

Base Protocol Plan for Aerobic Landfill Bioreactor Projects

Fast Track Protocol Development Process

Submitted: January 2009

This document has been prepared by Blue Source Canada ULC on behalf of the Industry
Provincial Offset Group Working Group 7: Landfill.

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Part I: Identification of the Protocol Developer

1.1 Title of the Base Protocol:

Quantification Protocol for Aerobic Landfill Bioreactor Projects

1.2 Lead Protocol Developer

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Initiating Entity

Organization:	Industry Provincial Offsets Group (IPOG)
Name:	
Title:	
Address:	
City:	
Province:	
Postal Code:	
Email:	
Website:	http://www.offsetsgroup.ca
Telephone:	
Fax:	

1.4 Rationale for initiating the development of the protocol (optional):

There is industry support behind the development of this protocol and a recognized opportunity to generate greenhouse gas offset credits.

Through the Industry Provincial Offset Group, members strive to ensure that protocols are:

- Based on a complete life-cycle analysis with consideration of all relevant GHG sources and sinks;
- Consistent in their treatment of cross-cutting issues;
- Based on accurate and unbiased best science and best practice guidance;
- Fully transparent; and
- Conservative so as to ensure that environmental integrity is maintained.

Part II: Base Protocol Applicability and Development Approach

2.1 Description of the Project Type:

This protocol is applicable to the quantification of direct GHG emission reductions arising from the implementation of an aerobic landfill bioreactor within one or more closed cells at a landfill. An aerobic bioreactor is an engineered network of wells and pipes within a landfill cell that provides controlled conditions to enhance the aerobic decay of organic wastes within a landfill such that methane emissions are essentially eliminated. The aerobic bioreactor acts like an in-situ aerobic composter within the landfill cell by controlling the circulation of moisture and oxygen (air) to enhance the microbial decomposition of the organic wastes. A properly functioning aerobic landfill bioreactor maintains the conditions necessary to support aerobic decomposition of the waste, which prevents the normal anaerobic (oxygen-free) conditions in the landfill that result in methane generation.

The decomposition of organic waste in landfills under oxygen-free (anaerobic) conditions results in the generation of methane, carbon dioxide and various trace gases, collectively referred to as landfill gas (LFG). The CO₂ emissions produced from the decay of waste are considered to be biogenic in nature as the release of CO₂ during decay represents the re-release of CO₂ originally absorbed from the atmosphere during the growth of the plant matter. The methane emissions from anaerobic waste decomposition in landfill, however, are considered to be anthropogenic in nature as the human activity of disposing waste under oxygen-free conditions resulted in the creation of a new source of GHG emissions.

The anaerobic decay of waste in landfill is a slow process and can continue to generate methane emissions for over 100 years. The two main options for controlling the release of methane emissions from existing landfill sites are to implement landfill gas capture and destruction systems or to implement aerobic processes, such as aerobic landfill bioreactors, that prevent the formation of methane altogether. A landfill gas capture and destruction system will usually only be viable for portion of the lifetime of the landfill and will therefore only reduce a portion of the GHG emissions. An aerobic landfill bioreactor, however, can speed up the waste decomposition process such that the organic material in the landfill can be stabilized within a few years with limited to no remaining methane generation potential. The implementation of an aerobic landfill bioreactor can therefore prevent the generation of methane emissions from waste decay that would have been released over many decades into the future.

This protocol is applicable to landfill cells (or entire landfills) that have reached their maximum capacity and will not be accepting additional waste materials. These landfill cells may have been closed for many years or may have been originally designed to incorporate an aerobic landfill bioreactor system at the time of closure.

The aerobic landfill bioreactor may be installed at sites where a landfill gas collection and destruction system previously existed. The implementation of brand new equipment to aerobically treat the waste would indicate that the previously installed LFG collection

system was not meeting the operational objectives for the site. As such, the aerobic landfill bioreactor technology would provide an option to remove the remaining methane potential of the organic waste materials at the site within a shorter period of time. Therefore, the baseline condition would remain as the passive emission of landfill gas generated under anaerobic conditions unless otherwise mandated by law.

Where landfill gas capture is mandated by law, a discount factor to account for the portion of landfill gas that would have been captured in the baseline is included to allow these projects to generation emission reductions for any activities surplus to regulatory requirements.

