The Corporation of the City of Sault Ste. Marie

Public Works & Engineering Services

Environmental Monitoring Committee
Meeting Agenda

Date: October 29, 2025

Time: 2:30 p.m.- 4:00 p.m.

In-Person Location: Sault Ste. Marie Landfill
402 Fifth Line East

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1. Introductions
2. Approval of Minutes – September 11, 2024
3. Information distributed:
    a. Terms of Reference
    b. Landfill Gas to Energy Feasibility Study
4. Facility Tour
5. Adjournment

The Corporation of the City of Sault Ste. Marie

Public Works & Engineering Services

Environmental Monitoring Committee
Minutes of Meeting

Draft

September 11, 2025
Time: 10:00 a.m. Thompson Room – Civic Centre

Present

Peter McLarty	Member of the Public (Committee Member)
Christopher Marsh	Member of the Public (Committee Member)
Carl Rumiel, P. Eng.	Director of Engineering (City)
Mike Blanchard	Manager of Waste Management (City)
Mikhaila Lafleur	Environmental Compliance Officer, MECP
Andrew Mallette, P. Eng.	Manager, Development and Environmental Engineering (City)
Corrina Barrett	General Manager, SSM Region Conservation Authority (via Teams)
Rick Talvitie, P. Eng.	Manager, Northern Ontario, AECOM
Tara Abernot	Project Manager, Water Business Line, AECOM
Corrina Barrett	SSM Regional Conservation Authority (via Teams)
Muntazir Pardhan, P.Eng.	Dillon Consulting (via Teams)
Rob Kell, P.Eng.	Dillon Consulting (via Teams)
Suzie Caron	Meeting Recorder (City)

Regrets

Ron Zagordo	City Councillor
David McLaughlin	Member of the Public (Committee Member)
Tom Peer	Member of the Public (Committee Member)
Anjum Amin	SSM Region Conservation Authority

No.	Details	Action By:
1.0	Introductions – Round table	Info
2.0	Minutes for the December 2, 2024 meeting were approved • Moved by P. McLarty • Seconded by M. Blanchard • P. McLarty stated that he used to chair the meetings, but declined continuing as Chair • New Chair will be required	Committee
3.0	Council Reports • One Council Report – Landfill Operations and Monitoring 2024 – Environmental Monitoring Committee • No comments or questions	Info
4.0	2024 Operations and Monitoring Reports	

	• Two reports annually • Presentation on Operations • Presentation on Monitoring • A copy of the presentation provided in Agenda	Info
5.0	Environmental Assessment Update • In final stages, pending acceptance with Ministry • The report has been published on the City's website • Waiting for Ministry approval to begin expansion	Info
6.0	Odour Control / Complaints • Covered by R. Talvitie in his presentation • List of eight (8) complaints included with the Agenda • Majority of complaints believed to be primarily related to biosolids deliveries • The flare was offline on three of the complaint days	Info
7.0	On-going Initiatives Overview a) Expansion and Development of New Waste Cells b) Source Separated Organics and Biosolids Composting Facility – Design phase in 2026, in operation by 2028 c) Pump Station Upgrades – upcoming project for end of life replacements	Info
8.0	Other • Past Landfill Gas feasibility report requested for review at future meeting. • Terms of Reference requested for review at future meeting. • P. McLarty volunteered to educate new committee members on past committee dealings. Contact Andrew Mallette at City for contact information. • Next Meeting will be held in late October (on-site at Landfill) • 3rd meeting for 2025 will be held in early December • 2026 – First meeting will be held in late June.	A. Mallette
9.0	Adjournment • Meeting Adjourned at 12:07	

Recorded by: Suzie Caron

THE CORPORATION OF THE CITY OF SAULT STE. MARIE

BY-LAW 2004-215

LOCAL BOARDS – (L.5.1.1.) A by-law to re-establish a Local Environmental Monitoring Committee for the Sanitary Landfill Site.

WHEREAS a condition of the Provisional Certificate of Approval issued by the Ministry of the Environment for the Sanitary Landfill Site requires that the City of Sault Ste. Marie establish an Environmental Monitoring Committee;

AND WHEREAS By-law 89-174 established the Local Environmental Monitoring Committee;

AND WHEREAS the City wishes to up-date the duties of the Environmental Monitoring Committee;

NOW THEREFORE the Council of the Corporation of the City of Sault Ste. Marie enacts as follows:

1. **COMMITTEE ESTABLISHED**

The Council hereby re-establishes a Committee to be known as "The Environmental Monitoring Committee for the Sanitary Landfill Site" to be comprised of not less than six and not more than eight members.

2. **MEMBERSHIP**

The committee is to be made up as follows:

(a) One Member of City Council;

(b) Two Members of the Corporation of the City of Sault Ste. Marie: Commissioner, Engineering & Planning or designate, Manager of Construction & Environmental Engineering;

(c) Four Members Representing Area Residents and the General Public, and

(d) Representative from the Ministry of Environment: (Ministry of Environment Senior Environmental Officer whose assigned area includes the landfill)

3. **DESIGNATE**

Designates may be appointed to attend meetings in the absence of members of the Committee.

4. **MINISTRY OF THE ENVIRONMENT REPRESENTATIVE**

The representative of the Ministry of the Environment shall attend all meetings as an ex officio member to act as a resource person and not to participate in any deliberations or decision making activities of the Committee.

5. **CHAIRPERSON – MINUTES**

(a) The Committee shall elect a chairperson and a secretary at the first meeting each year.

(b) Minutes of each meeting shall be kept and distributed to Committee members.

6. DUTIES OF COMMITTEE

The duties entrusted to the Environmental Monitoring Committee for the Landfill Site are as follows:

(a) To review and comment as considered necessary on information submitted under the requirements of the Certificate of Approval as well as any other information as it becomes available and pertains to the operation of the Sanitary Landfill Site.

(b) To report findings and make recommendations on the said site and its operation to Council, in an annual information report to Council following the Annual Operations and Monitoring Reports submitted to the Ministry of Environment in February.

(c) Committee members may make their views or the individual views of one or more of its members known to the Regional Director of the Ministry of the Environment by providing the Regional Director with a copy of the regular meeting minutes.

(d) To review and comment, as required on data regarding the operation of the site monitoring programmes as provided for in the certificate of approval and to review individual concerns and complaints.

7. NOTWITHSTANDING SECTION 6

The Committee shall not exercise any supervisory, regulatory, approval or other decision making role with respect to the operation of the Sanitary Landfill Site.

8. PUBLIC MEETINGS

Meetings of the committee shall be open to the public and minutes will be posted on the City's web page.

9. FREQUENCY OF MEETINGS

The Committee shall meet at least three (3) times each year.

10. REPEAL OF BY-LAW 89-174

By-law 89-174 is hereby repealed.

11. EFFECTIVE DATE

This by-law shall be in effect form the date of its final passing.

Read THREE times and PASSED in open Council this 29th day of November, 2004.

MAYOR – JOHN ROWSWELL

CLERK – DONNA IRVING

SCS ENGINEERS







LFG-to-Energy Feasibility Study Update

Presented to:

PUC Services Inc.
550A Second Line East
P.O. Box 9000
Sault Ste. Marie, Ontario
P6A 6P2

Presented by:

SCS ENGINEERS
4 Executive Boulevard
Suite 303
Suffern, New York 10901
845-357-1510

October 10, 2011
File No. 13204007.04

Offices Nationwide
www.scsengineers.com

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Table of Contents

Appendices

1.0 INTRODUCTION

This report updates SCS Engineers' (SCS) original landfill gas to energy (LFGE) feasibility study, dated January 24, 2008 and prepared for PUC Services Inc. (PUC), relative to the Sault Ste. Marie Municipal Landfill (Landfill) in Sault Ste. Marie, Ontario. The information presented in this report on landfill gas (LFG) energy utilization takes into account data and information provided by AECOM, for whom SCS is working as a sub-consultant. In preparing this report, SCS conducted the following activities:

- Reviewed and updated background information relative to the Landfill, including historical and future Landfill operations, as provided by AECOM.
- Revised LFG recovery projections.
- Researched and updated available energy markets.
- Revised conceptual technical models for two (2) future possible disposal scenarios.
- Estimated capital costs, operating costs, and expected revenues for the two cases.
- Provided conclusions and recommendations for further action.

LFG recovery estimates were prepared by SCS. Changes in Landfill operations and conditions (e.g., variations in rainfall, fill rates, water levels, system operations, final cover systems) may affect future LFG recovery at the Landfill. SCS does not guarantee the quantity or the quality of available LFG.

This report has been prepared in accordance with the care and skill generally exercised by reputable LFG professionals, under similar circumstances, in this or similar localities. No other warranty, express or implied, is made as to the professional opinions presented herein.

1.1 LANDFILL DESCRIPTION

The Landfill has been in operation since about 1954, and was privately owned and operated until 1989, when the Corporation of the City of Sault Ste. Marie (City) assumed ownership and operations. The Landfill currently receives about 60,000 tonnes of waste per year, which is estimated to be entirely municipal solid waste (MSW). As of December 2010, there is remaining capacity for waste and daily cover of just over 1 million cubic metres. At the current filling rates, this remaining capacity represents 9.1 years of landfill operation. The longevity of the Landfill may extend beyond 9.1 years at current filling rates as subsidence of the underlying waste occurs over time.

There are no formal cells for the Landfill, which consists of a single mound. Filling has and will occur throughout the Landfill in the future. However, for LFG recovery estimates, we describe the Landfill as consisting of north, south, east and west areas. The east area of the Landfill has generally been filled from 1954 through 1996, and from 2000 through 2004. The west area has been generally filled from 1997 through 2004. The north and south areas have been used for filling from 2005 through the present.

Although there is no liner beneath the Landfill, there is a continuous horizontal leachate collection system along the south and southeast sides of the Landfill and purge wells along the west side of the Landfill. Groundwater that is collected by these systems is pumped to the sanitary sewer system.

Between 2005 and 2010, LFG was controlled using passive flares on thirty (30) LFG wells in the east area of the Landfill. One additional well existed but was not equipped with a passive flare.

Waste processing research is performed by a private company (Elementa) in a building at the southwest corner of the Landfill (Elementa building).

1.2 CURRENT SITE CONDITIONS

In 2010, an active LFG collection and control system (GCCS) was installed, including 16 additional LFG wells, a LFG blower/flare station and associated LFG piping and appurtenances. 41 of the existing 47 wells are now connected to the GCCS. The Air Certificate of Approval (CofA) and the Waste CofA govern the construction and operation of the GCCS.

The blower/flare station is located adjacent to and south of the Elementa building, and a future LFGE facility may be located in the vicinity of the Elementa building.

1.3 WASTE FILLING HISTORY AND PROJECTIONS

AECOM provided SCS with the waste filling history for the Landfill, including amounts of waste placed and waste types. In recent history, the waste filling rate has been approximately 60,000 metric tonnes per year. Per AECOM's direction, SCS has prepared two future waste filling scenarios for LFG recovery. These two waste filling scenarios are summarized as follows:

Assumption	**Waste Filling Scenario #1**	**Waste Filling Scenario #2**
Base waste disposal rate	60,000 tonnes/year	
Biosolids disposal (i.e., 10,000 tonnes/year)	Diverted from base waste disposal rate as of 2016	
Elementa waste conversion project	No Elementa project	Elementa removes 20,000 tonnes/year* from base waste disposal rate beginning 2014
Base waste disposal rate growth	0.62 percent/year (no enhanced diversion)	0 percent/year (due to enhanced diversion)**
Landfill expansion	No expansion approved	

Notes:

* The capacity of the proposed Elementa project is in the range of 30,000 tonnes/year. The City has agreed to provide a minimum of 12,500 tonnes/year from the residential curbside collection program. It is expected that Elementa will find other local waste sources. For the purpose of this report, we have assumed 20,000 tonnes/year may be come from local sources and the remainder from sources outside the City. However, it is possible that Elementa may source more than 20,000 tonnes/year locally, which would result in a lower waste disposal rate at the Landfill.

