_{total,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Table .2.2.1; (2) $LFG_{flared,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Table .2.2.1; (3) $LFG_{thermal,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Table .2.2.1; (4) FE	Medium	Regular maintenance will ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
Table .2.2.1; (5) $w_{CH4,y}$	Low	The gas analyser should be subject to a regular maintenance and testing regime to ensure accuracy.
Table .2.2.1; (6) EGy	Low	Meter will be subject to regular maintenance.
Table .2.2.1; (7) $CEF_{electricity,y}$	Low	A conservative estimate will be used (please refer to section D.2.4 above)
Table .2.2.1; (8) legal	Low	Monitoring will be made through phone calls to the relevant authority.

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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

The project monitoring will be conducted by the designated site engineer. The monitoring protocol follows internationally recognized standards. See Annex 4 for details of the operational and management structure.

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

The monitoring study was concluded in November 2005. The entities determining the monitoring and participating in the project as the Carbon Advisors are EcoSecurities Ltd., UK, and EcoTraders Ltd, Israel, listed in Annex 1 of this document.

Annex 4

MONITORING PLAN

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the Hiriya Landfill Project in Israel. The main components covered within the monitoring plan are:

1. Parameters to be monitored, and how the data will be collected
2. The equipment to be used in order to carry out monitoring

3. Operational procedures and quality assurance responsibilities

The requirements of this MP are in line with the kind of information routinely collected by companies managing landfill gas collection and destruction systems, so internalising the procedures should be simple and straightforward. If necessary, the MP can be updated and adjusted to meet operational requirements, provided that such modifications are approved by a Designated Operational Entity during the process of verification.

As the Hiriya Landfill project is currently already operating, monitoring has been undertaken since January 2005. The monitoring plan details the actions necessary to record all the variables and factors required by the methodology ACM0001, as detailed in section D of the PDD. All data will be archived electronically, and data will be kept for the full crediting period, plus two years.

Table 4a Data to be collected or used to monitor emissions reductions from the project activity.

ID Number	Data Variable	Data Unit	Measured (m), calculated (c) or estimated (e)	Monitoring Frequency and Method	Proportion of data to be Monitored	Responsible Parties/ Individuals For Monitoring	Monitoring Equipment	Comments
1. $LFG_{total,y}$	Total amount of landfill gas captured	Nm^3	m	Data measured continuously by flow meter that automatically normalizes the reading to Nm^3 in a continuous manner. Data recorded weekly by site operator.	100%	DRAT Site Engineer	Flow meter	Data will be aggregated monthly and yearly, as of January 2005.
2. $LFG_{flared,y}$	Amount of landfill gas Flared	Nm^3	m	Data measured continuously by flow meter that automatically normalizes the reading to Nm^3 in a continuous manner. Data recorded weekly by site operator.	100%	DRAT Site Engineer	Flow meter	Data will be aggregated monthly and yearly, as of January 2005.
3. $LFG_{thermal,y}$	Amount of landfill gas combusted in boiler	Nm^3	m	Data measured continuously by flow meter that automatically normalizes the reading to Nm^3 in a continuous manner. Data recorded weekly by site operator	100%	DRAT Site Engineer	Flow meter	If any landfill gas is supplied to boilers in the future, this will have to be monitored according to ACM0001. Data will be aggregated monthly and yearly
4. FE	Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)	%	m/c	(1) Continuously by designated engineer (2) quarterly, monthly if unstable; samples will be sent to a lab for analysis	n/a	DRAT Site Engineer	(1) n/a (2) Lab	FE is critical to ensuring complete combustion of the methane. Samples of the exhaust gas will be taken quarterly to measure volatile organic compounds, which will provide a measure of the flare's efficiency. Samples will be taken monthly if readings are unstable.
5. $W_{CH4,y}$	Methane fraction in the LFG	Nm^3 CH_4/ Nm^3 LFG	m	Weekly, using a gas analyser	100%	DRAT Site Engineer	Gas analyser	Data will be aggregated monthly and yearly, as of January 2005.