To meet the requirements under this protocol, the project developer must supply sufficient evidence to demonstrate that:

- The landfill facility is being operated under the conditions of its operating license;
- The landfill or landfill cell(s) are covered as per the operating requirements to manage passive landfill gas migration, and therefore minimal fugitive release of methane; and
- If the landfill is subject to regulations requiring the capture and destruction of landfill gas, the quantification of baseline emissions accounts for the impact of these regulations.

Since the installation of aerobic landfill bioreactor projects can prevent the generation of methane emissions from waste decomposition in landfills, such projects will positively impact Canada's National GHG Inventory. The following impacts will be realized under the associated sectors, as outlined in the National Inventory Report 1990 – 2005: Greenhouse Gas Sources and Sinks in Canada:

- The reduction of GHG emissions from municipal or industrial solid waste landfills is addressed in section 8.2 “Solid Waste Disposal on Land (CRF Category 6.A).”

2.2 Description of Project-specific Technology (if applicable)

An aerobic landfill bioreactor is a landfill cell that is specifically engineered to enhance the aerobic decomposition of wastes through careful manipulation of site conditions. An example of this technology is SALT Inc.'s Aerobic Bioreactor technology¹.

Wells are drilled at various depths throughout the landfill or landfill cell(s). Some of these wells are used for pumping air into the waste material and recirculating leachate, while the rest are used as vents for the escaping gases. This provides the conditions to support aerobic decomposition and thus the production of carbon dioxide as the main

¹ <http://www.saltinc.ca/Technology.html>

product of decomposition. This carbon dioxide then follows a preferential escape pathway up and out of the venting wells.

2.3 GHG(s) that will be reduced:

The following GHGs will be reduced from aerobic landfill bioreactor projects:

- CH₄ through reduced emissions from anaerobic decomposition of waste in landfill.

The following GHGs will be impacted by aerobic landfill bioreactor projects (and will also be quantified by this protocol):

- CO₂ through combustion emissions and electricity usage;
- CH₄ through combustion emissions and venting and fugitive emissions from the aerobic treatment of waste in landfill; and
- N₂O through combustion emissions and venting emissions from the aerobic treatment of waste in landfill.

2.4 Description of how real reductions will be achieved:

The opportunity for generating carbon offsets with this protocol arises from the avoidance of methane emissions released from the anaerobic decomposition of organic materials in landfills.

The baseline condition represents the passive emissions of greenhouse gases (primarily methane) from the organic component of waste decomposing anaerobically in a landfill or landfill cell(s) that would have resulted had the aerobic landfill bioreactor not been implemented. The baseline is therefore dependent upon the methane generation potential (Lo) of the landfill or landfill cell(s), the value of which is determined through direct landfill waste sampling and analysis using the biochemical methane potential assay approach. This protocol does not apply to landfill sites that are regulated to capture and destruct methane emissions.

In the project condition, emissions are reduced as conditions are maintained to support aerobic decomposition of the waste and resulting carbon dioxide emissions are considered as biogenic. To ensure real reductions are achieved, the methane generation potential and venting and fugitive emissions of methane are measured directly using industry accepted standards.

A testing period for this activity will not be required prior to full implementation.

2.5 Base Protocol Flexibility (optional):

Flexibility in applying the quantification protocol is provided to project developers in one way:

1. Site specific emission factors and other project specific factors (i.e. relevant landfill characteristics) may be substituted for the generic emission factors indicated in this protocol document. The methodology for generation of these emission factors must ensure accuracy; and be robust enough to provide uncertainty ranges in the factors;

If applicable, the proponent must indicate and justify why flexibility provisions have been used.

2.6 Federal, Provincial/Territorial Legal Requirements & Climate Change Incentives

2.6.1 List of potentially relevant requirements:

Primarily, the legal requirements and climate change incentives impacting the projects included within the scope of this protocol relate to landfill gas (LFG) generation at landfills from which waste is diverted. This protocol will not be applicable at sites where LFG collection is a regulatory requirement.