** Additional waste from population growth is assumed to be approximately equal to reductions through enhanced waste diversion efforts.

2.0 LFG RECOVERY PROJECTIONS

2.1 SCS MODEL DESCRIPTION, INPUTS AND RESULTS

Several models are available for estimating LFG recovery rates from a landfill using site-specific input parameters. SCS typically estimates LFG recovery rates from landfills using the Landfill Gas Emission Model (LandGEM), which has been adopted by the U.S. EPA as part of the New Source Performance Standards (NSPS) for MSW landfills. Environment Canada does not currently require or propose use of any specific model or method for quantification of LFG generation or recovery, but have confirmed that they generally accept the use of the LandGEM for these purposes.

The LandGEM is a simplistic, first order, single stage model with only two input parameters (L_0, and k) other than waste receipts and LFG composition. It assumes that the gas production rate is at its peak upon initial waste placement, after a short lag time during which anaerobic conditions are established in the landfill. The gas production rate is then assumed to decrease exponentially (i.e., first order decay) as the organic fraction of the landfill refuse decreases.

The model equation is as follows:

$$Q = \sum_{i=1}^{n} 2kL_0 M_i (e^{-kt_i})$$

where,

Q = Methane generation rate from the landfill in the ith year, cf/yr
k = Methane generation rate constant, 1/yr
L_0 = Methane generation potential, cf/ton
M_i = Mass of refuse in the ith section, ton
t_i = Age of the ith section, yrs
i = Section number

The theoretical value for potential methane generation capacity of refuse, L_0, depends on the type of refuse only. The higher the cellulose content of the refuse, the higher the value of the theoretical methane generation capacity. The theoretical methane generation capacity is determined by a stoichiometric method, which is based on a gross empirical formula representing the chemical composition of composite refuse or individual refuse type. Some researchers have reported "obtainable L_0" which accounts for the nutrient availability, pH, and moisture content within the landfill. The researchers point out that "obtainable L_0" is less than the theoretical L_0. Even though refuse may have a high cellulose content, if the landfill conditions are not hospitable to the methanogens, the potential methane generation capacity of the refuse may never be reached. The "obtainable L_0" is approximated from overall biodegradability of "typical" composite refuse or individual waste components, assuming a conversion efficiency based on landfill conditions.

The methane generation rate constant, k, determines how quickly the methane generation rate decreases, once it reaches the peak rate upon placement. The higher the value of k, the faster the methane generation rate from each submass decreases over time. The value of k is a function of the following major factors: (1) refuse moisture content, (2) availability of the nutrients for methanogens, (3) pH, and (4) temperature. In general, increasing moisture content increases the rate of methane generation.

The input parameters selected for the purpose of preparing the LFG recovery estimates dictate the modeling results. It is also noted that the model developed by SCS is for LFG “recovery” as differentiated from “generation”. The most important or sensitive parameter that affects the results of the model output is the waste quantity information. The LFG decay rate constant and the ultimate methane recovery potential (k and L_0) also are important parameters that vary depending on the region and climatology of the site location.

Typical values for L_0 and k are published by Environment Canada’s Greenhouse Gas (GHG) Department and the U.S. EPA’s Office of Air Quality Planning and Standards, which develops emission factors for various industries, including landfills. In most cases, emission factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in a particular source category. Emission factors are updated periodically by the U.S. EPA and published in a document entitled “A Compilation of Air Pollutant Emission Factors”, which is commonly referred to by its document number, AP-42. The current AP-42 values (November 1998) for wet MSW landfills (25 inches or more of precipitation per year) are k of 0.04 yr^{-1} and a L_0 of 3,200 cubic feet per ton of waste received. Environment Canada suggests that site-specific values should be used.

The LFG model used by SCS applies the same first-order decay equation as the U.S. Environmental Protection Agency’s Landfill Gas Emissions Model (LandGEM). Unlike LandGEM which estimates LFG generation for regulatory purposes, the LFG model developed by SCS estimates LFG recovery for non-regulatory applications. The LFG recovery model used by SCS applies values for L_0 and k that are either (1) calibrated to LFG flow and methane data collected from the landfill being modeled, or (2) adjusted to default values developed by SCS based on a database of 764 years of LFG flow and methane data from 193 landfills with operational LFG collection systems.

The LFG modeling method used by SCS projects potential recovery, which is the maximum amount of LFG a fully comprehensive, efficiently operated GCCS can recover. Expected recovery given the limitations of the actual or proposed GCCS is calculated by multiplying potential recovery by the estimated fraction of LFG that is effectively collected, a measure called collection system coverage (discussed further below).

This approach to modeling allows us to take full advantage of our LFG recovery database, the most extensive in the industry. Dividing actual measured recovery by system coverage allows us to estimate with reasonable accuracy the potential recovery rates at the 193 sites in the database, and then find site-specific model k and L_0 values which best fit the data. SCS has found a good correlation between k values and average annual precipitation, which were used to develop a default “k vs. precipitation” curve to use for modeling sites without flow data for model calibration, or when collection system coverage is uncertain.

The SCS default model coefficients are empirically-based using a database much larger than any other in the industry (including EPA’s). This approach to modeling provides SCS with the most accurate possible estimates of potential recovery. Realistic estimates of collection system coverage based on the existing system design and performance, and planned GCCS build-out schedules, can then be applied to the model projections to derive estimates of expected recovery.

Annual precipitation in the vicinity of the Landfill is approximately 35 inches, as taken from Environment Canada Climate Normals for Sault Ste. Marie, Ontario, data averaged between 1971 and 2000. At 35 inches of annual precipitation, the SCS precipitation-based estimate for k value is 0.061 yr^{-1}.

SCS has also prepared calibrated LFG recovery models at other Canadian landfills. At a landfill in Montreal with approximately 45 inches per year, a k value of 0.0735 yr^{-1} was used by SCS in 2005, which resulted in recovery estimates that approximated actual recovery data over a 10-year period. Similarly, at three landfills in southern Ontario with approximately 35 inches of precipitation per year, k values of 0.09 yr^{-1}, 0.086 yr^{-1} and 0.06 yr^{-1} yielded recovery estimates which approximated actual recovery.

Similarly, SCS has analyzed LFG recovery (not generation) from over 197 MSW landfill sites across the U.S and Canada. The L_0 values for each landfill were estimated using actual LFG collection rates measured at the sites. The average L_0 value is 3,000 cubic feet per ton (93.6 m^3/tonne). SCS models LFG recovery directly, eliminating the need to multiply LFG generation by an estimated recovery rate. L_0 used as a model input parameter in the updated projections directly considers both methane generation and estimated recovery rate.

However, in comparison with other landfills, the Landfill is relatively small and shallow (with waste depths ranging from about 25 to 70 feet). In SCS's experience at numerous landfills, we have observed that the top 10 to 15 feet of waste can be influenced by air, which enters the waste due to changes in barometric pressure. This atmospheric pressure effect results in supply of oxygen to the waste, which encourages aerobic decomposition. Aerobic decomposition results in carbon dioxide formation, and no methane formation. This reduces the obtainable L_0 of the waste further, because aerobic decomposition reduces organic material available for anaerobic decomposition. The impacts of this atmospheric pressure effect on a small, shallow landfill are more pronounced than that at an average landfill, due to the significance of the depth of this effect (i.e., 10 to 15 feet) relative to the total depth of waste in the landfill. As such, we expect the obtainable L_0 value for the Landfill to be less than the average L_0 value estimated by SCS (i.e., 3,000 cubic feet per ton).

SCS has calibrated a LFG recovery model for another small, shallow landfill, with similar climatic conditions (i.e., annual precipitation and relatively cold temperatures) as the Landfill. The L_0 value for the calibrated LFG recovery model for this other landfill was 1,900 cubic feet per ton. SCS believes that a L_0 value in this range is suitable for use at the Landfill as opposed to our standard value of 3,000 cubic feet per ton.

The Landfill primarily accepts MSW. Construction & demolition (C&D) waste has also been disposed in the Landfill, but is not generally reported separately. SCS reviewed the proportions of C&D waste versus MSW in the Landfill for 1996 through 2000, 2003 through 2006, and 2008 through 2010, and found that C&D waste represents less than 10 percent of total waste in the

Landfill. As such, we have not considered use of a second model to estimate LFG recovery from other degradable wastes.

SCS's LFG recovery model estimates both the LFG recovery potential from the Landfill, assuming a 100 percent comprehensive GCCS, and the estimated LFG recovery rate, based on the estimated GCCS coverage. System coverage is a measure of the fraction of the refuse mass where LFG is recovered. The system coverage factor is based on engineering judgment, and considers many factors including:

- Closed or active status of the Landfill.
- Type of well construction and gas system construction.
- Status of GCCS operation, including open/closed status of wells, water conditions in the landfill, presence of a well dewatering system, etc.

The system coverage factor ranges between 0 percent (for no recovery) to 100 percent (for a fully comprehensive collection system). The system coverage factor for the Landfill was estimated, for the two scenarios discussed under Section 1.3 of this report, as follows:

- 1954-2010: 0 percent, no GCCS installed.
- 2011: 70 percent, based on GCCS installation and operation.
- Waste Filling Scenario #1:
  - 2012-2020: Increasing from 70 percent to 90 percent in evenly-spaced 10 percent intervals, reflecting expected GCCS expansions to cover new waste placement.
  - 2021: 100 percent, based on full system coverage and Landfill closure.
- Waste Filling Scenario #2:
  - 2012-2025: Increasing from 70 percent to 90 percent in evenly-spaced 10 percent intervals, reflecting expected GCCS expansions to cover new waste placement.
  - 2026: 100 percent, based on full system coverage and Landfill closure.

Generally, the GCCS has been continuously active since February 2011. Actual LFG recovery data for 2011 (to date) was provided by City staff from the flow meter at the Blower/Flare Station. Average 2011 LFG recovery was approximately 290 scfm at approximately 53 percent methane, which is equivalent to 300 scfm at 50 percent methane. SCS reviewed the estimated LFG recovery projection for 2011, based on the values for k, L_0 and LFG system coverage factors discussed above, and calibrated our LFG recovery model to the actual LFG recovery data.

Based on the 2011 data, lower precipitation at the Landfill as compared to the northeast US average, colder climatic conditions, calibrated LFG projections prepared for other landfills, and the effects of atmospheric pressure, we selected values for k and L_o as 0.061 yr^{-1} and 1,800 cubic feet per ton (i.e., approximately 56 m^3/tonne) , respectively, for the LFG recovery model.

The LFG recovery projections are based on a desktop analysis, waste receipt information and future projections provided by AECOM, and our engineering judgment as of the date of this report. Changes in Landfill operations and conditions (e.g., fill rates, variations in waste composition and tonnage, water levels, system operations, final cover systems) may affect future LFG recovery at the site. SCS does not guarantee the quantity or the quality of available LFG.

The LFG projections provided in Appendix A predict a future peak flow from the Landfill of approximately 420 scfm at 50 percent methane in 2021 for Waste Filling Scenario #1, and approximately 340 scfm at 50 percent methane in 2015 and 2020 (depending on timing of GCCS expansions) for Waste Filling Scenario #2. Estimated LFG recovery is at least 300 scfm, for Waste Filling Scenario #1, between 2013 and 2026, and between 2013 and 2027 for Waste Filling Scenario #2 (due to lower filling rate and extended filling period).

