GREER GALLOWAY
CONSULTING ENGINEERS

Lindsay-Ops Landfill Electricity Generation System Optimization Study



Prepared for:
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Project: 19-3-6414

June 2020

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Executive Summary

The City of Kawartha Lakes contracted The Greer Galloway Group to evaluate the performance of the electricity generation system at the Lindsay-Ops Landfill. The generator uses methane produced from the decomposition of landfilled waste to produce up to 0.335 MW of electricity which is primarily used in the operation of the City of Kawartha Lakes Wastewater Treatment Plant. Since being brought on-line in late 2015, there have been periods where generator has produced less than the expected quantity of electricity and the WWTP has received most of its power from the Hydro One grid. The objective of the study is to assess the existing operations and performance of the landfill gas generation facility, including the recently expanded gas collection system, and to provide recommendations for process, operational or other changes to maximize the overall benefit to the City.

The City of Kawartha Lakes has a Healthy Environment Plan that dovetails with the objectives of the generator – to increase capture of landfill emissions and put them to work offsetting other power sources. At the projected output without changes to the wellfield, 1,309 tonnes of carbon per year are offset from other generation sources by the operation of the generator. The size of the landfill requires that greenhouse gases be captured and may not be released to atmosphere. In the absence of alternatives, such as electricity generation, it must be flared. It is important to note that if modifications are not made and the generator is taken off-line, the on-going costs associated with mandatory operation of the flare system and well-field are approximately $43,612 annually, and this cost must be taken into account when assessing the net benefit of the generating facility to the City.

Our analysis covered multiple possibilities for optimizing the operation and value of the landfill gas generation facility. Aspects reviewed included the Hydro One contract, the service call strategy, downtime events, energy use and efficiency, and the landfill gas collection wellfield. Key findings include:

- Conversion of the billing and generation contracts to Distributed Generation classification or net metering could potentially produce cost savings. These changes would need to be negotiated between the City and Hydro One.
- There are multiple event types that will result in service calls including trips owing to low gas quantity/quality or trips tied to the power factor at the WWTP. The current policy prohibits service calls outside regular operating hours. Some generator trip events require a straightforward restart that could be accomplished by appropriately trained staff with limited teleconference support from the contractor. This has an immediate effect of returning the generator to activity and increasing the amount of generated electricity.
- Other sources of downtime include expected equipment aging, maintenance, and poor fuel quality. With trained staff, well management and wellfield maintenance, and spare parts review, the possible generation time may be increased to roughly 7,557 hours each year. This is nearly double the generation potential for 2018-19.
- Our updated modelling of methane generation potential suggests that the current methane generation rates in the old landfill area may be higher than originally modelled and that the methane collection efficiency in the old landfill area is lower than previously assumed. The construction of additional vertical collector wells within the old landfill area is predicted to improve the overall quantity and quality of the landfill gas delivered to the generator.

The economic analysis of the facility examined the assumptions made during the original business case. At the time, the generation potential of the landfill gas was estimated using the best available models. Using actual production numbers has allowed a more accurate evaluation of the generation potential and of Net Present Value.

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Our study indicates that the operation of the generator can be optimized with changes to operating practices, contract agreements, and wellfield. When taken in aggregate, the identified changes are predicted to increase Net Present Value from negative $722,388 to over $1,200,000 – a net increase of about $2 million. The simulations demonstrate the value of city staff training, and strategic well-field expansion and suggest that these improvements will have a synergistic effect when taken together.

Yours truly,

GREER GALLOWAY

CONSULTING ENGINEERS



Peter Zandbergen, P.Eng.

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1. Introduction

The City of Kawartha Lakes owns a generator at the Lindsay Ops Landfill site. The generator was commissioned in October 2015 and is primarily tasked with electricity generator for the adjacent Water Pollution Control Plant (WPCP). The original gas supply wells were supplemented by additional well to brought on-line in spring 2019.

The Greer Galloway Group has been retained by the City of Kawartha Lakes to complete an optimization study of the Lindsay-Ops Landfill Gas Power Generation Facility at 51 Wilson Road in Lindsay. The objective of the study is to assess the existing operations and performance of the landfill gas utilization facility, including the recently expanded gas collection system, and provide recommendations for process, operational or other changes to maximize the overall benefit to the City.

1.1 Project Scope and Methodology

The project is subdivided by the individual tasks to be performed.

Review existing hydro contracts

The Greer Galloway team will review the contracts the City has signed with Hydro One. Each of these contracts will be examined for opportunities to renegotiate rates or terms that will improve the energy cost offset at the WPCP or the revenue from selling energy to the grid. This will be achieved through review of agreements between Hydro One and other landfill gas generator operators.

Review existing operations and manuals

The current operations manuals will be reviewed by the Greer Galloway team to identify the processes used by the generator operators to manage the power generation. Opportunities to increase production of electricity from the harvested gas or to increase revenue by adjustment of supply timings will be highlighted.

Downtime reduction review

The statistics on downtime will be reviewed with the operators and the equipment manufacturers. This will identify operating conditions that may be adjusted to reduce downtime either from equipment maintenance operations or gas supply deficiencies. These statistics will rely on the initial months of data after the new wells are brought on-line in spring 2019. The conditions leading to downtime and the effects on the equipment and fuel supply will be examined to determine if opportunities exist to smooth the production and utilization of the energy to maximize the financial return.

Review hydro use

The records of use of electricity at both the WPCP and landfill facilities will be examined by the Greer Galloway team. Understanding when and how the electricity generated by the landfill gas is being used will provide insight to the opportunities to maximize the benefit of the generator system. Identifying peak use times and inefficient use of electricity will lead to recommendations on improving the use of generated power.

System operating value

The City may be able to take advantage of new policies and changes to existing frameworks at the provincial and federal levels with respect to green energy production and carbon offsets. The new programs will be investigated by the Greer Galloway team to identify those matching with the Lindsay Ops generator. For those programs, Greer Galloway will assist in funding applications to maximize the benefit to the City.

Financial assessment review

The team at Greer Galloway will review the assessments completed previously that were used to approve and justify continued operation of the landfill gas generation system. These assessments and

explanations will be adjusted and evaluated to reflect the current state of operations at the facility and provide accurate information to the City on the continued viability of the generator project.

Similarity assessment

Other municipal operators of landfill gas generators will be contacted by Greer Galloway to compare how their experience in operation of the equipment matches with that of the City of Kawartha Lakes. Understanding how other similar operators have maximized their production through efficient operations will provide additional recommendations to the City on improvements to their procedures and practices.

Landfill gas characteristics

To ensure the best possible use of the landfill gas, the characteristics of the landfill gas will be reviewed from the data supplied by the on-site equipment. Once the composition of representative samples is defined, recommendations will be made if additional equipment is required to refine the collected gases for optimal energy production. The variability of collected gas volume will be charted based on records. The variability and the previous assessments of downtime and hydro use will all be factored into a simulation to optimize the generation potential and maximize the revenue stream.

Optimization goals

When evaluating the options for the optimal use of the landfill gas consultations with the stakeholders will determine which criteria have the greatest weight. The Greer Galloway Group will consult with members of the City departments involved in the collection, generation, and use of the gas and its products to maximize the overall benefit factoring in the programs and policies of different levels of government. The optimization will take the form of Monte Carlo simulations using the distribution values uncovered by earlier research into the system aspects.

Summary Report

All the tasks will be summarized in a final report to stakeholders that will answer the underlying questions of continued viability of the generator facility and optimal use of the landfill gas. Process Model Optimization

1.2 Study Team

Peter Zandbergen, P.Eng. — Mechanical Engineer

Mr. Peter Zandbergen will be the Project Manager for this project. Mr. Zandbergen is a mechanical engineer for the Greer Galloway Group, with over ten (10) years of experience in project management and mechanical design. Mr. Zandbergen has completed building assessments for updating long-term capital planning; analysis of building systems coupled with construction cost data and financial trends to plan for future funding of building repairs and improvements. Mr. Zandbergen will utilize and coordinate the technical expertise and resources of the project team throughout the project to ensure all work is completed as scheduled and within budget. Mr. Zandbergen has strong communication and organization skills and works to ensure clients are satisfied, deadlines are met, and quality control is maintained. Mr. Zandbergen will report directly to the City and be responsible to ensure all project deliverables for this assignment are to the City's satisfaction.

For this project Mr. Zandbergen will take the mechanical lead in reviewing and making recommendations on operations and manuals, downtime, and gas utilization options. He will also be the lead author on the summary report with recommendations on the continued operation of the landfill gas generator.

Steve Blakey, P.Eng. — Director / Branch Manager

Mr. Steve Blakey has thirty-two (32) years of experience in consulting engineering; the past thirty (30) years in Canada as a municipal specialist. Mr. Blakey specializes in design engineering and project management.

Mr. Blakey has a Master of Science in Public Health and a Civil Engineering Degree; he is registered with the PEO as a P. Eng. and is Designated as a Consulting Engineer. Mr. Blakey is the Belleville Branch Manager and is responsible for the provision of professional services provided by Greer Galloway staff, including various municipal infrastructure works, water and wastewater planning and design, stormwater management, and solid waste management.

Mr. Blakey will ensure staff and resources are committed to the project, regularly reviewing the project with staff ensuring the Municipality receives a high level of service. Mr. Blakey will also assist the Project Manager with status reports and budget tracking.

Steve Lane, P.Eng. — Electrical Engineer

Mr. Steve Lane has over twenty (20) years of experience as an electrical engineer with expertise in building services design, backup power solutions, and municipal water/wastewater station design. With respect to building services, Mr. Lane has experience in electrical power distribution, interior/exterior lighting, emergency lighting and signage, and backup generators. Mr. Lane has broad knowledge of the electrical aspects of the Ontario Building Code (OBC), as well as the Ontario Electrical Safety Code (OESC) as they pertain to building design.

Mr. Lane will have the lead on the review and recommendation for energy use as produced by the landfill gas generation. He will also contribute to the review of Hydro One contracts to identify opportunities for improvements.

Dr. Charles Mitz, P.Geo. – Geologist

Dr. Charles Mitz is a Senior Hydrogeologist with a broad background in geoscience including characterization, monitoring and permitting of waste disposal sites throughout Ontario and in the management of multiple high-profile and multidisciplinary projects. Specific project experience includes the assessment of landfill gas generation and migration and in the design of a landfill gas collection system. He also brings an extensive background in the resource economics including mineral resource valuation.

Dr. Mitz is a licensed Professional Geoscientist who holds a Bachelor's Degree in Geological Science from Queen's University, a Master’s Degree in Civil Engineering from the University of Western Ontario, and a Doctorate in Medical Physics and Applied Radiation Sciences from McMaster University. He is also a licensed well technician under O.Reg. 903.

For this project his focus will be on generating a model of the landfill gas characteristics based on gas analysis records and deriving the process model for optimizing the operation of the landfill gas generator.

Shannon O'Rourke, B.Sc. — Mechanical Designer

Ms. Shannon O'Rourke is a mechanical engineering graduate of Queen's University with ten years of experience in manufacturing, process control, project management and quality system compliance. Since joining Greer Galloway, Ms. O'Rourke has been involved in Municipal Class Environmental Assessments for both water and wastewater projects including preparation of project file documentation and environmental study reports to comply with MCEA requirements. She has developed specific expertise in the creation of drinking water network models to evaluate the design and operation of existing water storage and distribution systems, and support infrastructure planning for future development. She has also completed numerous traffic and intersection studies to assess the potential impact of traffic generated by proposed commercial and residential subdivision developments as part of the development planning and approval processes.

For this project, Ms. O'Rourke will take the lead for the benchmark analysis including Hydro contract review and recommendations.

1.3 Acknowledgements

The Greer Galloway Group would like to acknowledge the following individuals for their contributions of time, expertise, and data to the successful completion of this project:

- Nikki Payne, Waste Technician II Waste Management, City of Kawartha Lakes,
- Lisa Peimann, Executive Assistant Engineering and Corporate Assets, City of Kawartha Lakes; and
- Matthew Dugan, M.A.Sc., P.Eng., Manager – Project Development and Southern Ontario Operations, Comcor Environmental Limited.

2. Existing System

The Facility is located entirely on the City-owned Lindsay – Ops Landfill Site and Water Pollution Control Plant. The property is legally described as part of Lots 25, 26 and 27, Concession 6, City of Kawartha Lakes, and the civic address is 51 Wilson Road, Lindsay. The total area of the property is approximately 92 hectares. The landfill site and WPCP are zoned as Rural. Land use surrounding the Facility within a 1,000 metre radius includes Prime Agricultural, Environmental Protection, and Industrial.