There are currently no federal legal requirements pertaining to LFG or GHG generation from landfills, and regulation is typically not undertaken at the municipal level. In Canada, landfill gas regulations are generally enacted at the provincial level, and to varying degrees according to general goals and requirements. The regulatory considerations are incorporated into site operating certificates or certificates of approval and generally do not specify an amount of landfill gas that must be combusted at the sites; provisions are made for combustion of landfill gas in flares (generally enclosed), reciprocating engines or other combustion devices. There are only three Provinces with legal requirements applicable to LFG projects including:

- British Columbia currently has proposed LFG regulation on GHG generation from landfills which is anticipated to come into effect January 1, 2009. The specific requirements and threshold values for implementing LFG control systems is currently under consideration.
- Alberta Reg. 139/2007 - Specified Gas Emitters Regulation: Regulation applies to facilities with total direct GHG emissions equal to or over 100,000 tonnes CO₂e per calendar year. Must submit a baseline emission intensity application, and annual compliance reports. These regulations are not specific to LFG.
- Ontario has specific legislation regarding LFG emissions and previously required all operating landfills above 3.0 million cubic meters in airspace to implement LFG control systems. Recently, Ontario Regulation (O. Reg.) 216/08 amended O.Reg.232/98 to lower the threshold landfill size to 1.5 million cubic meters for mandatory air emissions control; and
- Also in Ontario, O. Reg. 217/08 amends O.Reg.347 to ensure operating landfills which are not being expanded report on the design of LFG controls and have LFG controls in place.

- Quebec Règlement Sur Lafrisement et Incineration des Materials Residuals - landfills having a maximum capacity greater than 1.5 million cubic meters, or as soon as a landfill receives 50,000 tonnes or more of residual materials per year, the biogas collection system must have a gas pumping device. In addition, the biogas collected must be removed by means of thermal destruction equipment capable of destroying at least 98 percent.

The remaining western provinces, eastern provinces, and territories do not have provincial or municipal legal requirements governing LFG or GHGs generated from landfills.

No other relevant regulations have been identified.

2.6.2 List of potentially relevant climate change incentives:

The following federal and provincial climate change incentives have been identified for implementing LFG systems:

- Climate Fund – federal institution for the purchase of domestic and/or international emissions reductions and removal credits, which will be one of Canada’s approaches to climate change.
- Pilot Emissions, Removals, Reductions and Learning (PERRL) Initiative – federal initiative designed to provide Canadian companies, and organizations with an economic incentive to take immediate action to reduce GHG emissions. There were six Canadian landfills that successfully applied to this initiative and that received revenue for emissions reductions achieved.
- Renewable Power Production Incentive (RPPI) - 1 cent/kWh Incentive- is a federal funded program aimed at small hydro, biomass, and LFG utilization projects announced by the previous Liberal government. The status of this program is currently uncertain.
- New Brunswick Climate Change Action Plan – provincial initiative that includes financial incentive to install methane management systems at two of the six engineered provincial landfills.
- Standard Offer (through the Ontario Power Authority (OPA)) - provincial incentive provided by the Ontario government that encourages project developers to set up renewable energy systems by letting them sell "clean" power to the grid at a fixed premium. Several Ontario landfills are engaged in this program for the development of LFG to energy power plants.
- FCM’s Green Municipal Fund (GMF) - provides loans and loans with grants for projects related to brownfields, energy, transportation, waste, and water up to 80 percent of the capital cost.

No other climate change incentives have been identified for the development of aerobic landfill bioreactor projects in Canada.

2.7 Building on existing protocols or proprietary information (if applicable)

Registered name of protocol:	Quantification Protocol for Aerobic Landfill Bioreactor Projects
System for which protocol was developed:	Alberta Offset System
Date protocol was completed and approved:	January 2008
Developer of the protocol	
Name:	Keith Driver
Organization:	Blue Source Canada ULC

2.8 Explanation of how the existing protocol will be adapted:

The existing seed protocol will be adapted through an inclusive, transparent and consistent process coordinated through the Industry Provincial Offset Group's (IPOG) broad membership. In particular, work will be conducted by a protocol technical working group formed specifically to address adaptation of the protocol in question and potentially other related protocols. Cross-cutting issues groups will also be formed to address issues affecting a range of protocols, and to ensure consistency in approach.