2.2 LFG QUALITY ISSUES

LFG quality considerations must account for:

- The quality of gas generated in the landfill, and
- The quality of gas extracted from the landfill via the collection system.

While these two considerations are related and interdependent, it must be recognized that a collection system will be inefficient and result in some air intrusion into the landfill and/or the collection system itself. Accordingly, it is important to design, construct and operate the gas collection system to optimize the quality of the gas collected.

The quality of LFG generated in the landfill will include 55 to 60 percent methane and the balance will be carbon dioxide, over the lifetime of LFG generation. Trace concentrations of other organic and inorganic compounds will also be present in part per million (ppm) ranges. Hydrogen sulfide may be present in the ppm range or the percent range, depending on the quantities of sulfur waste landfilled (e.g., wallboard). Oxygen and nitrogen will not be present in the LFG unless introduced artificially by a vacuum system, or in some cases, via changing atmospheric pressure.

In general, the quality of gas extracted from a landfill is a function of:

- The vacuum applied to the collection device.
- The design and construction of the collection device.
- The liner and capping systems.

Based on our experience, a LFG collection system can be readily designed, constructed and operated such that 50 percent methane is present in the recovered LFG stream. Our LFG projections in Appendix A are presented with LFG flow corrected to 50 percent methane. LFG with 50 percent methane will also include about 10 percent oxygen and nitrogen, combined, which represents air intrusion and inefficient extraction. The oxygen and nitrogen content can be much higher in practice (and the methane content lower by dilution), if the LFG collection is poorly designed, constructed, or operated; or if the LFG system must be operated aggressively to control odors, emissions, or for other reasons.

The following LFG quality issues should be considered, if a LFG utilization project proceeds:

- Waste composition will impact LFG quality in terms of sulfur content.
- Well design and spacing will impact gas quality.
- Collection system vacuum will impact air intrusion.
- Regular collection system evaluation, monitoring and adjustments will impact quality and air intrusion.
- Unlined landfill sections with no leachate collection systems will have less efficient gas collection and have more migration issues.
- Tight capping systems result in less air intrusion and better quality gas.
- Gas collected from the perimeter of shallow unlined sections is likely to have lower quality gas than that collected from deeper, center areas.
- Most engine and turbine manufacturers require a minimum methane content of 45 percent.

3.0 ENERGY MARKETS

3.1 OVERVIEW OF LFGE MARKET

Electric power generation is the most widely applied LFGE technology in Canada and the United States, though the industry is more developed in the United States. As such, much of the energy market information presented in this section is based on experience in the United States.

Microturbines, reciprocating engines, combustion turbines, steam cycle and combined cycle power plants have been successfully employed at many facilities in Canada and the United States. LFGE power plants can usually produce more electricity than can be used at the host landfill so most of the power must be sold for off-site use. Direct power sale to an independent, proximate retail customer (known as an "over-the-fence" transaction) is rare. As a result, virtually all of the power generated by LFG is typically delivered into the local electric distribution grid. The default customer for power generated by LFG was, and in most cases still is, the utility owning the local electric distribution grid.

Medium-Btu gas sale is the second most widely applied LFGE technology in the United States. There are more than 150 medium-Btu projects operating or under construction with a total installed capacity of about 62.3 billion cubic feet per year. Medium-Btu gas projects usually subject LFG to light cleanup and then convey a product gas, which has about one-half the Btu content of natural gas, through a dedicated pipeline to an end user. The medium-Btu gas will partially or completely displace natural gas, and less frequently displace coal or fuel oil, at the end user. The applicability of the medium-Btu gas alternative is limited because the end user must be proximate to the landfill.

Pipeline quality gas, sometimes called high-Btu gas, was a popular LFGE alternative in the early 1980s. After a long period of dormancy, pipeline quality gas experienced a resurgence in the mid-2000s. Early high-Btu projects employed liquid absorption technology. New pipeline quality gas projects generally employ membrane technology or pressure swing adsorption technology. There are about 37 high Btu projects in operation or under construction in the United States, with a total installed capacity of about 54 billion cubic feet per year.

In the United States, the LFGE industry has largely been, and will probably always largely be, a wholesale business. LFGE projects sell electric power and pipeline quality gas in bulk at wholesale prices. Other companies distribute and sell these products to individual retail customers. In the United States, LFGE's position as a wholesale industry accounts for what appears to be an anomaly: a residential customer paying the local utility 10 cents per kilowatt-hour (¢/kWh) for power while a LFGE project sells power to the same utility at 5¢/kWh. The exception to the wholesale sale rule is medium-Btu gas, where the "middleman" is eliminated. The middleman is eliminated with the expenditure of capital to build a dedicated gas transmission line from the landfill to the gas user. However, in Ontario, as discussed under Section 3.2.3.1 below, the Ontario Power Authority (OPA) is implementing the Feed-in Tariff (FIT) program, which subsidizes green energy projects. As a result, in Ontario, power generated by LFGE facilities is sold at a higher rate (around 11¢/kWh) than the rate at which it is purchased by consumers (between 7 to 11¢/kWh).

3.2 OVERVIEW OF ELECTRIC POWER MARKETS

3.2.1 Background

Canada’s needs for electricity generally are met through the following energy resources: falling water, coal, natural gas and uranium. Installed generating capacity totaled 124.2 gigawatts (GW) in 2007, and approximately 59 percent of Canada’s electric power was generated from hydro, 21 percent from thermal and 14 percent from nuclear energy sources.
The Canadian electricity system is part of an integrated North American electricity grid, but Canada's electricity markets have primarily developed along provincial or regional boundaries. Electricity pricing generally varies by province or territory according to the volume and type of available generation and whether prices are market-based or regulated. The provinces have each established regulators, licensing authorities and Crown corporations to administer their industries.

Alberta has moved the farthest in restructuring its electricity market. Its electricity prices are more market-based compared to other provinces and territories. Ontario has chosen to partially restructure its electricity market. Prices in other provinces and territories are set by the electricity regulator to cover costs and allow for a reasonable rate of return to investors.

Alberta has established a fully-competitive wholesale and retail electricity market; Ontario has open access transmission, wholesale and retail markets, but remains heavily regulated; British Columbia and New Brunswick have each completed the separation of their generation and transmission components; the remaining provinces continue to be characterized by vertically-integrated utilities. Most of the provinces have encouraged independent power development, especially for renewable energy sources.

For more than ninety years, Ontario Hydro, a government-owned, vertically-integrated electric utility, produced, transmitted, and distributed electricity to its customers in Ontario. In November 1998, the Government of Ontario passed the Energy Competition Act, which divided Ontario Hydro into several companies including the Independent Electricity Market Operator (IMO), Hydro One, and Ontario Power Generation (OPG). This restructuring allowed for open electrical markets, which opened in May 2002, allowing private companies to purchase electrical transmission and distribution, and allowing these private companies to sell electricity directly to consumers.

The key benefit of electricity deregulation is that consumers should be able to purchase electricity from a range of power suppliers and brokers, who are in competition with each other. This competition is expected to result in cheaper electricity, better service, technological improvements, and additional consumer choice. However, shortly after the open electrical market began, several problems were observed, including:

- Rising electrical costs: Electricity prices rose sharply with unusually hot weather in the summer of 2002 and limited electrical supply.

- Consumer complaints: Due to the rise in prices, numerous complaints were received from consumers, businesses threatened with bankruptcy, and those relying on electrically-powered medical devices.
- Shortages: IMO warned that Ontario faced a serious shortage of generating capacity, which could lead to brownouts and possible blackouts.

In December 2002, the Ontario government addressed these issues with deregulation under the Electricity Pricing, Conservation and Supply Act by capping electrical costs (at 4.3¢/kWh) and freezing delivery charges until 2006.

In response to recommendations from the Electricity Conservation and Supply Task Force, the provincial government enacted the Ontario Electricity Restructuring Act. The legislation provided for the creation of the Ontario Power Authority (OPA). The OPA was to address the power system planning issues and to secure new electricity supply for Ontario.

Growing ranks of industrial companies are installing combined heat and power (cogeneration) systems, enabling the efficient consumption of fuel. Independent power producers (IPPs) have emerged across Canada, with companies such as TransAlta and Atco Power playing leading roles.

3.2.2 Ontario Electric Power Markets

The Ontario Energy Board (OEB) regulates all natural gas and electrical utilities in the Province of Ontario. In particular, the OEB licenses participants in the natural gas and electricity markets who sell to low-volume customers.

As discussed above, electricity was historically generated and sold by the regulated utility Ontario Hydro, which owned, operated and maintained generation, transmission and distribution assets covering the entire province. After the deregulation of the Ontario electricity market, the former Ontario Hydro was separated into five independent companies. Of these successor companies, OPG and Hydro One are commercial entities. Items of note are as follows:

- OPG generates electricity and competes with other generating companies in the marketplace.

- Hydro One transmits and distributes electricity through one of its subsidiaries, Hydro One Networks.

- IMO, a not-for-profit crown corporation, runs the electricity exchange for the sale and purchasing of electricity. It arranges for the dispatch of electricity to regulated distribution companies who distribute electricity to the end user.

- The Electrical Safety Authority is responsible for safety standards including wiring installations, and equipment and appliance certification.

- The Ontario Electricity Financial Corporation, a crown agency, is responsible for managing the payment of Ontario Hydro's debt.

3.2.3 Potential Electric Power Markets

A review of the projected LFG recovery indicates that there may be sufficient LFG for an 800 to 1000 kW LFGE facility. Section 5 of this report discusses sizing of the conceptual LFGE facility in further detail. The following discusses the markets to which electricity generated at the LFGE facility may be sold.

3.2.3.1 Feed-In Tariff Program

The Ontario government is committed to ensuring that electricity from renewable sources becomes an important part of Ontario's energy future. In May 2009, the government of Ontario enacted the Green Energy and Green Economy Act (GEGEA) to boost investment in renewable energy projects and increase conservation, creating green jobs and economic growth in Ontario. Specifically, the GEGEA is intended to:

- Spark growth in clean and renewable sources of energy such as wind, solar, hydro, biomass and biogas in Ontario.
- Create the potential for savings and better managed household energy expenditures through a series of conservation measures.
- Create 50,000 jobs for Ontarians in its first three years.

The Feed-In Tariff (FIT) Program was created under the GEGEA. The OPA is responsible for implementing the FIT Program, which is North America's first comprehensive guaranteed pricing structure for renewable electricity production. The program provides a way to contract for renewable energy generation. It includes standardized program rules, prices and contracts for anyone interested in developing a qualified renewable energy project. Prices are designed to cover project costs and allow for a reasonable return on investment over the contract term. Qualifying renewable fuel sources include biogas, renewable biomass, LFG, solar photovoltaic (PV), water power, onshore wind and offshore wind.

The term of the standard contract under the FIT Program is 20 years. Generally, the FIT Program offers a base rate of 11.1¢/kWh for LFGE projects with a capacity of less than 10 MW. The FIT Program includes an escalation factor for 20 percent of the base rate, which is adjusted annually based on the Ontario Consumer Price Index (CPI). Over the past 5 years, the CPI has risen by 0.4 to 2.5 percent per year.

While there is an on-peak performance incentive available for projects under the FIT Program, this incentive is only useful for projects that do not operate continuously (i.e., 24 hours per day, 365 days per year). LFGE projects generally operate continuously (aside from shutdowns due to maintenance activities). As such, this on-peak performance incentive is not likely appropriate for a potential LFGE project at the Landfill.