2.1 Waste Acceptance Rates

Waste acceptance rates are summarized on the following table:

Table 1 - Waste Acceptance Rates

Old landfill Area		North Expansion Area	
Year	**Waste Received (tonnes)**	**Year**	**Waste Received (tonnes)**
1980	12,159	2002	31,140
1981	18,999	2003	16,714
1982	19,359	2004	16,163
1983	19,251	2005	17,787
1984	19,449	2006	23,965
1985	21,510	2007	18,035
1986	28,530	2008	19,200[1]
1987	33,319	2009	19,200[1]
1988	38,909	2010	19,200[1]
1989	41,806	2011	19,200[1]
1990	35,075	2012	31,824
1991	20,489	2013	28,791
1992	15,665	2014	26,030
1993	17,164	2015	29,152
1994	12,220	2016	27,736
1995	14,201	2017	25,167
1996	13,334	2018	27,205[2]
1997	15,532		
1998	15,892		
1999	16,226		
2000	19,242		
2001	20,479		

1- Estimate of organic-containing wastes (Golder, 2008)
2- Data obtained from Golder, 2008 and Golder, 2019

Golder assumed that about 64% of the total waste received at the site would contain enough organics to be potentially methane generating. This is a reasonable assumption and consistent with limited information from recent waste audits carried out by the City of Kawartha Lakes.

2.2 Wellfield and Collection System

A combination of vertical wells and horizontal collectors extract landfill gas from the waste disposal areas and convey the captured gas to the generator using a network of buried high-density polyethylene (HDPE) piping. The collection system is sloped towards drainage locations for the collection of condensate removed from the landfill gas. The collection system is designed to be progressively expanded as filling operations continue at the Site. The existing collection system consists of approximately 35 vertical extraction wells located within the old landfill area and a further 12 wells in the north expansion area (five of which were constructed early in 2019). The system was intended to

collect on the order of 425 m3/hr (250 cfm) of landfill gas however actual gas collection has been lower. Monitoring data exists for 23 locations (12 in the north expansion area and 11 within the old landfill area). The main collection wells are briefly described below:

GW1-H - GW1-H is located within the northwest corner of the north expansion area (Cell 1). This well is currently valved off due to oxygen breakthrough, but it has yielded LFG with a methane content typically ranging from about 25% to 60% when the well was actively producing. When producing, the well has a measured vacuum of between 25 and 40 inches of H_2O. The well has potential to be re-connected to the collection system at low rate of extraction (i.e. a low vacuum at the wellhead).

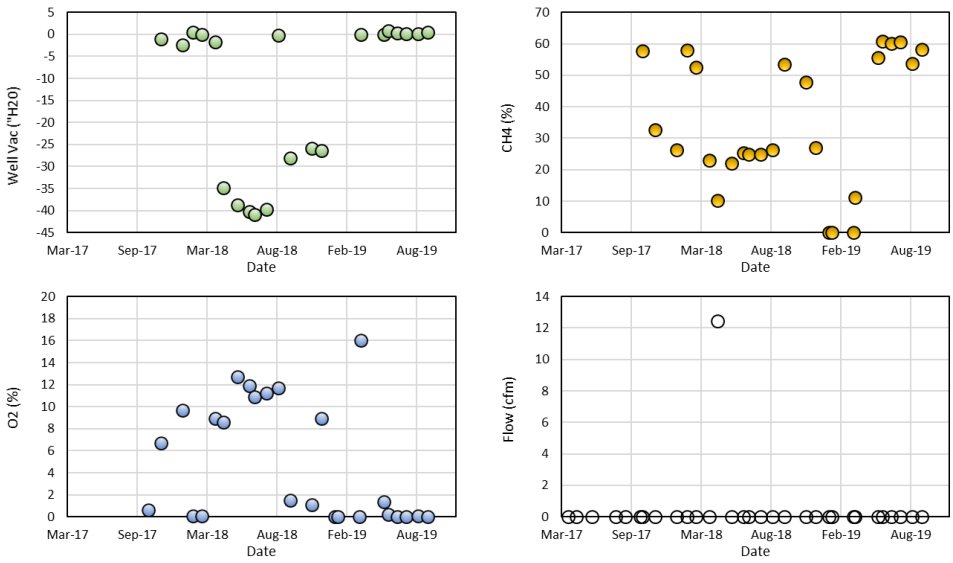


Figure 1 - Summarized Monitoring Results for GW1-H

GW2-H - GW2-H is located within the north central portion of the north expansion area (Cell 1). This well is currently producing at a rate of approximately 7.9 cfm with a methane content of about 37% and a measured vacuum of between 33 and 40 inches of H_2O. Oxygen levels are low and stable. In September 2019 this extraction well contributed 6.1% of total methane delivered to the generator.

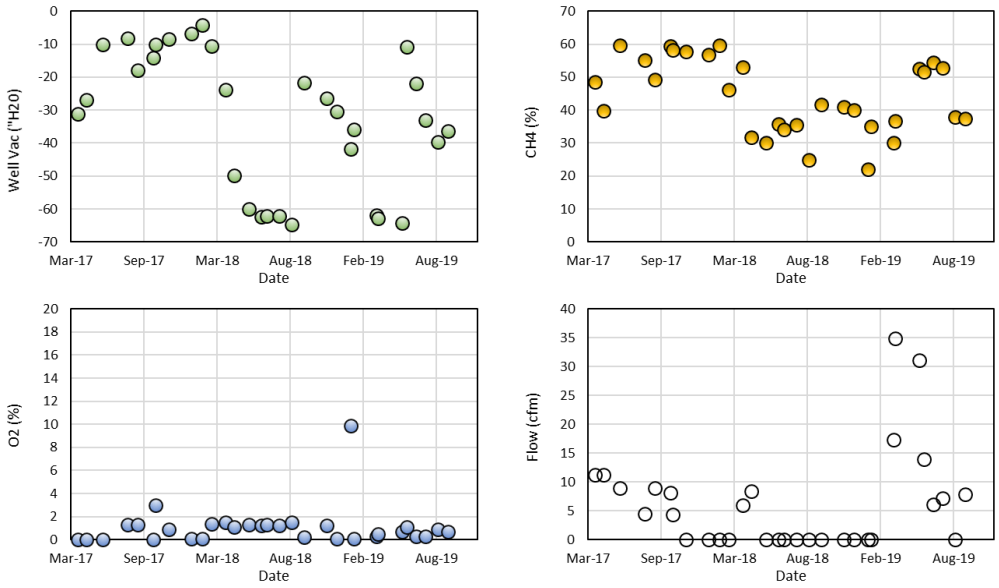


Figure 2 - Summarized Monitoring Results for GW2-H

GW3-H - GW3-H is located within the northeast corner of the north expansion area (Cell 1). This well is currently producing at a rate of approximately 6.7 cfm with a methane content of about 27% and a measured vacuum of between 33 and 40 inches of H_2O. Oxygen levels are low and stable but the methane content in this well has been declining. In September 2019 this extraction well contributed 3.8% of total methane.

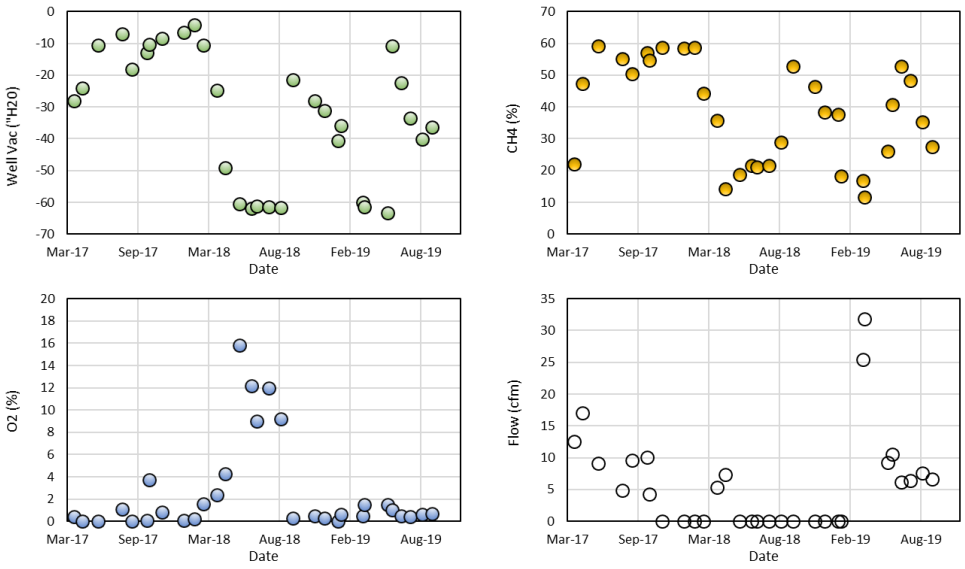


Figure 3 - Summarized Monitoring Results for GW3-H

GW4-H – This well is located within the northwest corner of the north expansion area, between Cells 1 and 2. This well is currently producing at a rate of approximately 8.2 cfm with a methane content of about 48% and a measured vacuum of between 33 and 39 inches of H_2O. Oxygen levels are low and stable. Methane content is stable. In September 2019, this extraction well contributed 8.1% of total methane delivered to the generator.

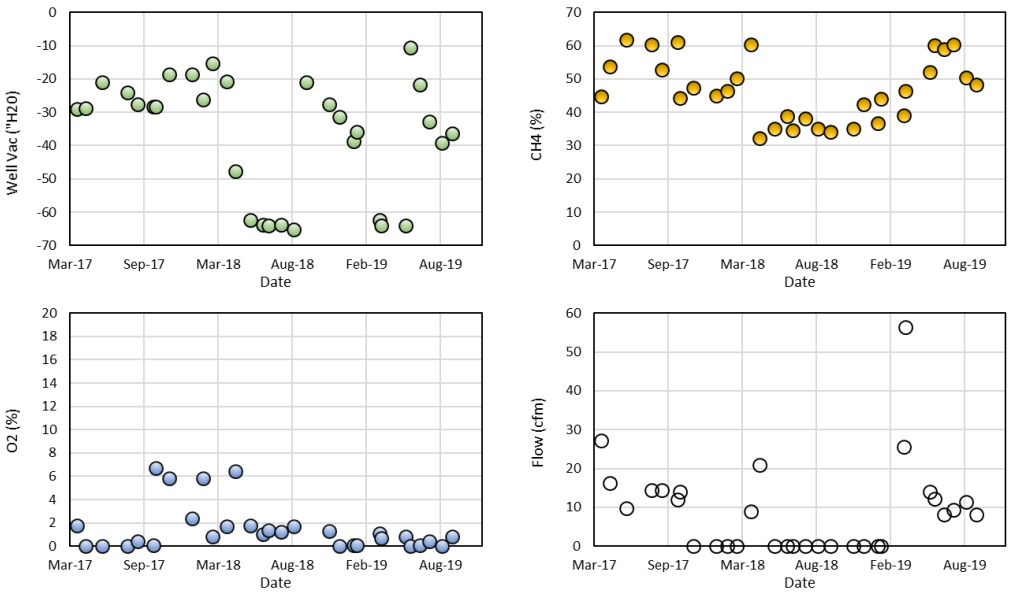


Figure 4 - Summarized Monitoring Results for GW4-H

GW5-H: GW5-H is located within the north central portion of the north expansion area (between Cells 1 and 2). This well is currently producing at a rate of approximately 8.1 cfm with a methane content of about 56% and a measured vacuum of between 22 and 39 inches of H_2O. Oxygen levels are low and stable. This extraction well has produced intermittently due to flooding in this area. In September 2019, GW5-H contributed 9.3% of total methane delivered to the generator.