Through this process the format and content of the existing protocol will be updated to meet the requirements of Environment Canada. Apart from the additional elements required, other noteworthy changes may be made to the Alberta Quantification Protocol for Aerobic Landfill Bioreactor Projects to adapt it for national applicability.

These may include the following:

- The applicability criteria for this protocol may be changed to allow landfills / landfill cells that are required to collect landfill gas to apply the protocol. The baseline calculation of methane emissions from the anaerobic decomposition of waste in landfill would be adjusted accordingly; and
- The SSRs for fuel extraction and processing (P9 and B8) may be excluded and the SSR for electricity usage at the site (P11) included for consistency.

Adaptation of the existing protocol will follow the multi-step process outlined below:

- Collection of technical and background information related to development, review and approval of the protocol to ensure transparency through the adaptation process;
- Review of the protocol to ensure consistency with Canada's "Turning the Corner" action plan and the requirements of the federal offset system. Any areas of inconsistency with the protocol documentation will be identified in this step;

- Review of existing provincial and federal regulations that could impact the surplus nature of the emission reductions from the project activity. This phase will serve to address the surplus requirement relative to applicable federal and provincial legislation;
- Review of the seed protocol's baseline condition to address the incremental nature of the project activity in the Canadian context. This review will include an assessment of the baseline's compatibility with Canadian best practices and potential alternative baseline approaches;
- Review of the protocol to ensure the quantification methodology is consistent with best practice guidance, and applicable to the range of Canadian geographical and climatic conditions;
- Review of the protocol's measurement and monitoring requirements to ensure they are reflective and reasonable in the Canadian context. This will include a review of data collection requirements and frequency of measurement and monitoring;
- Consideration of other environmental impacts and criteria air contaminants, as required by the "Turning the Corner" action plan;
- Additional analysis to address any outstanding issues identified to date that may present a significant challenge to protocol adaptation. This step will include assembly of the technical working group to drive further analysis;
- Redrafting of protocol to address technical issues identified in the previous steps and to ensure it meets the technical and format requirements of the Canadian offset system;
- Review of any material changes made to the quantification approach using project data to ensure the revised methodology is generally consistent with the original documentation;
- Cross-protocol review of the adapted protocol with other protocols adapted by IPOG, to ensure consistency in scope and approach to quantification; and
- Compilation of documents required for submission of the final draft protocol to Environment Canada for approval. The results of all stages of the review and adaptation process will be summarized and compiled to support Environment Canada's review.

Given the volume of work required under short timelines, multiple agencies will be required to provide a range of technical inputs, perspectives and capacity. To accomplish required tasks and meet timelines, technical resources within IPOG will be mobilized to provide input; drawing on group member's significant experience in protocol and project development.

This IPOG Working Group will draw on the experience of Climate Change Central to manage the adaptation process and to ensure broad stakeholder involvement by parties that may not be comfortable working directly with IPOG.

2.9 Explanation of the nature of the proprietary information and how it might be used in the Base Protocol:

We are anticipating full disclosure and transparency, therefore, there are no perceived issues regarding proprietary information associated with this protocol.

Part III: Declaration / Consent / Signature

The undersigned acknowledges that the undersigned has read, understood and that the undersigned agrees to abide by all the terms, conditions, instructions, and notices set out in the Guide for Protocol Development.

The undersigned acknowledges that the review of, and comments regarding, this base protocol plan or portions thereof does not ensure that the base protocol plan or portions thereof will be used in an Offset System Quantification Protocol by Canada's Offset System for Greenhouse Gases.

The undersigned is legally authorized to use any and all proprietary (or protected) information found in and submitted with the base protocol plan.

The undersigned is duly authorized to sign this application.

The undersigned declares that the base protocol plan submitted for Canada's Offset System for Greenhouse Gases and the information provided on, with or pursuant to this application is true, accurate and complete.

The undersigned consents to the public disclosure, in any manner including, without limitation, posting on Offset System website, of all the information in the base protocol plan and the information submitted with the base protocol plan.

By protocol developer (individual, or an organization's or a corporation's duly authorized representative, date, name, title)

By: **KEITH DRIVER**

Title: **VICE-PRESIDENT, OPERATIONS
BLUE SOURCE CANADA ULC**

Signature: _____

Signed this ____ day of _____, 2008