The FIT Program also includes incentives for aboriginal and community-based projects, including reduced security payments and an additional incentive to the base electrical sale price. OPA indicates that these incentives are available for aboriginal and community-based projects as these projects face barriers and higher project costs not encountered by commercial developers. The incentives are available to help ensure that the projects are economically viable, and to level the playing field for groups that may otherwise be excluded from developing renewable energy projects. A community-based project must have at least 50 percent community participation level. Community participation level is generally defined as the percentage of economic interest of the applicant or supplier that is held by community investment members, which are defined as:

- One or more individuals resident in Ontario.
- A registered charity with its head office in Ontario.
- A not-for-profit organization with its head office in Ontario.
- A "co-operative corporation", as defined in the Co-operative Corporations Act (Ontario), all of whose members are resident in Ontario.

It is uncertain whether the PUC, which will likely be the applicant for the potential LFGE project, would meet the definition of a community investment member. As such, the community-based project incentive has not been included in this feasibility study. If the incentive does apply, it will increase the economic viability of a potential LFGE project. The maximum value of the additional incentive to the electrical sales base price would be 0.4¢/kWh, and is pro-rated based on percentage of community participation level.

The FIT Program requires all generators under the Program to transfer to the OPA all environmental attributes associated with the combustion of LFG, including (but not limited to) renewable energy, emission reduction and greenhouse gas (GHG) credits.

3.2.4 Potential Direct Use Markets

Under the OEB Act of 1998, the definition of natural gas includes natural gas, substitute gas, synthetic gas, manufactured gas, propane-air gas or any mixture of any of them. Provided that LFG qualifies under this definition, the sale of LFG is permitted to low-volume consumers (consuming 1.77 million scf of gas per year or less). It requires that the LFGE facility be qualified as a natural gas marketer. In order to do this, the facility must be licensed as a gas marketer with the OEB and adhere to the OEB's Code of Conduct for Gas Marketers. It is not known how long the licensing process takes to be completed but it does require a non-refundable fee of $500 (CDN) and annual fees may be applicable.

There are no proximate facilities that require a significant volume of LFG. As such, direct use markets are not considered for the LFGE facility.

3.2.5 Summary

Based upon the above discussion, the most appropriate energy market for a LFG utilization project at the Landfill is the OPA FIT Program.

4.0 INCENTIVE PROGRAMS

Pursuant to direction from AECOM, no update to the incentive programs section of SCS's January 24, 2008 LFGE Feasibility Study was prepared. However, we note that the only incentive program that was included in the life cycle cost projections (and associated pro forma analysis) of the January 24, 2008 LFGE Feasibility Study was the Environment Canada "ecoEnergy" incentive for renewable power. This incentive was estimated at one cent per kilowatt-hour for up to 10 years to eligible low-impact, renewable electricity projects constructed between April 1, 2007 and March 31, 2011. Because the March 31, 2011 deadline has passed, this incentive may no longer be available (unless it has been renewed since our January 24, 2008 report), and is not included in the life cycle cost projections in Section 6 of this report.

5.0 TECHNICAL MODELS

As discussed in Section 3, the most appropriate energy market requires electrical generation. This section includes a discussion on prime mover alternatives and presents a recommendation for the prime mover. Thereafter, a technical model is developed for a potential LFGE project.

5.1 PRIME MOVER

Electrical generation can be accomplished using various prime movers, including microturbines, internal combustion engines, combustion turbines and steam boilers. Each is described below.

5.1.1 Microturbines

Microturbines can be used at small power generation facilities as 30 kW, 70 kW and 250 kW units are available for LFG service. Each microturbine can provide a small increment of additional capacity so plant output can closely match power requirements.

Microturbines can accommodate methane contents as low as 35 percent. NO_x emissions from microturbines are very low; in fact, they are lower than the NO_x emissions for a typical LFG flare. There are approximately 18 microturbine projects in the United States with a total installed capacity of approximately 1 billion cubic feet per year. SCS has participated in operation of four microturbine projects, over periods of 7 to 10 years. As such, microturbine projects appear to be technically feasible for long-term operation on LFG. However, we note that capital costs for microturbine projects are higher on a unit basis as compared to internal combustion (IC) engine projects.

Auxiliary equipment typically includes the following equipment:

- Common LFG processing skid, including blower/compressor, sulfur removal and siloxane removal.
- Exhaust system(s).
- Ancillary items, such as performance monitors.

5.1.2 Internal Combustion Engines

The reciprocating IC engine is the most commonly used conversion technology in LFG applications. The reason for such widespread use is their relatively low cost, high efficiency and good size match with the gas output of many landfills. IC engines are relatively efficient at converting LFG into electricity. IC engines running on LFG are generally capable of achieving efficiencies in the range of 30 to 40 percent. Efficiencies increase in cogeneration applications where waste heat is recovered from the engine cooling system to make hot water. IC engines adapted for LFG applications are available in a range of sizes (generally 400 to 2,000 kW per engine), and can be added incrementally as LFG recovery increases at a landfill.

A number of manufacturers have developed engines for use with LFG, including Waukesha, Caterpillar, and Jenbacher. Mechanically, internal combustion engines are all fairly similar to one another. The largest variations lie in the fuel system. Most current fuel systems are lean-burn, turbocharged, low-pressure fuel system. We typically recommend lean-burn, turbocharged, low-pressure engines.

Lean-burn refers to the fuel/air mixture relative to its chemically correct (i.e., stoichiometric) requirement for complete combustion of the fuel. A lean mixture contains excess air, whereas a rich mixture contains excess fuel. Lean-burn engines are typically turbocharged and aftercooled. This "supercharges" the combustion chamber and provides greater engine power output. The fuel/air mixture can be leaned to provide 7 to 11 percent excess oxygen to achieve complete combustion of the fuel, optimizing fuel consumption and lowering the exhaust temperature.

Systems are available with a fuel supply pressure requirement similar to that of a naturally aspirated engine, or 2 to 5 psig. These systems employ the turbocharger to provide the necessary fuel pressure, which lowers the power consumption for the blower/compressor. Most engine manufacturers offer low-pressure systems.

Power output of an engine is related to the heat input, and hence, flow to the machine. Engine manufacturers calculate and publish heat rates for specific engines. The heat rate is the amount of heat needed to produce a unit of power, and is usually expressed on a Btu per horsepower (Btu/hp) or per kilowatt (Btu/kW) basis.

In reviewing the LFG recovery projections discussed in Section 2.1, the engine(s) selected for a potential LFGE project at the Landfill should be sized to use approximately 300 scfm at 50 percent methane, or 8.1 MMBtu/hr (based on a lower heating value (LHV) for LFG of 450 Btu/ft^3) under both waste filling scenarios, as described in Sections 1.3 and 2.1. The following engines would be appropriately sized for this LFG input rate:

- Caterpillar:
  - Model 3516, with a gross output of 856 kW and a LFG input rate of 300 scfm at 50 percent methane.
  - Model 3412, with a gross output of 415 kW and a LFG input rate of 178 scfm at 50 percent methane.
- Jenbacher:
  - Model 316v81, with a gross output of 848 kW and a LFG input rate of 280 scfm at 50 percent methane.
  - Model 208v81 , with a gross output of 335 kW and a LFG input rate of 117 scfm at 50 percent methane.

Auxiliary equipment typically includes the following equipment:

- Common LFG processing skid, including blower/compressor and filters.
- Radiator(s), capable of handling an engine at full load.

- Exhaust system(s).
- Plumbing including lube oil, waste oil, LFG, and jacket water piping.
- Ancillary items, including engine starters, engine sensors, jacket water heaters, and performance monitors.

5.1.3 Combustion Turbines

Combustion turbines are typically used in medium to large LFG projects, where LFG volumes are sufficient to generate at least 3 to 4 MW. This technology is competitive in larger LFG electric generation projects because, unlike most IC engine systems, turbine systems have significant economies of scale. The cost per kW of generating capacity drops as turbine size increases, and the electric generation efficiency generally improves as well.

Single-cycle turbines applicable to LFG projects typically achieve efficiencies of 20 to 28 percent at full load, which is less than IC engines. Moreover, these efficiencies drop substantially when the unit is running at partial load. Another disadvantage of turbines is that they require high gas compression causing high parasitic load loss. More of the plant's power is required to run the compression system, as compared to other prime movers.

One advantage is that turbines are generally more resistant to corrosion damage than IC engines and have lower operations and maintenance costs in comparison to engines.

Auxiliary equipment typically includes the following equipment:

- Common LFG processing skid, including blower/compressor and filters.
- Exhaust system(s).
- Ancillary items, such as performance monitors.

5.1.4 Combined Cycle

A combined-cycle power plant includes a combustion turbine and a heat recovery steam generator that drives a steam turbine. The waste heat in the combustion turbine exhaust results in additional electrical generation via the steam boiler/turbine. The overall system efficiency is boosted to approximately 60 percent from about 25 percent for the single-cycle combustion turbine. However, the economics of combined cycle systems typically require LFG volumes that are sufficient to generate a minimum of 10 MW.

5.1.5 Recommendation

Based on the LFG projections (Section 2) and Energy Markets (Section 3), IC engines are recommended for generation of power.

5.2 RECOMMENDED TECHNICAL MODEL

A technical model for the potential LFGE facility is discussed below.

5.2.1 Electrical Generation at the Landfill

Electrical generation at the Landfill for sale to the grid requires the construction of the power plant on the Landfill property. An electrical interconnection with the grid is then needed to transmit electrical power to the local distribution company under the FIT Program. Waste heat recovery for use at the Landfill would be possible.

The following main components are discussed below:

- Major electrical generation equipment.
- Electrical interconnect.
- Building requirements.

5.2.2 Major Electrical Generation Equipment

Based on the LFG recovery projections and energy market information, the following equipment is recommended for the electrical generation facility:

- One (1) LFG engine, Jenbacher model 316v81, or equal.
- One (1) generator, 850 kW, 575 volts, 60 Hertz, 3 phase, equipped with protective relays.
- One (1) radiator, capable of handling an engine at full load.
- One (1) exhaust system with silencers.
- Combustion air supply and filters.
- Ventilation fans and exhaust louvers.
- Plumbing including lube oil, waste oil, LFG and jacket water piping.
- Ancillary items, including engine starters, engine sensors, jacket water heaters, and performance monitors.
- All necessary electrical equipment, motor controls, breakers, computer control systems.

5.2.3 Electrical Interconnect

Interconnection of a power plant to the local utility's distribution and transmission system can be complicated and costly. An agreement is usually required between the generator and the local utility for an interconnection. The owner of the LFGE facility will be responsible for reimbursing the utility for expenses associated with the interconnection.

5.2.4 Building

The LFGE facility requires some form of enclosure. The enclosure should be sufficiently sized to house all components of the power plant.

Options for a power plant structure include:

- Containers or trailers.
- Pre-engineered metal building.
- Split-faced concrete block bearing wall structure.
- Steel frame building with metal paneling.

The containers are the simplest option for IC engines, but does not provide the most aesthetic or durable structure. The bearing wall masonry structure is probably the most expensive but would provide the best aesthetics and durability. The cost projections in Section 6 assume that the engines are housed in containers.

6.0 LIFE CYCLE COST PROJECTIONS

This section presents life cycle cost projections for the LFG utilization option described in Section 5. The assumptions in this section are also summarized in tabular format in Appendix D.

6.1 GENERAL ASSUMPTIONS

Assumptions regarding LFG utilization project operations and general economic conditions have been made to prepare life cycle cost projections. The assumptions are as follows:

- PUC will finance, own and operate the project.
- The capital costs for expanding the GCCS and operation and maintenance costs for the GCCS are not included, as the GCCS is otherwise required to be expanded, operated and maintained under Ontario Ministry of Environment regulations.
- Inflation rates of 2 percent and 1 percent per year are assumed for Waste Filling Scenarios #1 and #2, respectively. Hence, all figures in the cost projections are expressed in inflated, not constant, dollars.
- Commercial operation will begin in January 2013.
- All monetary units are given in Canadian (CDN) dollars.