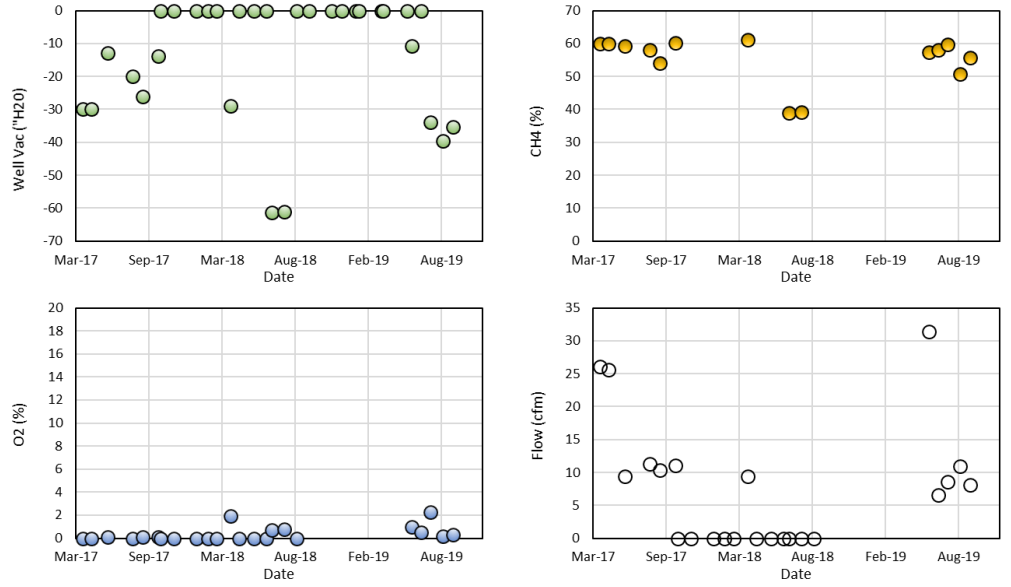


Figure 5 - Summarized Monitoring Results for GW5-H

GW6-H: is located within the northeast portion of the north expansion area (between Cells 1 and 2). This well is currently producing at a rate of approximately 7.1 cfm with a methane content of about 37% and a measured vacuum of between 23 and 40 inches of H_2O. Oxygen levels are low and stable. In September 2019, GW6-H contributed 5.7% of total methane delivered to the generator.

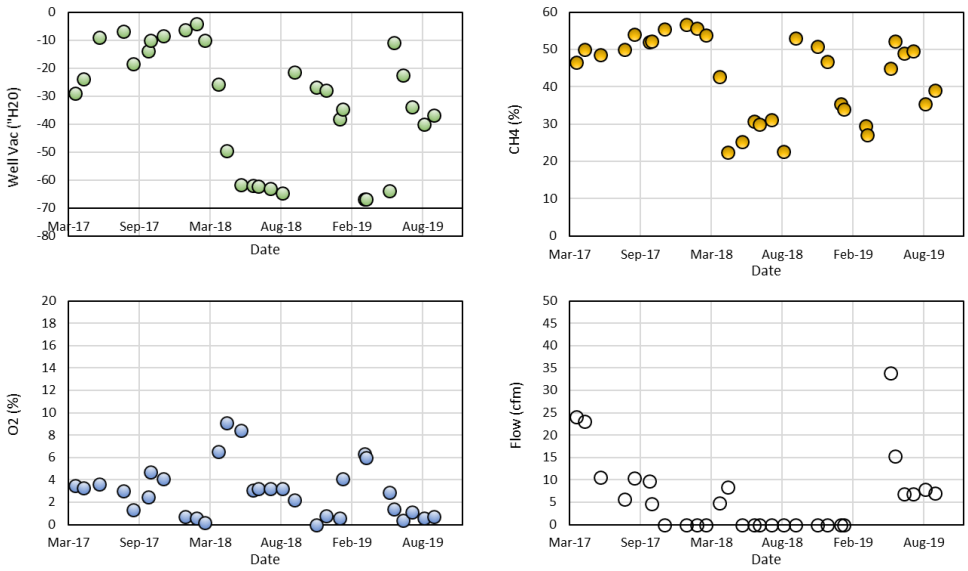


Figure 6 – Summarized Monitoring Results for GW6-H

GW7-H: is in the north expansion area (in the northeast corner of Cell 6). This well is currently producing at a rate of approximately 7.7 cfm with a methane content of about 54% and a measured vacuum of between 23 and 43 inches of H_2O. Oxygen levels are low and stable. The methane content is stable. In September 2019, GW7-H contributed 8.5% of total methane delivered to the generator.

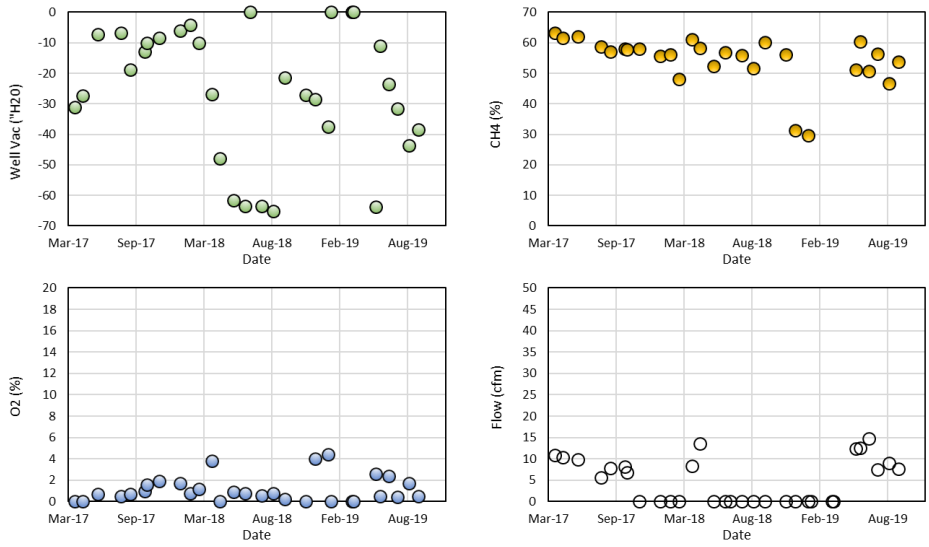


Figure 7 - Summarized Monitoring Results for GW7-H

GW8-1: is a new well (constructed in April, 2019) located in the eastern part of Cell 6 in the north expansion area. This well is currently producing at a rate of approximately 13.1 cfm with a methane content of about 41% and a measured vacuum of between 23 and 43 inches of H_2O. Oxygen levels are low and stable. The methane content is stable. In September 2019, GW8-1 contributed 11.2% of total methane delivered to the generator.

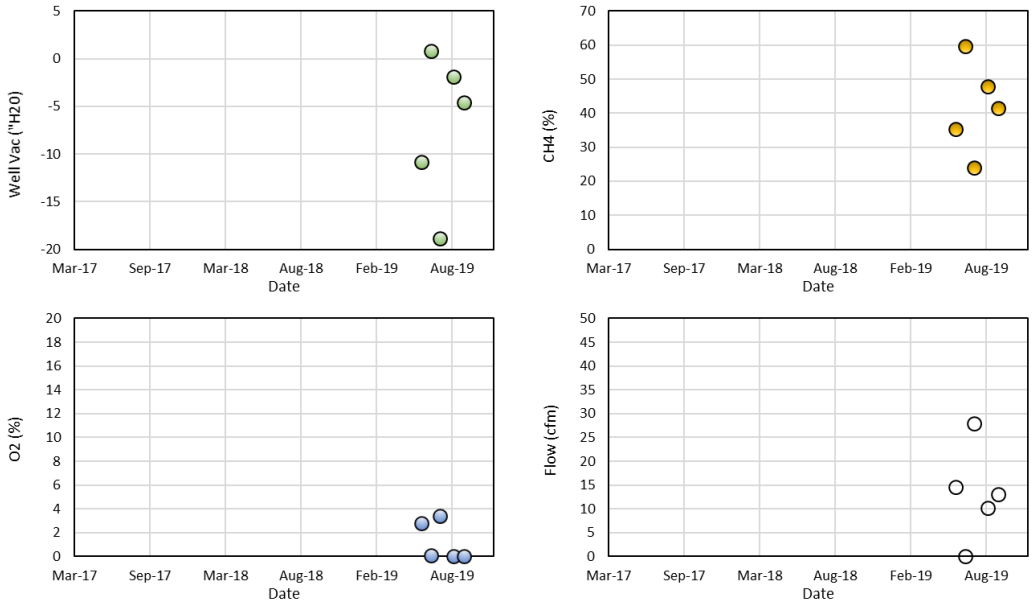


Figure 8 - Summarized Monitoring Results for GW8-1

GW9-1: is a new well (constructed in April, 2019) located in the north central part of Cell 6 in the north expansion area. This well is currently producing at a rate of approximately 20 cfm with a methane content of about 33% and a measured vacuum of between 24 and 39 inches of H_2O. Oxygen levels are low and stable. The methane content is stable but low. In September 2019, GW9-1 contributed 13.7% of total methane delivered to the generator.

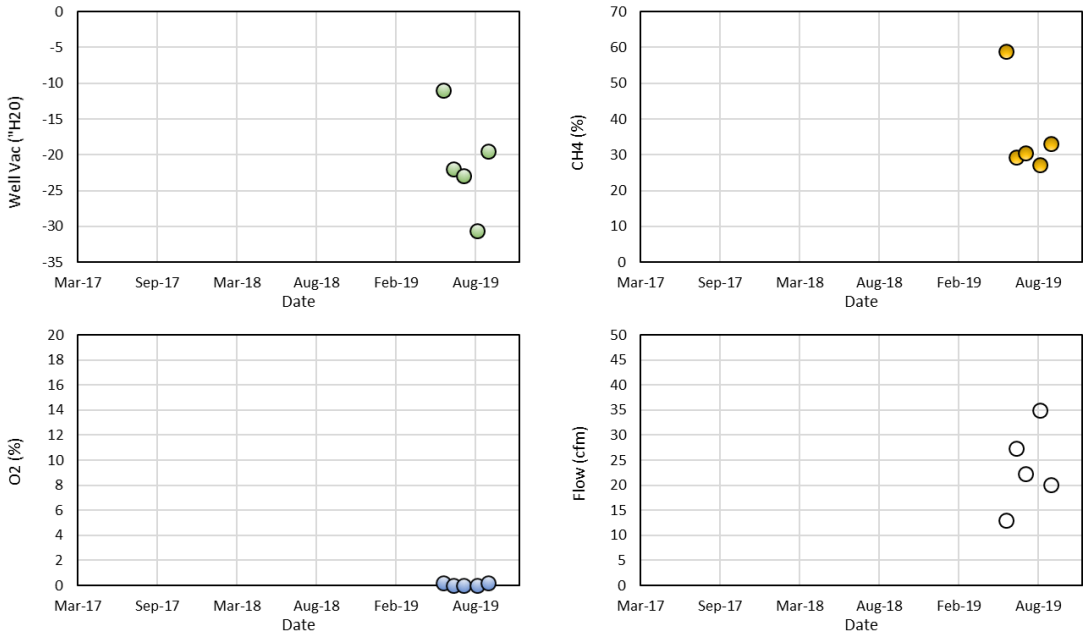


Figure 9 - Summarized Monitoring Results for GW9-1

GW11-1 is a new well (constructed in April, 2019) located in the western part of Cell 6 in the north expansion area. This well is currently valved off due to oxygen breakthrough, but it has yielded LFG

with a methane content typically ranging from about 29% to 43% at a low vacuum when the well was actively producing.

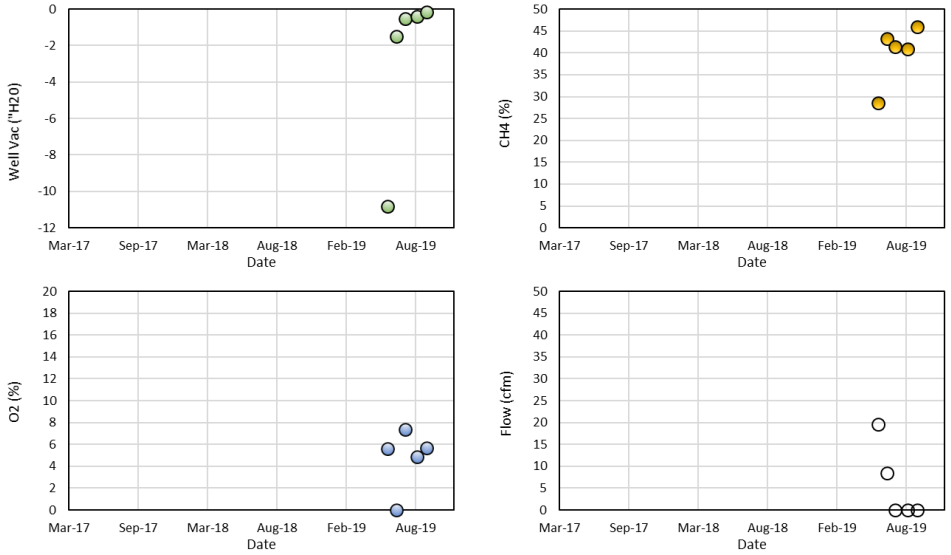


Figure 10 - Summarized Monitoring Results for GW11-1

GW12-1: is a new well (constructed in April, 2019) located in the east part of Cell 3 in the north expansion area. This well is currently valved off due to oxygen breakthrough, but it has yielded LFG with a methane content typically ranging from about 7% to 26% when the well was actively producing. Methane levels have increased since the well was shut in and this well is a candidate for reconnection to the collection system once this area of the landfill is capped.