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6.	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from the gas)	MWh	m	Continuously, using an electricity meter	100%	DRAT Site Engineer	Electricity Meter	It will be assumed for conservativeness that all electricity used in the project will be supplied from the grid. Electricity bills we be used to record electricity consumption. Data will be aggregated monthly and yearly, January 2005.
~~7.~~ 6	CO_2 emission intensity of the electricity in ID	T CO_2/ MWh	e	Annually	100%	EcoTraders	n/a	Grid CEF is based on assumption of 100% heavy coal (conservative). The make-up of the Israeli grid will be reassessed each year to ensure that the grid emissions factor does not exceed the highly conservative value chosen (see section D)
~~8.~~ 7	Regulatory requirements relating to LFG projects	Test	N/a	Annually	100%	EcoTraders	n/a	Israeli legislation relating to LFG flaring and/or usage will be assessed each year to determine whether any changes need to be made to the adjustment factor (AF) or $MD_{reg,y}$

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Table 4b Equipment used to monitor emissions reductions from the project activity

Equipment	Variables Monitored	Operational range	Calibration procedures	Parties responsible for operating equipment	Procedure in case of failure	Default value to use in case of failure	Comments
Flow meter	1. $LFG_{total,y}$ 2. $LFG_{flared,y}$ 3. $LFG_{thermal,y}$		Equipment will be calibrated annually by the equipment supplier on site	Site Operator	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. Failure events will be recorded in the site events log book.	Previous reading minus 5%	
Gas Analyser	5. $W_{CH4,y}$		Equipment will be calibrated annually by the equipment supplier on site	Site Operator	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. Failure events will be recorded in the site events log book.	previous reading minus 5%	
Electricity meter	6.		Equipment will be checked monthly by the DRAT Lead Engineer	Site Operator	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. Failure events will be recorded in the site events log book.	Previous reading plus 5%	

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Table 4c Operational procedures and responsibilities for monitoring and quality assurance of emissions reductions from the project activity (E = responsible for executing data collection, R = responsible for overseeing and assuring quality, I = to be informed)

Task	DRAT Lead Engineer	DRAT Site Engineer	Equipment Supplier	EcoTraders	EcoSecurities
Collect Data	R	E			
Enter data into Spreadsheet	R	E		R	
Make monthly and annual reports	R	E		R	I
Archive data & reports	R	E		R	I
Calibration/Maintenance, rectify faults	I	R	E	I	I

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6. T	Temperature of the landfill gas	Project developer	ºC	m	Weekly	100%	ele
7. P	Pressure of the landfill gas	Project developer	Pa	m	Weekly	100%	ele

86. EG_y	Total amount of electricity and/or other energy carriers used in the project for gas pumping. (not derived from the gas)	Project developer	MWh	m	Continuously	100%	electronic	Only electricity will be used. Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity.

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Table .2.2.1; (6) T	Low	The equipment should be subject to a regular maintenance ar
Table .2.2.1; (7) p	Low	The equipment should be subject to a regular maintenance ar

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6. T	Temperature of the LFG	℃	m	Weekly, using a temperature sensor	100%	DRAT Site Engineer	Temperature sensor.	
7. p	Pressure of the LFG	Pa	m	Weekly, using a pressure meter	100%	DRAT Site Engineer	Pressure meter	
86.	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from the gas)	MWh	m	Continuously, using an electricity meter	100%	DRAT Site Engineer	Electricity Mete	

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Temperature Sensor	6. T		Equipment will be calibrated annually by the equipment supplier on site	Site Operator	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. Failure events will be recorded in the site events log book.	Previo mir

Pressure meter	7. p		Equipment will be calibrated annually by the equipment supplier on site	Site Operator	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item. Failure events will be recorded in the site events log book.	Previo mir