6.2 COST PROJECTIONS

Quantities, revenues and expenses are described in the following sections.

6.2.1 Quantities

The quantity of LFG available for project use is shown in Appendix B. The following projected quantities are presented in Exhibits 6-1 and 6-2:

- Available LFG, MMcf: LFG quantities recovered from the Landfill and available to the power plant, in million cubic feet. Estimated LFG recovery quantities are based on continued expansion of the GCCS throughout areas of the Landfill as discussed in Section 2.
- Available LFG, MMBtu: LFG quantities recovered from the Landfill and available to the Facility, in million Btu. A methane content of 50 percent and a lower heating value of 450 Btu/cf were assumed.
- LFG consumed, MMcf: LFG quantities consumed in the operation of the IC engines, in million cubic feet. One Jenbacher engine (848kW) was used with gross heat rates of 8,915 Btu/kWh and 9,288 Btu/kWh at full and 75 percent loads, respectively. The engine generally does not function at less than 75 percent load.

- Gross plant production, kWh: It is assumed that the power plant generates electrical power at design capacity (e.g., 848 kW at full load) 90 percent of the time, subject to LFG availability. The other 10 percent of the time is allotted to scheduled and unscheduled maintenance.

6.2.2 Revenues

The following projected revenues are presented in Exhibits 6-1 and 6-2:

- FIT Program price, $/kWh: The price paid by the utility for electrical power. The starting sales rate is $0.111/kWh. Twenty percent of the FIT Program base sales rate is escalated at the assumed CPI inflation rate, based on the provisions of the FIT Program. The CPI inflation rate is assumed to be 2 percent per year for Waste Filling Scenario #1 (as shown in Exhibit 6-1), and 1 percent per year for Waste Filling Scenario #2 (as shown in Exhibit 6-2).

- Energy revenue: Revenues earned are calculated by multiplying the FIT Program sales rate by the net plant electrical production.

6.2.3 Expenses

Projected expenses are presented in Exhibits 6-1 and 6-2. Common assumptions used to estimate expenses are as follows:

- Debt Service-Power Plant: Estimated capital costs for the power plant are presented in Tables 1 and 2 in Appendix C. Sixty percent (60%) of estimated capital cost is assumed to be financed at an interest rate of 6 percent. Payments of interest and principal are constant throughout the life of the loan (i.e., 20 years). Estimated capital costs are included for the engine/generator, electrical interconnect, and a step-up transformer.

- O&M, Power Plant: The cost for O&M of the engine plant is estimated at $0.024/kWh (as of 2011), based on gross power production. These costs are projected to increase at the rate of inflation.

- Electrical Purchase Rate: The price paid for electricity for parasitic load of the LFGE facility. For Waste Filling Scenario #1, energy for parasitic load is assumed to be taken from the LFGE facility before electricity is sold to FIT program, therefore the electrical purchase rate is equal to the FIT program price above. For Waste Filling Scenario #2, all energy generated is assumed to be sold to the FIT program, and energy for parasitic load is assumed to be imported from the grid at business rates. These business rates are assumed to be $0.090/kWh in 2011 (including distribution, transmission and other rates or fees), with 4.5 percent annual inflation.

- Electrical Load-Power Plant: The cost for electrical power needed to operate the Facility (e.g., compressors) is estimated to be 10 percent of gross power production (e.g., 85 kW at full load), at the electrical purchase rate above.

- O&M, Other: Other O&M costs include insurance, administration, engineering, and miscellaneous, and are estimated to be $40,000 in 2013. These costs are projected to increase at the rate of inflation.

6.2.4 Cash Flow

The cash flow is equal to revenues minus expenses. The present value of annual cash flow is calculated by applying an annual discount rate equal to the rate of financing, which approximates the rate of return expected for capital investment. The sum of cash flow present value for each year is the total present value of the project.

EXHIBIT 6-1: COST PROJECTIONS: WASTE FILLING SCENARIO #1

PROJECT YEAR	1	2	3	4	5	6	7	8	9	10	11	12
CALENDAR YEAR	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
QUANTITIES												
(1) Available LFG, MMcf	157	180	181	182	181	202	202	201	218	205	193	182
(2) Available LFG, MMBtu	70,600	81,100	81,500	81,900	81,400	91,100	90,700	90,300	98,100	92,300	86,900	81,700
(3) LFG Consumed, MMcf	132	132	132	132	132	132	132	132	132	132	132	132
(4) Gross plant production, MWh	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686
REVENUES												
(5) FIT Program Price ($/kWh)	$0.1110	$0.1114	$0.1119	$0.1123	$0.1128	$0.1132	$0.1137	$0.1141	$0.1146	$0.1151	$0.1155	$0.1160
(6) Energy Revenue	$742,105	$745,074	$748,054	$751,046	$754,050	$757,066	$760,095	$763,135	$766,188	$769,252	$772,329	$775,419
TOTAL	$742,105	$745,074	$748,054	$751,046	$754,050	$757,066	$760,095	$763,135	$766,188	$769,252	$772,329	$775,419
EXPENSES												
(7) Debt Service - Power Plant*	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090
(8) O&M - Power Plant	$185,486	$189,196	$192,980	$196,839	$200,776	$204,792	$208,888	$213,065	$217,327	$221,673	$226,107	$230,629
(9) Electrical Purchase Rate ($/kWh)	$0.1110	$0.1114	$0.1119	$0.1123	$0.1128	$0.1132	$0.1137	$0.1141	$0.1146	$0.1151	$0.1155	$0.1160
(10) Electrical Load-Power Plant	$74,211	$74,507	$74,805	$75,105	$75,405	$75,707	$76,009	$76,314	$76,619	$76,925	$77,233	$77,542
(11) Other (Admin., Insurance, Eng., etc.)	$40,000	$40,800	$41,616	$42,448	$43,297	$44,163	$45,046	$45,947	$46,866	$47,804	$48,760	$49,735
TOTAL	$413,786	$418,593	$423,491	$428,482	$433,568	$438,751	$444,033	$449,416	$454,901	$460,492	$466,189	$471,995
CASH FLOW												
(12) Operating income from LFG project	$328,319	$326,481	$324,563	$322,564	$320,482	$318,315	$316,061	$313,719	$311,286	$308,761	$306,140	$303,423
PRESENT VALUE	$309,735	$290,567	$272,509	$255,501	$239,483	$224,400	$210,199	$196,831	$184,250	$172,410	$161,271	$150,792
2013 CAPITAL COST - POWER PLANT*	$872,000											
TOTAL NET PRESENT VALUE	**$2,558,000**											

*Note that power plant capital cost/debt service
are based upon a facility capital cost estimate
of $2,000/kW.

PROJECT YEAR	13	14	15	16	17	18	19	20
CALENDAR YEAR	2025	2026	2027	2028	2029	2030	2031	2032
QUANTITIES								
(1) Available LFG, MMcf	171	161	151	142	134	126	118	111
(2) Available LFG, MMBtu	76,900	72,300	68,100	64,000	60,200	56,700	53,300	50,200
(3) LFG Consumed, MMcf	132	132	132	123	116	109	102	96
(4) Gross plant production, MWh	6,686	6,686	6,686	6,204	5,837	5,492	5,167	4,861
REVENUES								
(5) FIT Program Price ($/kWh)	$0.1164	$0.1169	$0.1174	$0.1178	$0.1183	$0.1188	$0.1193	$0.1197
(6) Energy Revenue	$778,520	$781,634	$784,761	$731,160	$690,644	$652,373	$616,223	$582,076
TOTAL	$778,520	$781,634	$784,761	$731,160	$690,644	$652,373	$616,223	$582,076
EXPENSES								
(7) Debt Service - Power Plant*	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090	$114,090
(8) O&M - Power Plant	$235,241	$239,946	$244,745	$231,662	$222,312	$213,340	$204,729	$196,466
(9) Electrical Purchase Rate ($/kWh)	$0.1164	$0.1169	$0.1174	$0.1178	$0.1183	$0.1188	$0.1193	$0.1197
(10) Electrical Load-Power Plant	$77,852	$78,163	$78,476	$73,116	$69,064	$65,237	$61,622	$58,208
(11) Other (Admin., Insurance, Eng., etc.)	$50,730	$51,744	$52,779	$53,835	$54,911	$56,010	$57,130	$58,272
TOTAL	$477,913	$483,944	$490,090	$472,703	$460,378	$448,676	$437,571	$427,036
CASH FLOW								
(12) Operating income from LFG project	$300,608	$297,691	$294,671	$258,457	$230,266	$203,697	$178,652	$155,040
PRESENT VALUE	$140,937	$131,669	$122,956	$101,741	$85,513	$71,364	$59,047	$48,342
2013 CAPITAL COST - POWER PLANT*								
TOTAL NET PRESENT VALUE								

*Note that power plant capital cost/debt service
are based upon a facility capital cost estimate
of $2,000/kW.

EXHIBIT 6-2: COST PROJECTIONS: WASTE FILLING SCENARIO #2

PROJECT YEAR	1	2	3	4	5	6	7	8	9	10
CALENDAR YEAR	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
QUANTITIES										
(1) Available LFG, MMcf	157	157	177	174	169	165	161	177	173	169
(2) Available LFG, MMBtu	71,000	71,000	80,000	78,000	76,000	74,000	72,000	79,000	78,000	76,000
(3) LFG Consumed, MMcf	132	132	132	132	132	132	132	132	132	132
(4) Gross plant production, MWh	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686
REVENUES										
(5) FIT Program Price ($/kWh)	$0.1110	$0.1112	$0.1114	$0.1117	$0.1119	$0.1121	$0.1123	$0.1126	$0.1128	$0.1130
(6) Energy Revenue	$742,105	$743,589	$745,077	$746,567	$748,060	$749,556	$751,055	$752,557	$754,062	$755,570
TOTAL	$742,105	$743,589	$745,077	$746,567	$748,060	$749,556	$751,055	$752,557	$754,062	$755,570
EXPENSES										
(7) Debt Service - Power Plant*	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089
(8) O&M - Power Plant	$181,867	$183,686	$185,523	$187,378	$189,252	$191,144	$193,056	$194,986	$196,936	$198,905
(9) Electrical Purchase Rate ($/kWh)	$0.1027	$0.1073	$0.1122	$0.1172	$0.1225	$0.1280	$0.1337	$0.1398	$0.1461	$0.1526
(10) Electrical Load-Power Plant	$68,665	$71,755	$74,984	$78,358	$81,884	$85,569	$89,419	$93,443	$97,648	$102,042
(11) Other (Admin., Insurance, Eng., etc.)	$40,000	$40,400	$40,804	$41,212	$41,624	$42,040	$42,461	$42,885	$43,314	$43,747
TOTAL	$447,621	$452,929	$458,399	$464,037	$469,849	$475,842	$482,025	$488,404	$494,988	$501,784
CASH FLOW										
(12) Operating income from LFG project	$294,484	$290,660	$286,677	$282,530	$278,211	$273,714	$269,030	$264,153	$259,075	$253,786
PRESENT VALUE	$277,815	$258,686	$240,700	$223,790	$207,895	$192,957	$178,920	$165,733	$153,346	$141,713
2013 CAPITAL COST - POWER PLANT*	$1,201,000									
TOTAL NET PRESENT VALUE	**$1,671,000**									

*Note that power plant capital cost/debt service
are based upon a facility capital cost estimate
of $3,000/kW.