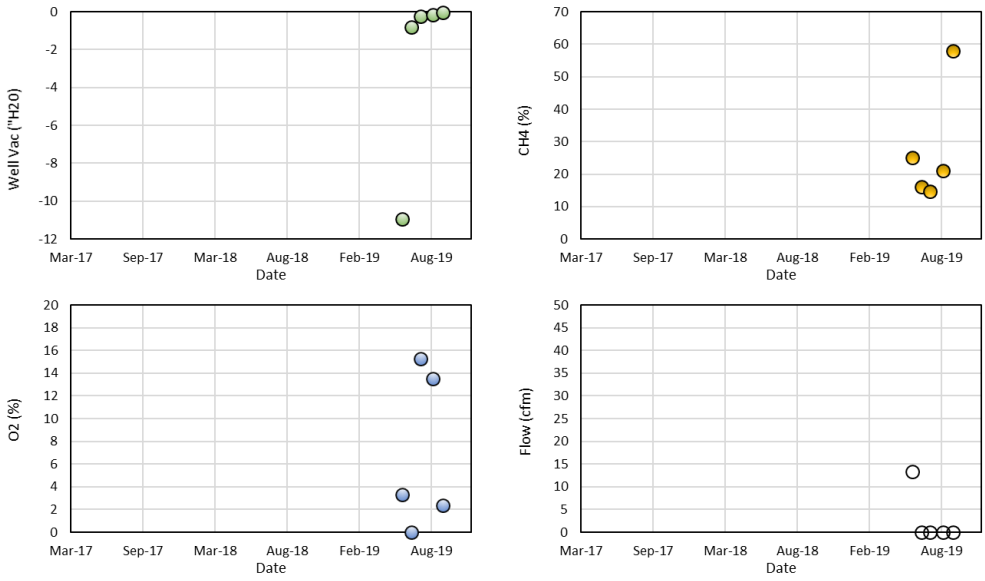


Figure 11 - Summarized Monitoring Results for GW12-1

GW13-1: is a new well (constructed in April, 2019) located in the western part of Cell 3 in the north expansion area. This well is currently valved off due to oxygen breakthrough, but it has yielded LFG with a methane content typically ranging from about 28% to 37% when the well was actively producing.

As with GW12-1, methane levels have increased since the well was shut in and this well is a candidate for reconnection to the collection system once this area of the landfill is capped.

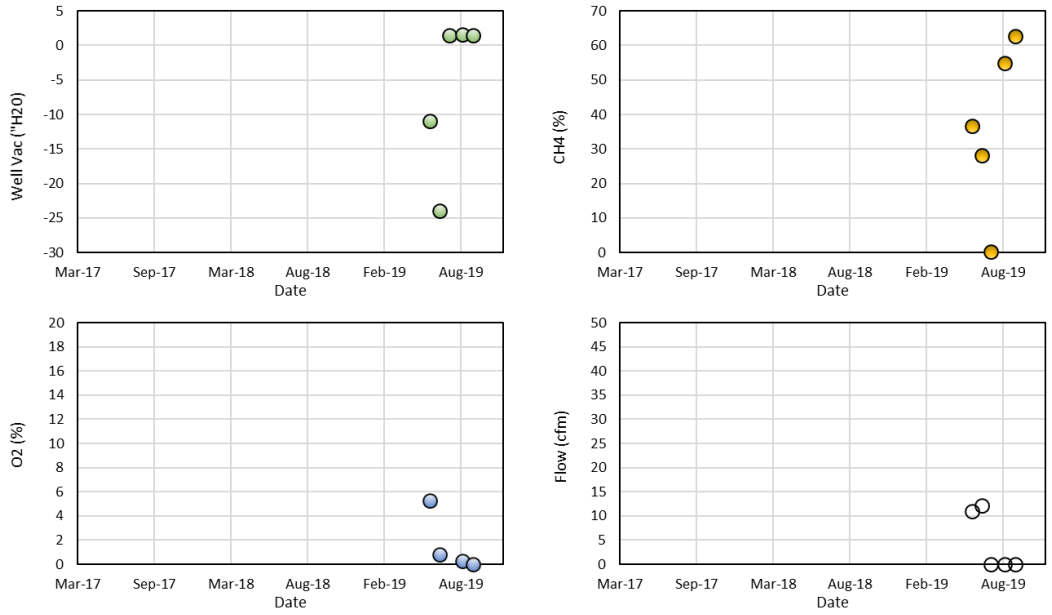


Figure 12 - Summarized Monitoring Results for GW13-1

GV25: is located in the southwest corner of the old landfill area. This collection point is currently producing intermittently at a low flow rate and a variable methane content ranging from 23 to 54%. Oxygen levels are high and variable. In September 2019, this collection point contributed a negligible amount of total methane delivered to the generator.

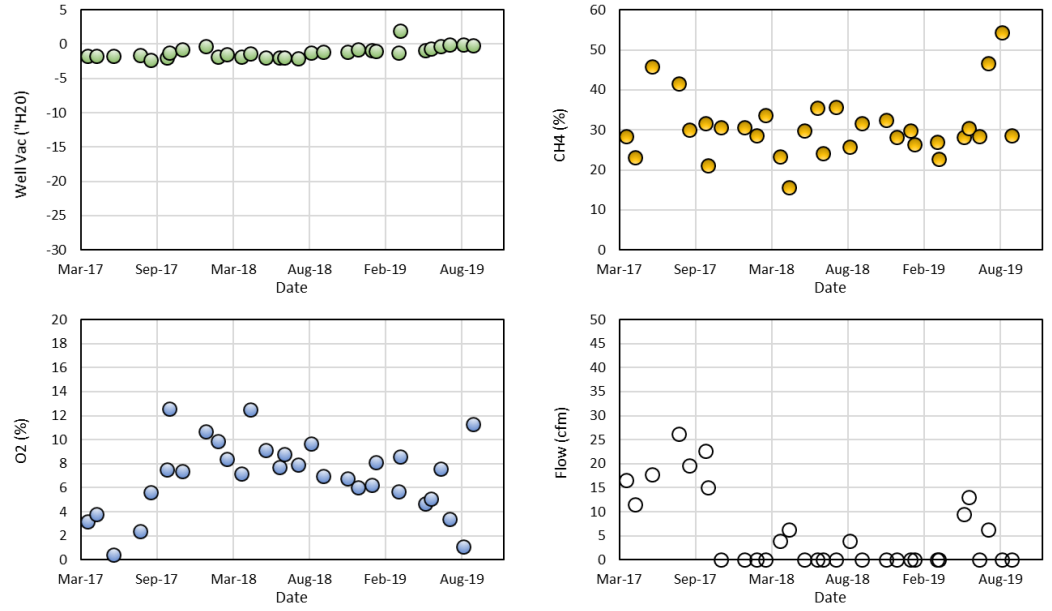


Figure 13 - Summarized Monitoring Results for GV-25

GV27: is located in the south central part of the old landfill area, near the base of the slope. This collection point is currently producing at approximately 9.5 cfm with a methane content of 49%. Oxygen levels are high and variable. In September 2019, this collection point contributed 9.5% of total methane delivered to the generator.

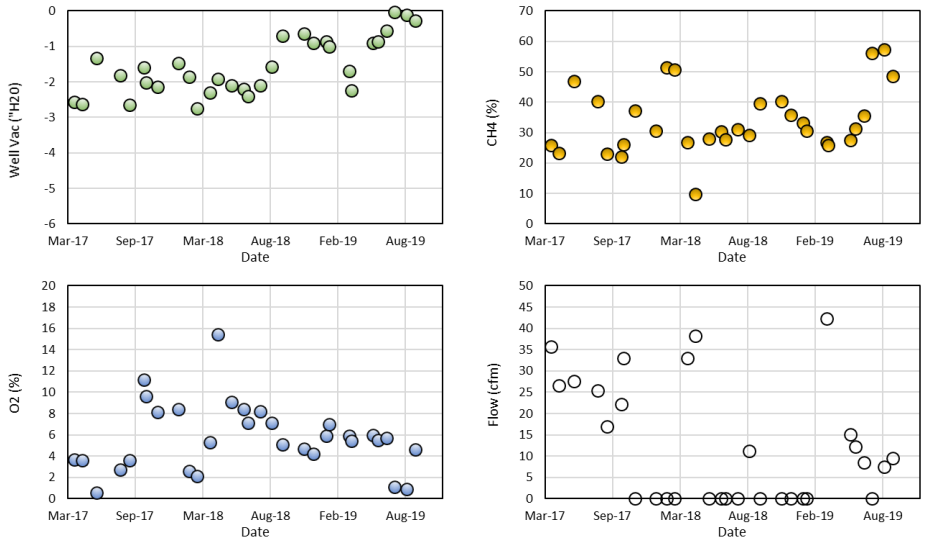


Figure 14 - Summarized Monitoring Results for GV27

GV29: is located in the southeast part of the old landfill area, near the base of the slope. This collection point is currently producing at approximately 12.5 cfm with a methane content of 48%. Oxygen levels are high and variable. In September 2019, this collection point contributed 12.3% of total methane delivered to the generator. As with GV27, the presence of elevated oxygen levels at this point combined with stable and high methane suggests leakage through the geomembrane into the shallow vent network.

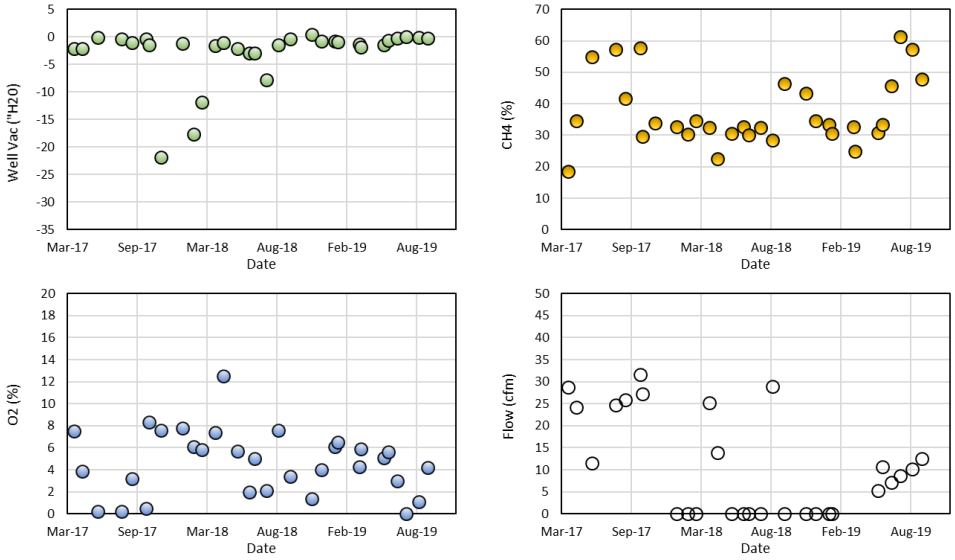


Figure 15 - Summarized Monitoring Results for GV29

GWT-1: is located within the north central portion of the old landfill area immediately to the north of the area capped with the geomembrane in 2007. This well is currently not producing but has produced at

a rate of between 3 and 21 cfm at a methane content between 32 and 53% during the early part of 2019. Oxygen levels are high and erratic. In September 2019, GWT-1 contributed a negligible amount of total methane delivered to the generator.

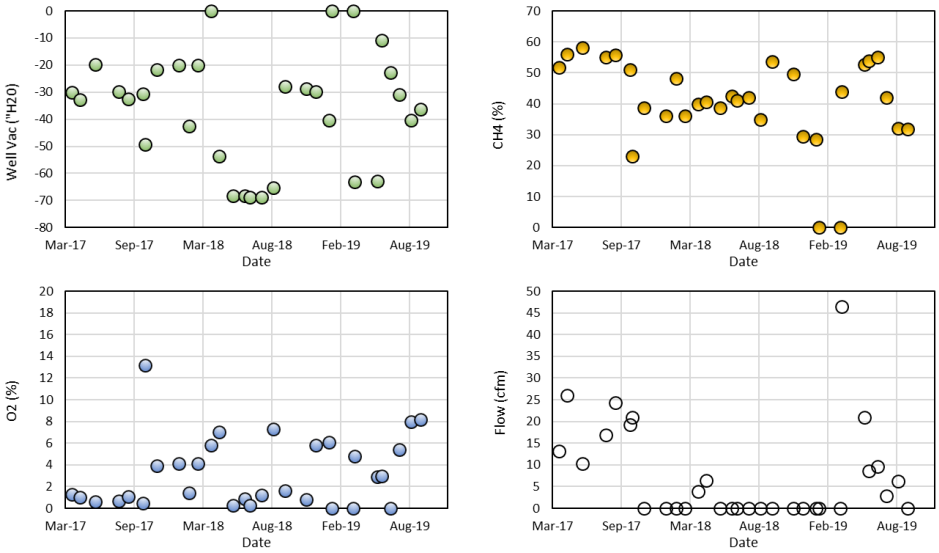


Figure 16 - Summarized Monitoring Results for GWT-1

GWT-2: is located within the northwest portion of the old landfill area immediately to the north of the area capped with the geomembrane in 2007. This well is currently producing at 7.4 cfm and a methane content of 59%. Oxygen levels are low and stable. In September 2019, GWT-2 contributed 9% of total methane delivered to the generator.

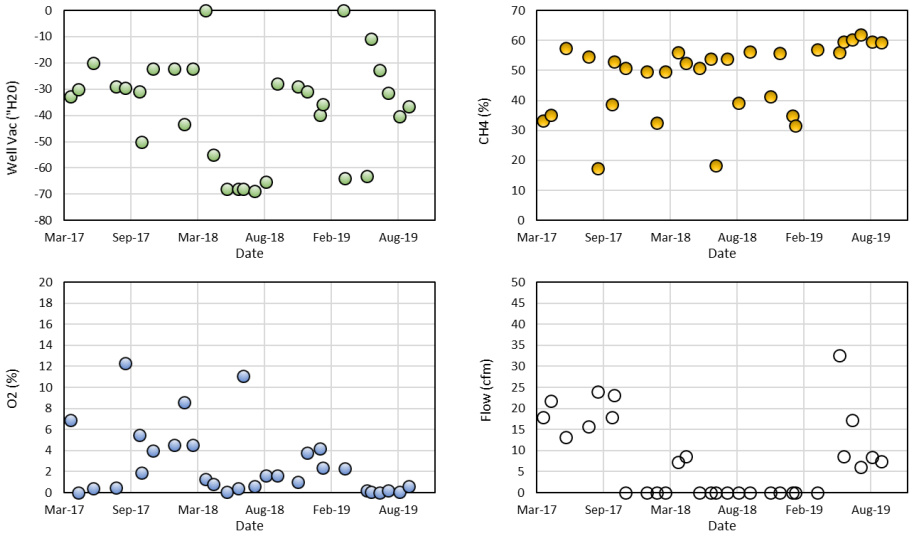


Figure 17 - Summarized Monitoring Results for GWT-2

A summary of all existing wells is provided on Table 2 below.

Table 2 - Existing Well Summary

Plant	Location	CH_4(%)	Trend	O_2(%)	Trend	% of total	Comment
GW1-H	New	…	…	…	…	…	Valve closed due to oxygen breakthrough
GW2-H	New	37.4	declining	0.7	stable	6.1	
GW3-H	New	27.4	declining	0.7	stable	3.8	
GW4-H	New	48.2	stable	0.8	stable	8.1	
GW5-H	New	55.6	stable	0.3	stable	9.3	
GW6-H	New	39.1	Stable	0.7	stable	5.7	
GW7-H	New	53.9	stable	0.5	stable	8.5	
GW8-1	New	41.5	stable	0.0	stable	11.2	New in 2019
GW9-1	New	33.1	declining	0.2	stable	13.7	New in 2019
GW11-1	New	…	…	…	…	…	New in 2019 Valve closed due to oxygen breakthrough
GW12-1	New	…	…	…	…	…	New in 2019 Valve closed due to oxygen breakthrough
GW13-H	New	…	…	…	…	…	New in 2019 Valve closed due to oxygen breakthrough
GV4	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV9	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV17	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV25	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV26	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV27	Old	48.6	stable to increasing	4.6	stable	9.5	Valve closed due to oxygen breakthrough
GV28	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GV29	Old	47.9	stable	4.2	stable	12.3	Valve closed due to oxygen breakthrough
GV30	Old	…	…	…	…	…	Valve closed due to oxygen breakthrough
GWT1	Old	31.9	declining	8.2	increasing	2.6	
GWT2	Old	59.3	stable	0.6	stable	9.0	

Contributions to the useable gas are primarily from 12 wells; 8 in the north expansion area and 4 within the old landfill area. The remaining wells are either unavailable for monitoring or have been valved off due to poor gas quality (usually because of oxygen breakthrough). In September 2019, 66% of the methane was collected from wells within the north expansion area and 33% from the old landfill area. In May, 2019 (before the recently constructed wells in the north expansion area were brought online) the old landfill area contributed an even greater proportion (44%) of the total methane collected.

2.3 Methane Generation Potential

LFG is generated from the anaerobic decay of the organic components of waste. The amount of methane and the rate at which it is generated is therefore a function of the degradable organic content of the landfilled waste, along with factors such as temperature, moisture, and time. Landfill gas contains roughly equal parts of carbon dioxide (CO_2) and methane (CH_4) along with trace levels of other parameters including siloxanes.

An initial estimate of methane generation potential was prepared by Integrated Gas Recovery Services (IGRS) in 2003. It is our understanding that this report concluded that the Lindsay Operations landfill was too small and too shallow to allow for economic electricity generation at the site. This assumption was revisited by Golder Associates Ltd. In 2008 following the capping of most of the old landfill area with a geomembrane cover. This impermeable capping allowed for potentially higher collection efficiencies over the old landfill area and warranted a re-examination of the economic feasibility of LFG utilization for electricity generation.

Golder's assessment used the United States Environmental Protection Agency's (USEPA's) LandGEM model (USEPA. 2005a) to model methane and LFG generation. The LandGEM model uses a simple first-order equation, which assumes that methane generation follows an exponential trend. to model methane generation. and requires the following input parameters:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{l} kL_0 \left(\frac{M_i}{10}\right)\left(e^{-kt_{ij}}\right)$$

Where:

Q_{CH4} = estimated methane generation flow rate (in m^3 per year)

i = 1-year time increment

n = (year of the calculation) – (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate (1/year)

L_0 = potential methane generation capacity (m^3 per tonne of waste)

M_i = mass of solid waste disposed in the i^{th} year (tonne)

t_{ij} = age of the j^{th} section of waste mass disposed in the i^{th} year (decimal years)

L_0 = 127 m3/tonne of waste

K = 0.096/yr

Besides the waste acceptance rates, the model is dependent on the value selected for K which is a decay constant quantifying the rate that landfilled waste decays and produces methane, and L_0 which is the ultimate methane yield per tonne of waste disposed. Golder based their methane generation model on a K of 0.096/yr and L_0 of 127 m^3/tonne of waste. A collection efficiency of 75% was assumed.

The model (see Figure 18) predicted that the site would rapidly reach a stable methanogenic state (Phase IV after Farquhar and Rovers, 1973) with peak methane generation of 1,630 tonnes/year reached in 2033 immediately following the estimated closure of the landfill.

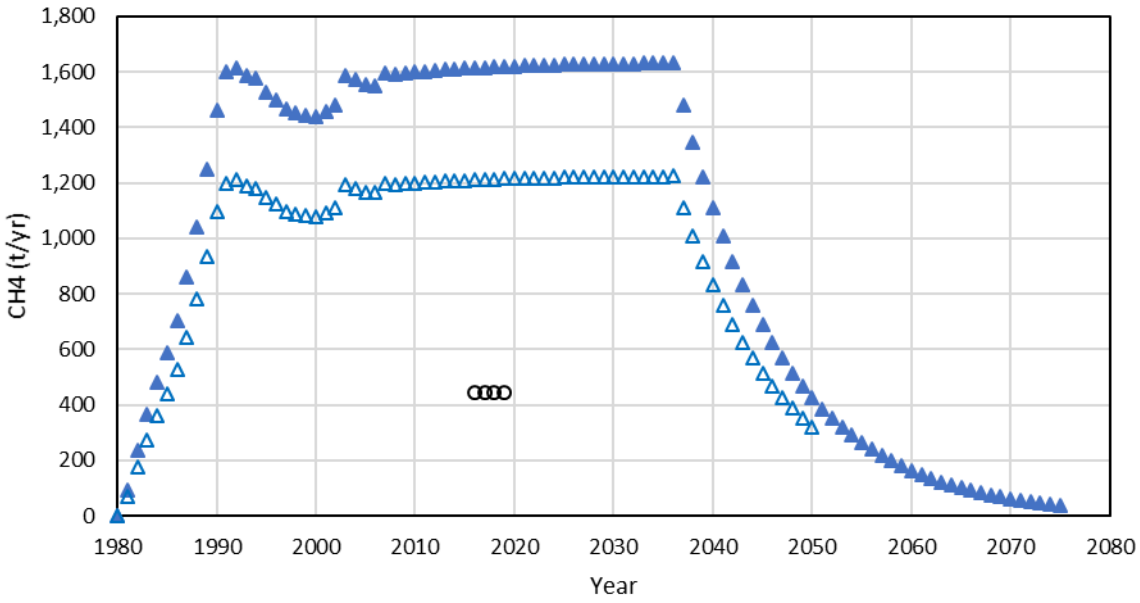


Figure 18 - Predicted Methane Generation Rate (Golder, 2008)

Filled triangles represent the methane generation rate while open triangles represent the estimated collectable methane. The open circles show the average methane collected during the initial 4 years of plant operation.

Greer Galloway re-analyzed the methane generation assumptions using more conservative parameters that reflect the tendency for LandGEM to overestimate methane generation rates (Scharff and Jacobs, 2006; Mou et al., 2015). The modelled assumptions are summarized below:

- Methane generation using k=0.096 and L_0= 127 (i.e. replicating the results of the Golder analysis)
- Methane generation using k=0.06 and L_0= 110 (Greer Galloway estimate taking into account the increasing diversion of organic wastes from landfills in Ontario)
- Methane generation using k=0.04 and L_0= 100 (USEPA default standards for LandGEM 3.02)

Modelling was carried out for a single undifferentiated landfill and using a two-compartment model partitioning methane generation between the old landfill area and the north expansion area. The Modelling was carried out using LandGEM 3.02 as insufficient waste characterization data exists to allow for the application of multi-phase models such as the Afvalzorg model (Krause et al, 2016) Fugitive emissions (methane loss to the atmosphere and methane oxidation within cover material) was estimated using the German EPER Model (Scharff and Jacobs, 2006):

$$M_e = M * BDC * BDC_f * F * D * C$$

Where,

M_e = amount of diffuse methane emission (tonnes CH_4/a)

M = annual amount of landfilled waste (tonnes/a)

BDC = proportion of biodegradable carbon (0.15)

BDC_f = proportion of biodegradable C converted (0.5)

F = calculation factor of carbon converted into CH4 (1.33)

D = collection efficiency:

- active degassing (0.4)
- no recovery (0.9)
- active LFG recovery and cover (0.1)

C = methane content (50%)

The model output (see Appendix A) was calibrated using methane collection data for the old and north expansion areas. Monitoring data shows that approximately two thirds of current methane yield is obtained from wells in the north expansion area with the remaining third obtained from the old landfill area. If the wellfield is constructed similarly in both areas, then the 2:1 ratio should mirror their respective methane generation rates corrected for the differences in cap (assume 80% for geomembrane vs. 60% for earth cover). Under these assumptions, the 2:1 ratio is obtained only for the model scenario using USEPA default values for k and L_0 (0.04/yr and 100 m^3/tonne, respectively). The modelled methane generation under different modelled scenarios is shown below on Figure 19 along with an estimated best fit generation curve for the entire site.