PROJECT YEAR	11	12	13	14	15	16	17	18	19	20
CALENDAR YEAR	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
QUANTITIES										
(1) Available LFG, MMcf	165	162	158	170	160	150	141	133	125	118
(2) Available LFG, MMBtu	74,000	73,000	71,000	76,000	72,000	68,000	64,000	60,000	56,000	53,000
(3) LFG Consumed, MMcf	132	132	132	132	132	132	122	115	108	102
(4) Gross plant production, MWh	6,686	6,686	6,686	6,686	6,686	6,686	6,157	5,793	5,450	5,127
REVENUES										
(5) FIT Program Price ($/kWh)	$0.1132	$0.1135	$0.1137	$0.1139	$0.1141	$0.1144	$0.1146	$0.1148	$0.1151	$0.1153
(6) Energy Revenue	$757,082	$758,596	$760,113	$761,633	$763,156	$764,683	$705,633	$665,204	$627,091	$591,162
TOTAL	$757,082	$758,596	$760,113	$761,633	$763,156	$764,683	$705,633	$665,204	$627,091	$591,162
EXPENSES										
(7) Debt Service - Power Plant*	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089	$157,089
(8) O&M - Power Plant	$200,894	$202,903	$204,932	$206,982	$209,051	$211,142	$196,393	$186,619	$177,331	$168,506
(9) Electrical Purchase Rate ($/kWh)	$0.1595	$0.1667	$0.1742	$0.1820	$0.1902	$0.1988	$0.2077	$0.2171	$0.2268	$0.2370
(10) Electrical Load-Power Plant	$106,634	$111,433	$116,447	$121,687	$127,163	$132,886	$127,886	$125,733	$123,616	$121,534
(11) Other (Admin., Insurance, Eng., etc.)	$44,185	$44,627	$45,073	$45,524	$45,979	$46,439	$46,903	$47,372	$47,846	$48,324
TOTAL	$508,803	$516,052	$523,542	$531,282	$539,283	$547,556	$528,272	$516,813	$505,882	$495,453
CASH FLOW										
(12) Operating income from LFG project	$248,279	$242,544	$236,571	$230,351	$223,874	$217,127	$177,361	$148,391	$121,209	$95,709
PRESENT VALUE	$130,790	$120,537	$110,914	$101,885	$93,415	$85,471	$65,866	$51,988	$40,061	$29,842
2013 CAPITAL COST - POWER PLANT*										
TOTAL NET PRESENT VALUE										

*Note that power plant capital cost/debt service are based upon a facility capital cost estimate of $3,000/kW.

7.0 SUMMARY OF RESULTS

The capital cost of the LFGE facility is estimated to be approximately $2.2 million under Waste Filling Scenario #1 (as described in Sections 1.3, 2.1 and 6.2), and approximately $3.0 million under Waste Filling Scenario #2. The total present value of the project is estimated to be approximately $2.6 million over the 20-year term under Waste Filling Scenario #1, and $1.7 million under Waste Filling Scenario #2. For further detail, see the pro forma analyses included in Exhibits 6-1 and 6-2.

Appendix A
LFG Recovery Projections

Table A-1
LFG RECOVERY PROJECTIONS
Sault Ste. Marie Landfill
Waste Filling Scenario #1

Year	MSW Disposal Rate (tons/yr)	MSW Refuse In-Place (tons)	LFG Recovery Potential (scfm)	LFG Recovery Potential (mmcf/day)	LFG Recovery Potential (mmBtu/yr)	LFG System Coverage (%)	LFG Recovery from Existing and Planned System (scfm)	LFG Recovery from Existing and Planned System (mmcf/day)	LFG Recovery from Existing and Planned System (mmBtu/yr)
1954	1,102	1,102	0	0.00	0	0%	0	0.00	0
1955	1,102	2,204	0	0.00	119	0%	0	0.00	0
1956	1,102	3,306	1	0.00	232	0%	0	0.00	0
1957	1,102	4,408	1	0.00	337	0%	0	0.00	0
1958	1,102	5,510	2	0.00	437	0%	0	0.00	0
1959	1,102	6,612	2	0.00	530	0%	0	0.00	0
1960	1,102	7,714	2	0.00	618	0%	0	0.00	0
1961	1,102	8,816	3	0.00	701	0%	0	0.00	0
1962	1,102	9,918	3	0.00	779	0%	0	0.00	0
1963	1,102	11,020	3	0.00	852	0%	0	0.00	0
1964	1,102	12,122	3	0.00	921	0%	0	0.00	0
1965	1,102	13,224	4	0.01	986	0%	0	0.00	0
1966	1,102	14,326	4	0.01	1,047	0%	0	0.00	0
1967	1,002	15,328	4	0.01	1,105	0%	0	0.00	0
1968	1,102	16,430	4	0.01	1,148	0%	0	0.00	0
1969	1,102	17,532	5	0.01	1,199	0%	0	0.00	0
1970	41,888	59,420	5	0.01	1,248	0%	0	0.00	0
1971	41,888	101,308	21	0.03	5,712	0%	0	0.00	0
1972	41,888	143,196	37	0.05	9,912	0%	0	0.00	0
1973	41,888	185,084	52	0.08	13,864	0%	0	0.00	0
1974	41,888	226,972	66	0.10	17,582	0%	0	0.00	0
1975	41,888	268,860	79	0.11	21,080	0%	0	0.00	0
1976	41,888	310,748	92	0.13	24,371	0%	0	0.00	0
1977	41,888	352,636	103	0.15	27,467	0%	0	0.00	0
1978	42,031	394,667	114	0.16	30,380	0%	0	0.00	0
1979	42,329	436,996	125	0.18	33,136	0%	0	0.00	0
1980	42,659	479,655	134	0.19	35,761	0%	0	0.00	0
1981	42,880	522,535	144	0.21	38,266	0%	0	0.00	0
1982	43,652	566,187	153	0.22	40,648	0%	0	0.00	0
1983	44,423	610,610	162	0.23	42,972	0%	0	0.00	0
1984	45,195	655,805	170	0.24	45,242	0%	0	0.00	0
1985	45,966	701,771	178	0.26	47,461	0%	0	0.00	0
1986	46,683	748,454	187	0.27	49,632	0%	0	0.00	0
1987	66,139	814,593	195	0.28	51,753	0%	0	0.00	0
1988	85,980	900,573	210	0.30	55,856	0%	0	0.00	0
1989	75,985	976,558	233	0.33	61,866	0%	0	0.00	0
1990	80,873	1,057,431	250	0.36	66,437	0%	0	0.00	0
1991	63,016	1,120,447	268	0.39	71,268	0%	0	0.00	0
1992	62,340	1,182,787	278	0.40	73,878	0%	0	0.00	0
1993	65,680	1,248,467	287	0.41	76,260	0%	0	0.00	0
1994	67,727	1,316,194	297	0.43	78,863	0%	0	0.00	0
1995	66,562	1,382,756	307	0.44	81,534	0%	0	0.00	0
1996	100,235	1,482,991	316	0.45	83,921	0%	0	0.00	0
1997	83,767	1,566,758	338	0.49	89,814	0%	0	0.00	0
1998	73,244	1,640,002	352	0.51	93,575	0%	0	0.00	0
1999	74,052	1,714,054	361	0.52	95,973	0%	0	0.00	0
2000	70,457	1,784,511	370	0.53	98,317	0%	0	0.00	0
2001	72,133	1,856,644	377	0.54	100,132	0%	0	0.00	0
2002	82,106	1,938,750	384	0.55	102,022	0%	0	0.00	0
2003	75,674	2,014,424	394	0.57	104,880	0%	0	0.00	0
2004	82,685	2,097,109	402	0.58	106,872	0%	0	0.00	0
2005	67,461	2,164,570	412	0.59	109,506	0%	0	0.00	0
2006	60,303	2,224,873	415	0.60	110,335	0%	0	0.00	0

LFG RECOVERY PROJECTIONS
Sault Ste. Marie Landfill
Waste Filling Scenario #1

	MSW Disposal Rate	MSW Refuse In-Place	LFG Recovery Potential			LFG System Coverage	LFG Recovery from Existing and Planned System		
Year	(tons/yr)	(tons)	(scfm)	(mmcf/day)	(mmBtu/yr)	(%)	(scfm)	(mmcf/day)	(mmBtu/yr)
2007	59,914	2,284,787	415	0.60	110,339	0%	0	0.00	0
2008	57,559	2,342,346	415	0.60	110,301	0%	0	0.00	0
2009	67,550	2,409,896	414	0.60	110,010	0%	0	0.00	0
2010	74,576	2,484,472	417	0.60	110,818	70%	292	0.42	77,573
2011	66,138	2,550,610	422	0.61	112,340	70%	296	0.43	78,638
2012	66,548	2,617,158	424	0.61	112,858	70%	297	0.43	79,000
2013	66,961	2,684,119	426	0.61	113,389	70%	298	0.43	79,372
2014	67,376	2,751,495	428	0.62	113,934	80%	343	0.49	91,147
2015	67,794	2,819,288	430	0.62	114,491	80%	344	0.50	91,593
2016	56,771	2,876,059	433	0.62	115,061	80%	346	0.50	92,049
2017	57,123	2,933,181	430	0.62	114,403	80%	344	0.50	91,522
2018	57,477	2,990,658	428	0.62	113,822	90%	385	0.55	102,439
2019	57,833	3,048,491	426	0.61	113,313	90%	383	0.55	101,982
2020	38,296	3,086,787	424	0.61	112,873	90%	382	0.55	101,586
2021	0	3,086,787	415	0.60	110,343	100%	415	0.60	110,343
2022	0	3,086,787	390	0.56	103,813	100%	390	0.56	103,813
2023	0	3,086,787	367	0.53	97,670	100%	367	0.53	97,670
2024	0	3,086,787	346	0.50	91,890	100%	346	0.50	91,890
2025	0	3,086,787	325	0.47	86,452	100%	325	0.47	86,452
2026	0	3,086,787	306	0.44	81,336	100%	306	0.44	81,336
2027	0	3,086,787	288	0.41	76,523	100%	288	0.41	76,523
2028	0	3,086,787	271	0.39	71,995	100%	271	0.39	71,995
2029	0	3,086,787	255	0.37	67,734	100%	255	0.37	67,734
2030	0	3,086,787	240	0.35	63,726	100%	240	0.35	63,726
2031	0	3,086,787	225	0.32	59,955	100%	225	0.32	59,955
2032	0	3,086,787	212	0.31	56,407	100%	212	0.31	56,407

Methane Content of LFG Adjusted to: 50%
Selected Decay Rate Constant (k): 0.061
Selected Ultimate Methane Recovery Rate (Lo): 1,800 cu ft/ton

NOTES:

1. Actual waste tonnage :1954 through 1995 and 2001 through 2002 by Dillon: "SSMWasteQuantities.xls", provided via e-mail by J. Maclachlan 10/16/2007.
   Actual waste tonnage :1996 through 2000 and 2003 through 2006 provided by Rick Talvitie of AECOM via e-mail on 11/7/2007. "1996 to 2000 waste quantities.doc" and "2003-2006 waste quantities.pdf"
2. Actual waste tonnges for 2007 and 2008 provided by J. Maclachlan via e-mail dated June 2, 2009.
3. Actual waste tonnage for 2009 from file, "2009 nov-dec waste quantities.xls" provided by Rick Talvitie via email dated 8/12/11.
4. Actual waste tonnage for 2010 from file, "2010 jan-dec waste quantities.xls" provided by Rick Talvitie via email dated 8/12/11.
5. Inert portion of the waste; road sweepings, asbestos, contaminated soil, shingles, metal batteries, is based on conversation with AECOM on 11/20/2007. All remaining waste disposed in landfill modeled as MSW.
6. Waste projections based on assumptions detailed in LFGE Feasibility Study Update, dated 08/31/11, and remaining waste disposal capacity of 546,400 tonnes, from 2010 Site Development and Operations Report.