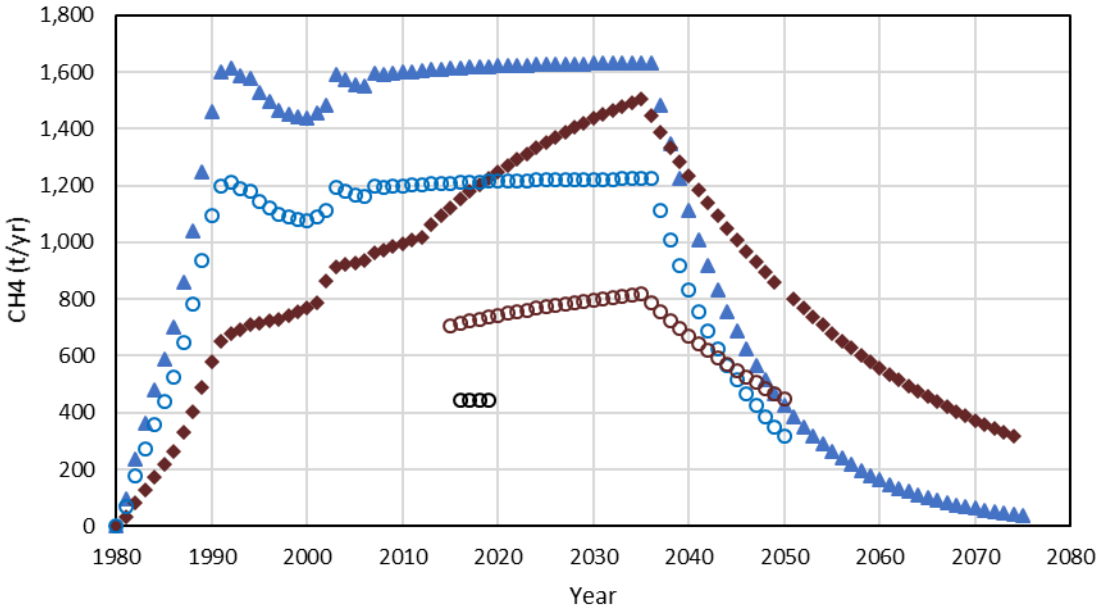


Figure 19 - Predicted Methane Generation Rate (Golder, 2008)

Filled blue triangles represent the methane generation rate under the original model while open blue triangles represent the estimated collectable methane (again under the original model parameters. The filled brown diamonds represent methane generation under our revised model while the open brown circles represent estimated collectable methane. The black open circles represent the actual collected methane over the first four years of operation.

2.4 Methane Collection Efficiency

Collection efficiency for the existing system is estimated according to:

$$CE = \frac{Q_c}{Q_p} * 100\%$$

Where:

CE = the collection efficiency expressed as a percentage (%)
Q_c = the normalized average collected flow rate of methane in the given calendar year (m^3/hr)
Q_p = the estimated generated methane flow rate in the given calendar year (m^3/hr)

The resulting value for CE ranges from 36% for the 2008 LandGem model to 57% for the current estimate of methane generation. In either case, the actual collection efficiency is lower than estimated (75% for the 2008 model and 75 and 60% for the old landfill and north expansion areas respectively under the current re-analysis). Under our revised generation model, the collection efficiency is the product of assumed collection efficiency over the old landfill area (assumed to be 75% reflecting the geomembrane cover over most of the area and consistent with Golder's 2008 assumptions) and the north expansion area (assumed to be 60% consistent with collection efficiencies for earth cover in other Canadian landfills). The resulting prediction is still substantially higher than that currently achieved at the site – raising the question why?

We consider the collection efficiency estimates for the north expansion area to be robust as this area has a good well coverage and it is unlikely that the collection efficiency in this area is substantially lower than 60%. This raises the possibility that the assumed 75% collection efficiency over the old landfill area might be an over-estimate. Supporting this speculation is the consistent good performance of Collection Well GWT-2 which has produced >50% methane for most of the period since the commissioning of the generation facility, and currently supplies close to 10% of the total methane collected. Most of the collection over the old landfill area uses the gas vents that appear to be shallow collectors designed primarily to prevent the build-up of gas pressures from damaging the geomembrane. The absence of deep vertical extraction wells over the old landfill area may have left substantial volumes of trapped methane in this area to be extracted only slowly as the methane migrates to the shallow vents. If correct, then the extraction efficiency over the old landfill area may be substantially lower than 75%.

2.5 Landfill Gas Treatment System

When the landfill gas is collected it may be taken through one of two paths; the flare path or the generation path. The path is common from the extraction wells through the moisture separator. From there, if gas is to be flared, no further conditioning is performed. The blower pulling the gas from the wells sends it to the flare where it mixes with combustion air and is burned with no additional energy recovered.

When used for generation, several additional steps of conditioning are completed to remove contaminants and optimize the gas condition for the genset. The blower sends the collected gas through a cooler and dryer to further reduce the moisture. The gas is processed through the siloxane filter to remove that specific contaminant which will negatively affect the performance and longevity of the genset. From the siloxane filter, the gas is fed to the genset to produce electricity. There are no

equipment redundancies in the gas treatment path. If the gas is not suitable for use in the genset either for condition (moisture, siloxane) or quality (CH_4 percentage), it is recirculated to the flare to be combusted.

2.6 Electricity Generating Equipment

Electrical power is generated from LFG through the use of an internal combustion engine generator. The generator is connected directly to the WWTP 600V power distribution and operated in parallel with the Hydro One utility connection. An underground 600V power feed connects the generator/flare facility to the WWTP.

2.7 Control System

Because the generator is directly tied to the WWTP distribution, and thus directly tied to the Hydro One grid, monitoring equipment is used to ensure that the generator is operating in a satisfactory condition. If abnormal conditions arise, the monitoring equipment will kick off the generator to ensure that the Hydro One grid is not adversely affected. Of particular importance to Hydro One is ensuring that the power factor observed at the service entrance is within acceptable limits. Power factor is heavily influenced by motor loads in the WWTP, the generator, and WWTP power factor correction capacitors. The power factor correction system consists of a bank of capacitors that can selectively connected to the grid to provide varying levels of correction depending on the amount of motor load in service. The power factor correction capacitors themselves may cause a generator shutdown if they are not synchronized with motor switching by causing over-correction.

2.8 Electrical Transmission System

The 600V underground feed between the WWTP and generator/flare facility is directly connected to the main WWTP electrical distribution, and serves as a bi-directional power path. When the generator is operating, generator/flare equipment (such as the gas blower) are essentially fed directly from the generator. After powering generator/flare equipment, the majority of the generator power is fed to the WWTP distribution system. When the generator is not operating, power flows from the WWTP to the generator/flare facility to supply required loads.

The WWTP is tied to Hydro One via a single connection point with a single bi-directional utility meter.

The generator serves to reduce the demands of energy imported from Hydro One. When the generator creates power in excess of that demanded by the WWTP, net power will flow out to the Hydro One grid.

3. Benchmark Analysis

3.1 Hydro Contract Review

3.1.1 Contract Review

The 0.335 MW Lindsay-Ops Landfill Gas Power Generation Facility began operations in 2016 under Renewable Energy Approval Number 8446-9HSGRP. The main component of the system is a Jenbacher biogas-fired generator, purchased used in 2012 from Glenridge Gas Utilization Inc. (a landfill gas utilization company in which St. Catharines Hydro is a main partner). Electricity generated at the Lindsay-Ops facility is used primarily to offset energy usage at the landfill site and the adjacent Water Pollution Control Plant (WPCP) at 48 Lagoon Road. Together, the two facilities consume more than 200,000 kWh of electricity per month, with the WPCP being responsible for approximately 92% of the total. The generation facility is connected to the Hydro One distribution grid and is governed by the terms of a connection agreement dated July 2, 2015.

A review of the connection agreement and current hydro billing for the Lindsay WPCP was conducted to provide information to assess the financial viability of the generation facility and identify opportunities for improving financial performance. The Hydro One Business Customer Centre was contacted to obtain a detailed explanation of current billing practices based on hourly metering data.

The following documents were reviewed:

1. "Connection Agreement for a Small Embedded Generation Facility or a Mid-Sized Embedded Generation Facility" dated July 2, 2015 between Hydro One Networks Inc. and the City of Kawartha Lakes
2. Schedules to the Connection Agreement:
    - Schedule A: Application and Connection Cost Agreement
    - Schedule E: Billing and Settlement Procedures
3. "Conditions of Service for Hydro One Networks Inc. Distribution Customers" (March 1, 2019)
4. Ontario Energy Board (OEB) documents:
    - Retail Settlement Code (Jan. 1, 2017)
    - Distribution System Code (March 14, 2019)
    - Standard Supply Service Code for Electricity Distributors (revised March 14, 2019)
    - Interim Rate Order EB-2017-0049 Hydro One Networks Inc. (revised June 11, 2019)
5. Independent Electricity System Operator (IESO) historical data for electricity pricing:
    - Hourly Ontario Energy Price (HOEP) and
    - Global Adjustment (GA)
6. Hydro One statements for the Lindsay-Ops Landfill/WPCP:
    - Invoices covering August, November and December 2018, and January through September 2019 billing periods (Account #200160856582)
    - Generation Payment Statements for November 2015 - October 2019 (Account #280001570225)

According to the Connection Agreement, the Lindsay-Ops Landfill is a "Small Embedded Generation Facility" (rated capacity greater than 10kW and not more than 1 MW, connected to a 44kV line), and the City of Kawartha Lakes is an "Embedded Retail Generator" with the intention to deliver and sell electricity to Hydro One (the "Distributor"). Under the terms of the agreement, payments for electricity supplied to the grid by the landfill generator are settled monthly in accordance with the Retail Settlement Code. Since the generator is connected to the grid indirectly through the WPCP, generation payments only result when the electricity generated exceeds the electricity consumed at the WPCP.

The City currently receives two hydro statements each month for the Lindsay-Ops facility: a generation payment statement, and a regular monthly invoice for standard electricity services provided by Hydro One. Monthly charges include a commodity price for electricity as well as distribution charges.

Interval metering on a sub-hourly (15-minute) basis is used to determine the net electricity consumed or supplied in each hour. For each hour where electricity is supplied to the grid, payments are calculated based on the metered generation multiplied by the hourly spot price (HOEP) set by IESO based on market prices.

Electricity costs for consumption (during hours when the generator output is insufficient to meet the needs of the WPCP) are calculated at the HOEP in a similar manner. However, for billing purposes, metered consumption is adjusted (increased) by a loss factor of 1.061 to account for distribution system losses and an additional Global Adjustment (GA) applies. The global adjustment is set monthly by IESO to reflect the difference between market prices and the actual costs of providing generating capacity through fixed-price contracts, maintaining infrastructure, administering the wholesale electricity market and delivering conservation programs. The result is that the cost per kWh of electricity consumed is higher than the price paid for electricity supplied to the grid.

Historical electricity prices including the global adjustment are shown in Table 3 below. For 2018, the average HOEP was 2.43 cents/kWh and the average global adjustment was 9.07 cents/kWh for a total

price of 11.5 cents/kWh on adjusted energy consumption. Factoring in the loss adjustment results in an electricity price of approximately 12.2 cents/kWh of metered consumption.

Table 3 - Average HOEP plus Average GA

Year	Average Ontario Energy Price (cents/kWh)	Average Global Adjustment (Actual) (cents/kWh)	TOTAL (cents/kWh)
2008	5.17	0.61	5.78
2009	3.16	3.06	6.22
2010	3.79	2.72	6.51
2011	3.15	4.02	7.17
2012	2.41	4.92	7.33
2013	2.65	5.92	8.57
2014	3.60	5.46	9.06
2015	2.36	7.78	10.14
2016	1.66	9.66	11.32
2017	1.58	9.97	11.55
2018	2.43	9.07	11.50

(http://www.ieso.ca/Power-Data/Price-Overview/Global-Adjustment)

In addition to the electricity cost and global adjustment, monthly hydro bills also include distribution charges made up of delivery and regulatory components. Hydro One rate schedules for distribution charges are approved by the Ontario Energy Board. Current billing rates are documented in Interim Rate Order EB-2017-0049 implemented July 1, 2019.

Delivery charges are assessed differently depending on the customer's billing classification. The available billing classifications are described in the Hydro One Conditions of Service document.

The current billing classification for the Lindsay-Ops facility is "General Service Demand Billed (GSd)". This classification applies to non-residential customers with average monthly maximum demands greater than 50kW. The monthly maximum demand for the Lindsay Ops facility ranges from 299 kW to 395 kW based on the hydro bills provided.

The delivery component includes fixed monthly service charges as well as variable charges based on the peak demand during the billing cycle. The current rate order also includes as part of the delivery component, a Global Adjustment Rate Rider based on kWh adjusted electricity consumption. However, on the monthly hydro bills this amount is included in the global adjustment. Delivery charges typically make up a significant percentage of the monthly hydro bills for the Lindsay-Ops facility (approximately 41% of total cost based on the July to September 2019 billing periods).

Regulatory charges are based mainly on consumption and make up a relatively small portion (2%) of the monthly hydro costs. Regulatory rates are consistent across the various billing classifications.

A small customer-supplied transformer credit based on monthly billing demand ($0.60/ kW) is also applied since the City owns its own transformer.

3.1.2 Review of Monthly Hydro Statements

Based on a review of hydro bills provided by the City for the Lindsay-Ops facility (August 2018, and November 2018 - September 2019 billing periods), total monthly hydro costs (not including HST) ranged

from approximately $38,575 in November 2018 (when the generator was down for an extended period of time) to $15,275 in August 2019 following the recent wellfield expansion. This represents a total monthly savings of approximately $23,300 achieved by offsetting about 133,000 kWh of electricity consumption at the WPCP. The electricity component including global adjustment accounted for more than 100% of this savings since both the peak demand and associated delivery charges were higher in August despite the lower overall cost. There were no generation payments for electricity supplied to the grid during either of these months.

Hourly interval metering data for the August 2019 billing period (Aug. 9th to Sept. 9th) was examined to confirm the detailed electricity cost calculations with the following results:

1. The peak demand during the month for billing purposes was 371 kW (August 13th at 10:00 EST). The distribution of hourly demands is shown in Figure 20 below. For comparison, the peak demand for the November 2018 billing period was 344 kW.

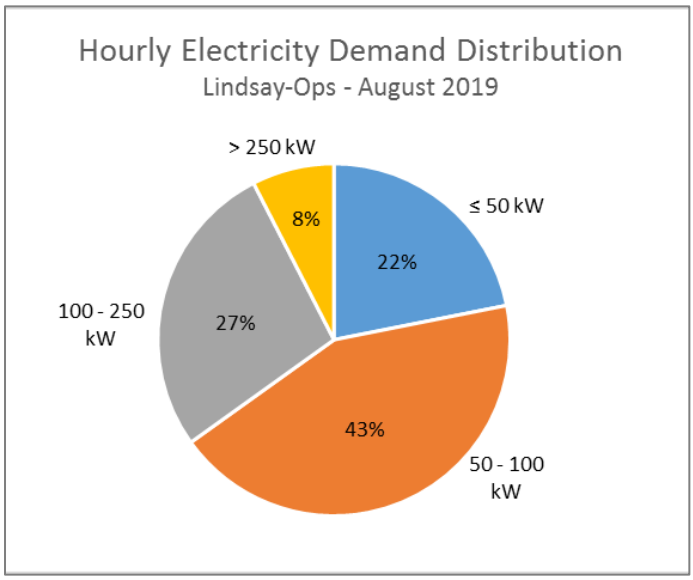


Figure 20 - Hourly Electricity Demand Distribution

2. The global adjustment was 7.21 cents/kWh at the beginning of the August billing period and increased to 12.93 cents/kWh hour on September 1st.
3. The weighted average electricity price based on actual consumption over the billing period was 1.51 cents/kWh (electricity only) and 9.11 cents/kWh including the global adjustment. The comparable prices based on the November 2018 billing period (see above) were 2.55 cents/kWh and 14.26 cents/kWh.
4. Table 4 below shows the range of hourly electricity prices over the billing period. Note that the HOEP was less than or equal to zero for 105 out 768 hours (approximately 14% of the time).

Table 4 - Hourly Electricity Costs - August 2019 Billing Period

	Invoice Weighted Average (¢ / kWh)	Average (¢ / kWh)	Minimum (¢ / kWh)	Maximum (¢ / kWh)
Electricity (HOEP)	1.51	1.41	-0.42	14.30
Electricity plus GA	9.11	10.23	6.80	27.23

Generation statements for the Lindsay facility for the past four years (November 2015 - October 2019) were also reviewed resulting in the following key observations:

1. The Lindsay-Ops facility supplied approximately 60,000 kWh of electricity to the grid over the 4-year period and received total generation payments of $852.06 (before HST). This translates into an average price of 1.41 cents/kWh.
2. Electricity was supplied to the grid during 37 out of 48 calendar months. There were no generation payments for the following 11 months:
    - November 2015
    - February, July, and December 2017
    - November 2018 through February 2019
    - April, June, and August 2019
3. The maximum electricity supplied to the grid during any calendar month was 11,336 kWh (in February 2018). Remaining months were all below 4,200 kWh.
4. The total excess electricity supplied to the grid over the 4-year period (~ 60,000 kWh) is less than the metered consumption (~ 74,000 kWh) during the August 2019 billing period.

3.1.3 Revenue Opportunities

From the above discussion, it is clear that the biggest opportunity for increasing revenue from the generating facility is to increase the output of the generator. Recommended strategies for increasing electricity production (e.g. through reduced downtime or improved gas supply) are covered in other areas of this report.

Additionally, since the price received for energy supplied to the grid is significantly lower than the price paid for energy consumed, offsetting power usage at the WPCP is preferable to generating excess electricity to supply the grid. The maximum benefit (in terms of hydro costs) would be derived by controlling the generator output to completely offset power usage at the WPCP ***in each hour*** before generating excess electricity to supply to grid, and shifting any excess generation to hours where electricity prices are likely to be high.

However, attempting to shift hourly electricity generation in response to treatment plant loads or variations in energy pricing is not considered feasible. It would require additional control systems along with storage of either the landfill gas or the electricity produced by the generator to avoid simply flaring any excess landfill gas not required for immediate use. Also, hourly electricity prices vary with market conditions and efforts to predict them would be of limited benefit. As an example, Figure 21 below illustrates the variation in the hourly electricity price (HOEP) and projected HOEP over several days in November 2019.

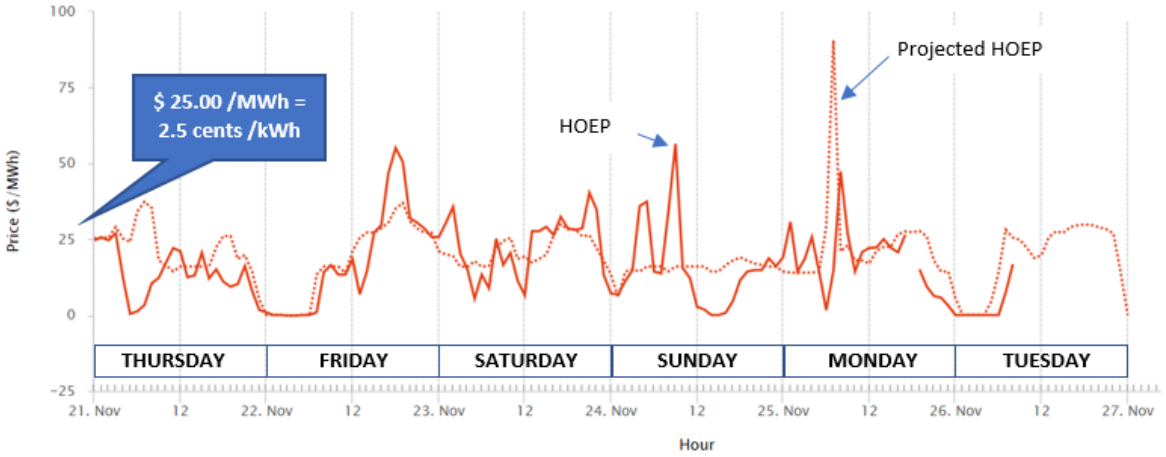


Figure 21 - HOEP and Projected HOEP (Nov. 21 - 27, 2019)

(Data Source: http://www.ieso.ca/power-data)

The delivery charges portion of the monthly hydro bill presents another opportunity for savings. Under the current rates for the "General Service - Demand Billed (GSd)" classification, delivery charges are approximately $8,000 per month based on typical peak demands of 370kW, regardless of the total amount of electricity generated during the month. Reducing billing demand is not a practical means of generating savings since typical peak demands in the range of 299 - 395 kW can result from only one hour of generator downtime during the month. That one-hour peak measure during the month is used to calculate the monthly demand charge regardless of how brief the outage lasted.

However, it may be possible to take advantage of reduced delivery rates available under the "Distributed Generation (DGen)" billing classification. Under the current rate order, the DGen classification has a higher fixed monthly service charge, but significantly lower variable rates based on billing demand. This could produce cost savings of approximately $3,500 to $4,600 per month based on current demands - roughly equivalent to the savings from generating an additional 35,000 kWh per month of electricity. Table 5 summarizes the rate differences between the two billing classifications.

Table 5 - Summary of Rate Differences - GSd and DGen Billing Classifications

	General Service - Demand (GSd)	Distributed Generation (Dgen)
Fixed Charges		
Monthly Service Charge	$ 114.96	$ 179.90
Service Charge Rate Rider	$ (0.05)	$ 0.05
Total Fixed	**$ 114.91**	**$ 179.95**
Variable Charges (per kW)		
Volumetric Rate	$ 17.9552	$ 7.8078
Volumetric Rate Rider	$ (0.2655)	$ (0.1097)
Retail Tx Rate - Network	$ 1.9327	$ 0.9395
Retail Tx Rate - Connection	$ 1.6437	$ 0.8007
Total Variable (per kW)	**$ 21.27**	**$ 9.44**

According to the "Conditions of Service for Hydro One Networks Inc. Distribution Customers" (March 1, 2019) document (section 3.4.11 B):

> "any Embedded Generation Facility with a name-plate capacity greater than 10 kW … will be classified under the ***Distributed Generation Rate classification***. This Rate classification is used for Embedded Generation Facilities whose associated load is supplied through a single point of Connection to the Distribution System. This classification does not apply to Load Displacement Embedded Generation Facilities."

Also, from the Conditions of Service document (section 4):

> "***Load Displacement*** means in relation a Generation Facility that is connected on the Customer side of the Ownership Demarcation Point, that the output of the Generation Facility is used or intended to be used exclusively for the Customer's own consumption;
>
> ***Load Displacement Generation Facility*** means an Embedded Generation Facility that is used exclusively for Load Displacement purposes at all times."

The Lindsay-Ops facility appears to meet the conditions for the Distributed Generation rate classification. It is classified as a "Small Embedded Generation Facility" with a "name-plate rated capacity more than 10 kW" in the Connection Agreement. The agreement also establishes the City of Kawartha Lakes as an "Embedded Retail Generator" and provides payment terms for purchasing the electricity supplied by the facility. Over the past 4 years, the City has received a series of monthly generation payments for electricity supplied to the grid. This suggests that Lindsay-Ops is not a Load Displacement Generation Facility as defined above.

A second, less attractive option to consider if the Distributed Generation classification is not available, is to change to a net metering arrangement. Rather than receiving monthly generation payments for electricity supplied to the grid, the City would receive a credit that could be carried forward for up to one year. Unlike monthly generation payments which are calculated at the HOEP, electricity credits under net metering are calculated at the HOEP plus global adjustment (and variable regulatory rate), producing savings of approximately 9 cents/kWh. Based on the maximum monthly generation to date of 11,366 kWh, this would result in savings of approximately $1,020 per month. This arrangement would not be advisable if monthly electricity generation in the future is expected to exceed the requirements of the WPCP.

3.1.4 Summary

The City of Kawartha Lakes Connection Agreement with Hydro identifies the Lindsay-Ops facility as a "Small Embedded Generation Facility" and the City as an "Embedded Retail Generator". The facility is currently billed under the General Service Demand classification as a load displacement customer. Our analysis of recent hydro bills shows that a potential cost savings of $3,500 to $4,600 per month could be realized if the facility were billed under the Distributed Generation classification instead. Recent discussions with Hydro One Business Customer Centre staff indicate that Hydro would be open to reviewing the current billing classification for the facility and that there would be no charge for this review. We recommend contacting the City's Hydro One account representative to review this potential cost saving opportunity.