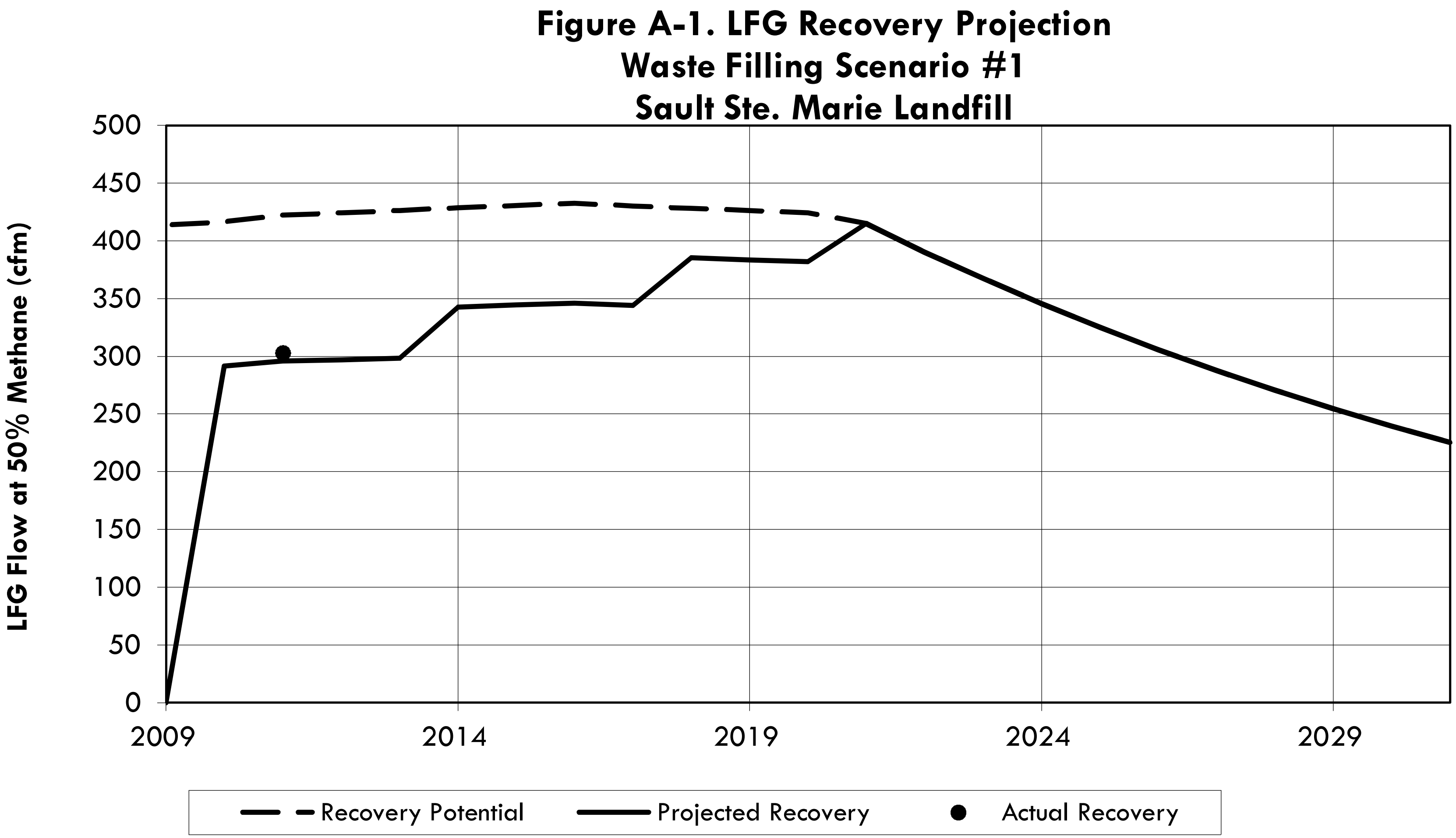
Figure A-1. LFG Recovery Projection
Waste Filling Scenario #1
Sault Ste. Marie Landfill
LFG Flow at 50% Methane (cfm)
500
450
400
350
300
250
200
150
100
50
0
2009
2014
2019
2024
2029
Recovery Potential
Projected Recovery
Actual Recovery

10/10/2011

Table A-2
LFG RECOVERY PROJECTIONS
Sault Ste. Marie Landfill
Waste Filling Scenario #2

Year	MSW Disposal Rate (tons/yr)	MSW Refuse In-Place (tons)	LFG Recovery Potential (scfm)	LFG Recovery Potential (mmcf/day)	LFG Recovery Potential (mmBtu/yr)	LFG System Coverage (%)	LFG Recovery from Existing and Planned System (scfm)	LFG Recovery from Existing and Planned System (mmcf/day)	LFG Recovery from Existing and Planned System (mmBtu/yr)
1954	1,102	1,102	0	0.00	0	0%	0	0.00	0
1955	1,102	2,204	0	0.00	119	0%	0	0.00	0
1956	1,102	3,306	1	0.00	232	0%	0	0.00	0
1957	1,102	4,408	1	0.00	337	0%	0	0.00	0
1958	1,102	5,510	2	0.00	437	0%	0	0.00	0
1959	1,102	6,612	2	0.00	530	0%	0	0.00	0
1960	1,102	7,714	2	0.00	618	0%	0	0.00	0
1961	1,102	8,816	3	0.00	701	0%	0	0.00	0
1962	1,102	9,918	3	0.00	779	0%	0	0.00	0
1963	1,102	11,020	3	0.00	852	0%	0	0.00	0
1964	1,102	12,122	3	0.00	921	0%	0	0.00	0
1965	1,102	13,224	4	0.01	986	0%	0	0.00	0
1966	1,102	14,326	4	0.01	1,047	0%	0	0.00	0
1967	1,002	15,328	4	0.01	1,105	0%	0	0.00	0
1968	1,102	16,430	4	0.01	1,148	0%	0	0.00	0
1969	1,102	17,532	5	0.01	1,199	0%	0	0.00	0
1970	41,888	59,420	5	0.01	1,248	0%	0	0.00	0
1971	41,888	101,308	21	0.03	5,712	0%	0	0.00	0
1972	41,888	143,196	37	0.05	9,912	0%	0	0.00	0
1973	41,888	185,084	52	0.08	13,864	0%	0	0.00	0
1974	41,888	226,972	66	0.10	17,582	0%	0	0.00	0
1975	41,888	268,860	79	0.11	21,080	0%	0	0.00	0
1976	41,888	310,748	92	0.13	24,371	0%	0	0.00	0
1977	41,888	352,636	103	0.15	27,467	0%	0	0.00	0
1978	42,031	394,667	114	0.16	30,380	0%	0	0.00	0
1979	42,329	436,996	125	0.18	33,136	0%	0	0.00	0
1980	42,659	479,655	134	0.19	35,761	0%	0	0.00	0
1981	42,880	522,535	144	0.21	38,266	0%	0	0.00	0
1982	43,652	566,187	153	0.22	40,648	0%	0	0.00	0
1983	44,423	610,610	162	0.23	42,972	0%	0	0.00	0
1984	45,195	655,805	170	0.24	45,242	0%	0	0.00	0
1985	45,966	701,771	178	0.26	47,461	0%	0	0.00	0
1986	46,683	748,454	187	0.27	49,632	0%	0	0.00	0
1987	66,139	814,593	195	0.28	51,753	0%	0	0.00	0
1988	85,980	900,573	210	0.30	55,856	0%	0	0.00	0
1989	75,985	976,558	233	0.33	61,866	0%	0	0.00	0
1990	80,873	1,057,431	250	0.36	66,437	0%	0	0.00	0
1991	63,016	1,120,447	268	0.39	71,268	0%	0	0.00	0
1992	62,340	1,182,787	278	0.40	73,878	0%	0	0.00	0
1993	65,680	1,248,467	287	0.41	76,260	0%	0	0.00	0
1994	67,727	1,316,194	297	0.43	78,863	0%	0	0.00	0
1995	66,562	1,382,756	307	0.44	81,534	0%	0	0.00	0
1996	100,235	1,482,991	316	0.45	83,921	0%	0	0.00	0
1997	83,767	1,566,758	338	0.49	89,814	0%	0	0.00	0
1998	73,244	1,640,002	352	0.51	93,575	0%	0	0.00	0
1999	74,052	1,714,054	361	0.52	95,973	0%	0	0.00	0
2000	70,457	1,784,511	370	0.53	98,317	0%	0	0.00	0
2001	72,133	1,856,644	377	0.54	100,132	0%	0	0.00	0
2002	82,106	1,938,750	384	0.55	102,022	0%	0	0.00	0
2003	75,674	2,014,424	394	0.57	104,880	0%	0	0.00	0
2004	82,685	2,097,109	402	0.58	106,872	0%	0	0.00	0
2005	67,461	2,164,570	412	0.59	109,506	0%	0	0.00	0

Table A-2
LFG RECOVERY PROJECTIONS
Sault Ste. Marie Landfill
Waste Filling Scenario #2

	MSW Disposal Rate	MSW Refuse In-Place	LFG Recovery Potential			LFG System Coverage	LFG Recovery from Existing and Planned System		
2006	60,303	2,224,873	415	0.60	110,335	0%	0	0.00	0
2007	59,914	2,284,787	415	0.60	110,339	0%	0	0.00	0
2008	57,559	2,342,346	415	0.60	110,301	0%	0	0.00	0
2009	67,550	2,409,896	414	0.60	110,010	0%	0	0.00	0
2010	74,576	2,484,472	417	0.60	110,818	70%	292	0.42	77,573
2011	66,138	2,550,610	422	0.61	112,340	70%	296	0.43	78,638
2012	66,138	2,616,748	424	0.61	112,858	70%	297	0.43	79,000
2013	66,138	2,682,886	426	0.61	113,345	70%	298	0.43	79,341
2014	44,092	2,726,978	428	0.62	113,803	70%	300	0.43	79,662
2015	44,092	2,771,070	421	0.61	111,846	80%	336	0.48	89,476
2016	33,069	2,804,139	414	0.60	110,004	80%	331	0.48	88,003
2017	33,069	2,837,208	403	0.58	107,077	80%	322	0.46	85,662
2018	33,069	2,870,277	392	0.56	104,323	80%	314	0.45	83,459
2019	33,069	2,903,346	383	0.55	101,733	80%	306	0.44	81,386
2020	33,069	2,936,415	373	0.54	99,295	90%	336	0.48	89,366
2021	33,069	2,969,484	365	0.53	97,002	90%	328	0.47	87,302
2022	33,069	3,002,553	357	0.51	94,845	90%	321	0.46	85,360
2023	33,069	3,035,622	349	0.50	92,815	90%	314	0.45	83,533
2024	33,069	3,068,691	342	0.49	90,905	90%	308	0.44	81,815
2025	18,096	3,086,787	335	0.48	89,108	90%	302	0.43	80,198
2026	0	3,086,787	323	0.46	85,796	100%	323	0.46	85,796
2027	0	3,086,787	304	0.44	80,719	100%	304	0.44	80,719
2028	0	3,086,787	286	0.41	75,942	100%	286	0.41	75,942
2029	0	3,086,787	269	0.39	71,448	100%	269	0.39	71,448
2030	0	3,086,787	253	0.36	67,220	100%	253	0.36	67,220
2031	0	3,086,787	238	0.34	63,242	100%	238	0.34	63,242
2032	0	3,086,787	224	0.32	59,500	100%	224	0.32	59,500

Methane Content of LFG Adjusted to: 50%
Selected Decay Rate Constant (k): 0.061
Selected Ultimate Methane Recovery Rate (Lo): 1,800 cu ft/ton

NOTES:
1. Actual waste tonnage :1954 through 1995 and 2001 through 2002 by Dillon: "SSMWasteQuantities.xls", provided via e-mail by J. Maclachlan 10/16/2007.
   Actual waste tonnage :1996 through 2000 and 2003 through 2006 provided by Rick Talvitie of AECOM via e-mail on 11/7/2007. "1996 to 2000 waste quantities.doc" and "2003-2006 waste quantities.pdf"
2. Actual waste tonnges for 2007 and 2008 provided by J. Maclachlan via e-mail dated June 2, 2009.
3. Actual waste tonnage for 2009 from file, "2009 nov-dec waste quantities.xls" provided by Rick Talvitie via email dated 8/12/11.
4. Actual waste tonnage for 2010 from file, "2010 jan-dec waste quantities.xls" provided by Rick Talvitie via email dated 8/12/11.
5. Inert portion of the waste; road sweepings, asbestos, contaminated soil, shingles, metal batteries, is based on conversation with AECOM on 11/20/2007. All remaining waste disposed in landfill modeled as MSW.
6. Waste projections based on assumptions detailed in LFGE Feasibility Study Update, dated 08/31/11, and remaining waste disposal capacity of 546,400 tonnes, from 2010 Site Development and Operations Report.

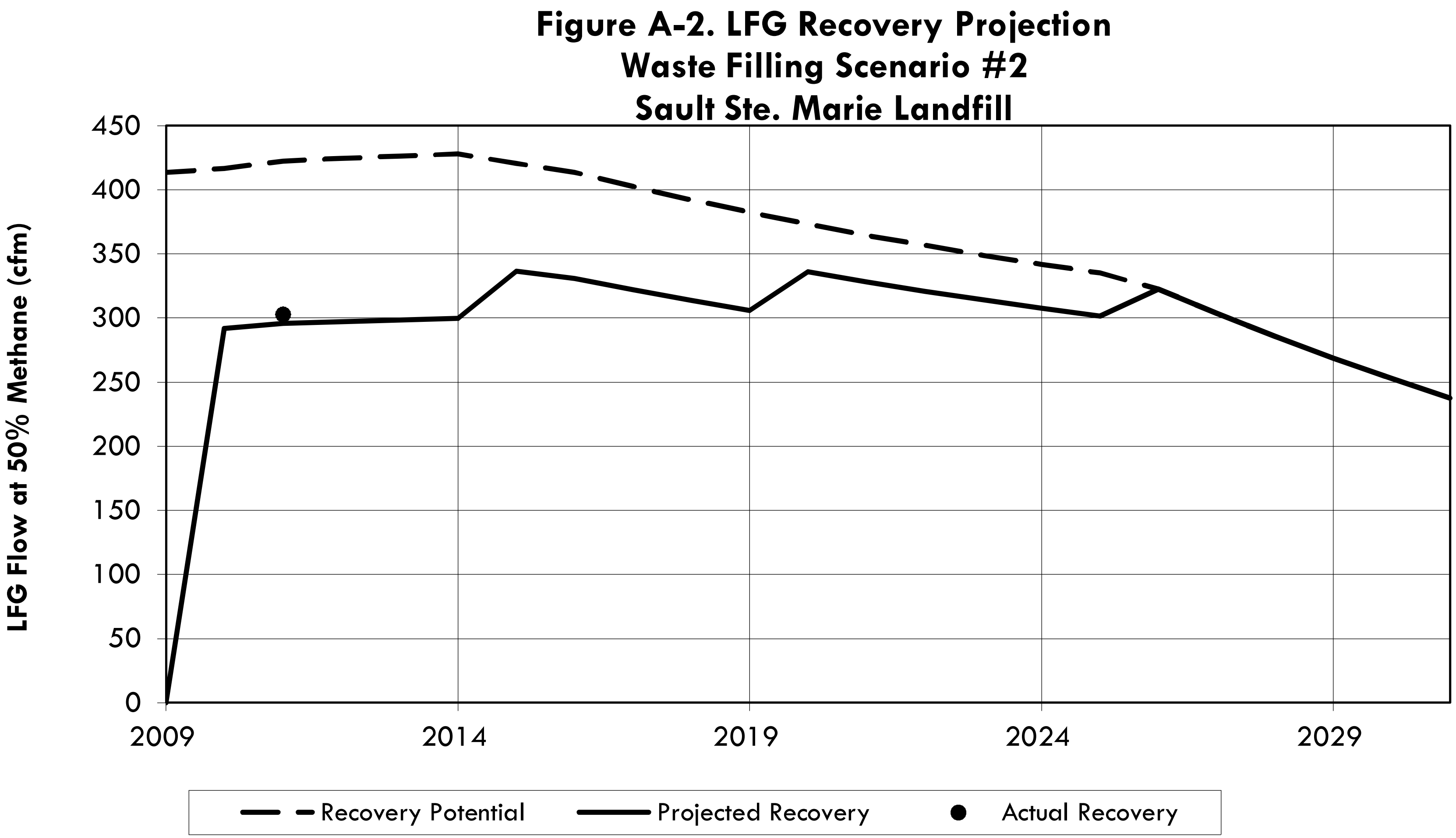
Figure A-2. LFG Recovery Projection
Waste Filling Scenario #2
Sault Ste. Marie Landfill
LFG Flow at 50% Methane (cfm)
450
400
350
300
250
200
150
100
50
0
2009
2014
2019
2024
2029
Recovery Potential
Projected Recovery
Actual Recovery

Appendix B
LFG Quantities

TABLE B-1
WASTE FILLING SCENARIO #1
QUANTITIES SUMMARY

	LFG Recovery Rates (1)		Gross Energy Recovery(2)
Year	cfm	MMBtu/yr	MWh/yr
2013	298	70,588	6,686
2014	343	81,060	6,686
2015	344	81,456	6,686
2016	346	81,862	6,686
2017	344	81,393	6,686
2018	385	91,102	6,686
2019	383	90,695	6,686
2020	382	90,343	6,686
2021	415	98,131	6,686
2022	390	92,324	6,686
2023	367	86,861	6,686
2024	346	81,721	6,686
2025	325	76,885	6,686
2026	306	72,335	6,686
2027	288	68,054	6,686
2028	271	64,027	6,204
2029	255	60,238	5,837
2030	240	56,673	5,492
2031	225	53,320	5,167
2032	212	50,164	4,861

(1) From SCS LFG Model: cfm; MMcf/yr*LHV 450 Btu/cf = MMBtu/hr
(2) Gross Energy Recovery based on 848kW engines, heat rates of 8,915 Btu/kWh (100% load) and 9,288 Btu/kWh (75% load), and includes a 90% availability factor.

TABLE B-2
WASTE FILLING SCENARIO #2
QUANTITIES SUMMARY

	LFG Recovery Rates [1]		**Gross Energy Recovery[2]**
Year	cfm	MMBtu/yr	MWh/yr
2013	298	70,560	6,686
2014	300	70,846	6,686
2015	336	79,574	6,686
2016	331	78,264	6,686
2017	322	76,181	6,686
2018	314	74,222	6,686
2019	306	72,379	6,686
2020	336	79,475	6,686
2021	328	77,640	6,686
2022	321	75,913	6,686
2023	314	74,288	6,686
2024	308	72,760	6,686
2025	302	71,322	6,686
2026	323	76,301	6,686
2027	304	71,785	6,686
2028	286	67,537	6,686
2029	269	63,541	6,157
2030	253	59,781	5,793
2031	238	56,243	5,450
2032	224	52,915	5,127

(1) From SCS LFG Model: cfm; MMcf/yr*LHV 450 Btu/cf = MMBtu/hr
(2) Gross Energy Recovery based on 848kW engines, heat rates of 8,915 Btu/kWh (100% load) and 9,288 Btu/kWh (75% load), and includes a 90% availability factor.

Appendix C
Capital Cost Estimates

TABLE C-1. LFGE FACILITY CAPITAL AND OPERATING COSTS
Waste Filling Scenario #1

Item	Capacity	Cost[1]
Engine/Generator + Installation [2]	848 kW	$ 1,696,000
Elect. Interconnect/Transformer[3]	-	$ 400,000
O&M (Power Plant)	per kWh	$0.024
2011 Capital Cost Total		$ 2,096,000
2013 Capital Cost Total[4]		$ 2,181,000

(1) All prices in 2011 Canadian dollars.
(2) Engineer's estimate based on $2,000/kW total LFGE system capital cost estimate.
(3) Allowance, to be confirmed by PUC Services Inc.
(4) Inflation assumed to be 2 percent per year.

TABLE C-2. LFGE FACILITY CAPITAL AND OPERATING COSTS
Waste Filling Scenario #2

Item	Capacity	Cost[1]	
Engine/Generator + Installation [2]	848 kW	$	2,544,000
Elect. Interconnect/Transformer[3]	-	$	400,000
O&M (Power Plant)	per kWh	$0.024	
2011 Capital Cost Total		$	2,944,000
2013 Capital Cost Total[4]		$	3,003,000

(1) All prices in 2011 Canadian dollars.
(2) Engineer's estimate based on $3,000/kW total LFGE system capital cost estimate.
(3) Allowance, to be confirmed by PUC Services Inc.
(4) Inflation assumed to be 1 percent per year.

Appendix D
Cost Projection Assumptions

GENERAL ASSUMPTIONS

	Scenario #1	Scenario #2	
FACILITIES OPERATIONS			
Year Commenced Operation	2013	2013	
Methane Content	50%	50%	
Start of operation	1-Jan-2013	1-Jan-2013	
	Sale under the FIT Program		
DEBT SERVICE			
Interest Rate	6.0%	6.0%	
Term (years)	20	20	
Initial Capital Cost - Power Plant	$ 2,181,000	$ 3,003,000	2013 Cost
Debt Portion of Capital	60%	60%	
EXPENSES			
General Inflation Rate	2%	1%	
Other (Admin, Insurance, Eng., etc.)	$ 40,000	$ 40,000	
O&M - Power Plant (2011 dollars)	$ 0.024	$ 0.024	/gross-kWh
Electrical purchase price (2011 dollars)	(FIT Price)	$ 0.090	/kWh
Electrical Purchase Price Annual Inflation Rate	n/a	4.5%	
ELECTRICITY REVENUE			
FIT Base Rate	$ 0.111	$ 0.111	/kWh
Annual Base Rate escalation	2.0%	1.0%	of 20% of base rate
PLANT INFORMATION			
Number of Engines	1	1	
Gross Plant Capacity (kW)	848	848	
Parasitic load (%)	10%	10%	
Parasitic load (kw)	85	85	
LFG Intake Capacity at 100% Load (scfm)	280	280	
Heat Value for LFG (Btu/cf; LHV)	450	450	
Gross Heat Rate (Btu/kWh; LHV)(100% load)	8,915	8,915	
Gross Heat Rate (Btu/kWh; LHV)(75% load)(1)	9,288	9,288	
Plant Availability (%)	90%	90%	
Max Gross Production (kWh/yr)	6,685,632	6,685,632	
Max Net Production (MWh/yr)	6,017	6,017	

Notes:
1. Based on conversation with M. Siebert of GE/Jenbacher Rep-Nixon Energy Solutions on 08/31/11.