3.2 System Operating Value

3.2.1 Government Incentives

Potential sources of funding to help offset future investment for improvements at the Lindsay-Ops generating station appear to be limited. The following is a partial list of potential programs reviewed for applicability.

1. **Save ON Energy Process and Systems Upgrades Program** - The IESO currently offers a suite of energy-efficiency incentives and rebates through the Save ON Energy Program. The Process and Systems Upgrades Program provides financial incentives for the implementation of energy efficiency and generation projects that are expected to deliver a minimum of 300 MWh of electricity savings per year. However, projects undertaken at a generation facility and waste energy recovery projects that transfer generated electricity to the grid are NOT eligible.
2. **Climate Action Incentive Fund (CAIF)** - an Environment and Climate Change Canada program funded through the proceeds of the federal carbon pollution pricing system consists of three funding streams: SME (Small- and Medium-sized Enterprises) Project Stream, MUSH (Municipalities, Universities, Schools and Hospitals) Retrofit Stream, and Rebate Stream. The MUSH Retrofit Stream provides funding for energy efficiency improvements and retrofits to reduce energy use, costs, and carbon pollution. Funding for municipalities, university/colleges and hospitals will be announced later in 2019-2020. The Lindsay-Ops facility could potentially be eligible for funding under this program.
3. **Low Carbon Economy Fund (LCEF)** - supports the Pan-Canadian Framework on Clean Growth and Climate Change by providing funding for initiatives that reduce greenhouse gas emissions and generate clean growth. It is composed of the Low Carbon Economy Leadership Fund and Low Carbon Economy Challenge. The Low Carbon Economy Leadership Fund allocated funding to provinces and territories and most agreements have been finalized. Applications for the Low Carbon Economy Challenge Champions stream closed Sept 28, 2018, and the first intake of the Partnerships stream, available to small municipalities, closed March 8, 2019. The program should be monitored for future intake options.
4. **Investing in Canada Infrastructure Program (ICIP) Green Stream** - the current intake (open until January 22, 2020) provides combined federal, provincial and other partner funding for small municipalities to improve water, wastewater and stormwater infrastructure. Eligible projects must increase capacity to treat and/or manage wastewater and stormwater or increase access to potable water, and eligible asset types are limited to water/wastewater/stormwater infrastructure. Therefore, the Lindsay-Ops landfill gas collection and generation system would NOT qualify under the current funding intake.
5. **Federation of Canadian Municipalities Green Municipal Fund** - offers low-interest loans in combination with grants to support capital projects that "demonstrate an innovative solution or approach to a municipal environmental issue … offer significant environmental benefits, a strong business case and social advantages, while being complemented by local policies and measurement systems." The Signature Initiative, which funds "transformative, best-in-class

municipal projects" that "reduce GHG emissions and protect the air, water or land", would be the most applicable to the Lindsay-Ops facility. Retrofit funding requires a 30% reduction in facility energy consumption with a maximum of 10% achieved through on-site renewable energy. Applications for Signature Initiatives under the Green Municipal Fund are accepted on a continuous, year-round basis as of April 1, 2020. Funding from this program may be used to implement programs to achieve the changes recommended in this report.

3.3 Municipal Similarity Assessment

A desktop review of similar landfill gas generation facilities was conducted. Primary sources of information included: the IESO Active Contracted Generation List (June 30, 2019) and other public documents (e.g. project descriptions, annual reports, newspaper articles etc.) available through online search. Attempts to contact landfill gas generating facilities directly were either unsuccessful or resulted in information which was not approved for disclosure.

All of the active landfill gas generation facilities for which information was publicly available were included on the IESO supplier list with 20-year supply contracts under various renewable energy procurement programs including:

- Renewable Energy Supply Contracts (RES1) - launched 2004
- Renewable Energy Standard Offer Program - launched 2006
- Feed-in Tariff Program (FIT1) - launched 2009 and closed to new applications by provincial government in 2016

Table 6 below summarizes the equipment and generating capacity at selected sites and includes additional notes concerning operations.

Table 6 - Landfill Gas Generation Plants

Landfill Site	Electricity Supplier Name	Capacity / Equipment	Commercial Operation Date	Contract Type	Notes
Merrick Landfill - North Bay	North Bay Hydro Services Inc.	1.6 MW CAT G3520C generator	2012	FIT1	Average generation of 814,145 kWh per month in 2015.
Bensfort Rd. Landfill - Peterborough	LFG Power Corporation (wholly owned subsidiary of Peterborough Utilities Inc.)	1.6 MW CAT G3520C generator	2013	FIT1	
Eastview Landfill - Guelph	Envida Community Energy Inc. (subsidiary of Guelph Hydro Inc.)	(3) x 925 kW CAT G3516LE generators	2005	RES1	Toromont Energy operates the plant under a performance-based operations and maintenance contract with graduated payments based on availability. - Reported gross availability is 98.75%

Landfill Site	Electricity Supplier Name	Capacity / Equipment	Commercial Operation Date	Contract Type	Notes
Glanbrook Landfill - Hamilton	Hamilton Renewable Power Inc. (HRPI) (subsidiary of City of Hamilton)	(2) x 1.6 MW CAT G3520C generators	2008	RESOP	- Administration through City staff with outsourced operations and maintenance. - Toromont's Run Ready Magazine (Spring 2019) quotes HRPI's vice president Frank Gazzola: "It's all about uptime, and we've achieved a very satisfactory uptime with the units at Glanbrook." - Reported uptime is over 95%. - HRPI receives 11 cents /kWh for electricity produced (plus 3.52 cents/kWh for on-peak generation).
Mapleward Rd. Landfill - Thunder Bay	Thunder Bay Renewable Power Inc. (affiliate of Synergy North - formerly Thunder Bay Hydro and Kenora Hydro)	(2) x 1.6 MW CAT G3520C generators	2010	RESOP	- In a September 2019 newspaper article, the president of Synergy North reports that the facility has been "barely breaking even" over the last 4 years, due to challenges with the gas supply. - City of Thunder Bay is in the process of adding 5 to 8 new gas collection wells.
Trail Road Landfill - Ottawa	Power Trail Inc. (partnership between Energy Ottawa Inc. and Integrated Gas Recovery Services Inc.)	(5) x 1 MW Jenbacher JGC320 generators (1) x 1MW generator added in 2012	2007	RES1	- City of Ottawa receives royalty payments for landfill gas and also realizes savings in costs that would otherwise be required to upgrade and maintain the gas collection system. -2017 proposal to add a 7th generator rejected by IESO
Waterloo Landfill	Toromont Energy Ltd.	6.2 MW CAT generators	2007	RESOP	- Generation plant owned and operated by Toromont Energy Ltd. has been producing electricity since 1999. - Reported availability greater than 98%. - Region of Waterloo receives a royalty for the landfill gas based on electricity revenues. - March 2019 news article reports plans to expand gas collection system beginning this year with funding assistance from Low Carbon Economy Fund.

All the listed facilities are larger than the Lindsay-Ops facility, with generating capacities ranging from 1.6MW to more than 6 MW. Most facilities are owned and/or operated through partnerships with local utility companies, established environmental or energy companies, or new companies formed specifically for the purpose of producing power to sell to the grid. Typically, the municipality owns the landfill site and receives payments for supplying the landfill gas. In the case of the Waterloo plant, which is owned and operated by Toromont Energy, the Region of Waterloo receives a royalty for the landfill gas based on electricity revenues. Operations and maintenance contracts for the generation facilities may include performance incentives based on facility availability. A Toromont project sheet notes that the company receives graduated payments per megawatt-hour based on availability for operations of the Eastview Landfill to Energy Plant in Guelph.

Facility uptime is recognized as a critical success factor and the generation plants for which information was available reported over 95% plant availability. The landfill gas supply is also highlighted as a factor influencing financial performance.

Several news articles (dated July 2014, and January 2018) about the Bluewater Power landfill gas generating facility at the closed Sarnia Landfill site in Lambton County reported that gas production from the landfill was not as high as originally anticipated leading to an earlier than forecasted closure of the generation plant. A more recent September 2019 newspaper article about the Mapleward Road landfill gas generating facility in Thunder Bay also reports revenue shortfalls due to gas supply challenges. It notes that the gas supply from the landfill is much lower than originally forecast and mentions plans to improve and expand the gas collection system. Several other sources also mention the need for ongoing maintenance, monitoring, and control of the gas collection system to maximize electricity production.

According to a July 2018 newspaper article, the City of London's plans for a landfill gas power plant were abandoned with the cancellation of its FIT5 contract. (The IESO archive confirms a FIT5 contract offer to the City of London for a 500 kW Landfill Gas Power Plant). A more recent September 2019 news article announces that the City is considering utilizing the landfill gas to produce and sell renewable natural gas.

The Lindsay-Ops facility has the distinctive advantage of being able to utilize the landfill gas to offset the electricity demands of the nearby sewage treatment plant. Combined with reduced downtime and improved operational efficiency, this should enable the Lindsay-Ops facility to be financially viable.

4. Process Optimization

4.1 Operations and Manuals Review

Under normal operating conditions, the generator is monitored by the SCADA system and alarms identify when intervention is required. This allows the generator to run without constant on-site personnel. When conditions require intervention by the operations personnel, a request for service is made by City staff and field technicians are dispatched with the objective of bringing the genset back on-line within 24 hours or starting the flare within 48 hours. When the technician arrives, minor troubleshooting will be completed prior to restarting the equipment. Spare components are stocked at the site to allow quick turn-around on minor maintenance activities.

In all cases, the operations manuals are not formatted to replace comprehensive operator training. The manuals are guides that qualified personnel can use as references when conducting troubleshooting and maintenance activities.

The operations manual for the Lindsay-Ops generation and flare system was provided. The manual carried a revision date of September 2016 and was provided by Enviro EMD. The manual details several aspects of the flare system, the gas blower and control system, and the SCADA system. There are fewer details and no visual representation of the generator system. Generator alarms are covered in the operations manual to amplify details from the SCADA system. There is an opportunity to augment

the data in the manual if staff from the City will have restored involvement in reset from minor generation interruptions. This aspect of operations is detailed in Sections 4.3 and 4.4 of this report.

A technical data package for the Jenbacher 208 was reviewed. The data package provides a detailed maintenance schedule but lacks operating instructions for start-up or other routine operations. High-level data on the DIA.NE fuel management system is included but no detailed guidance on use is provided. Detailed instructions on operation of the generator will not benefit staff from the City. Only high-level data for resets from minor interruptions is necessary at the City level. Detailed operations information is optimal for Comcor when performing more involved servicing. No changes to the Jenbacher O&M manual are recommended at this time.

A separate manual for Siloxane Skid was provided. The manual is produced by DCL International Inc. and has a revision date of May 2015. This manual provides information on the basic installation and operation of the equipment and a section for general troubleshooting. The data is straightforward and qualified personnel can use the manual to resolve minor alarm notifications. No changes to the Siloxane O&M manual are recommended at this time.

The Operation & Maintenance Manual for the newterra landfill gas conditioning system contains details on the components within the system. The sections of the document that outline the component pieces are useful if spare parts are required. Operations instructions for the blower, chiller, and glycol pumps are included with detailed instructions for operations. There is a detailed maintenance schedule and a comprehensive troubleshooting chart. Qualified personnel will be able to use the manual for routine operations. No changes are recommended at this time.

4.2 Wellfield Management/Expansion

If our analysis of methane generation rates is correct, the methane collection efficiency in the old landfill area is lower than previously predicted. Improved methane recovery may be obtained in this area by constructing a number of additional LFG collection wells. Such wells may be effective in improving the quality of LFG delivered to the generation plant and in bridging the period until the north landfill area reaches stable methane generation.

4.2.1 Contract Structure

Most landfill gas generating facilities in Ontario operate on a royalty basis with the operator owning the generating equipment and paying a royalty for landfill gas used. Given the small size of the Lindsay Operations landfill and the low potential electricity output we do not believe that a royalty-based contract will prove to be a practical option.

4.3 Service Call Strategy

The generator startup sequence is a manual process. Every generator re-start requires manual on-site intervention, which is currently handled by sending Comcor field personnel to site. This arrangement suffers from A) the cost for Comcor to travel to site, and B) the downtime realized in waiting for Comcor to arrive. Additionally, the existing service agreement does not allow for restarts to be initiated during the weekend. Thus, an outage that occurs on Friday could result in losing a whole weekend of electrical generation.

The restart process will vary depending on the cause of the shutdown. A breakdown of downtime causes is shown in Section 4.4. Some types of shutdown require the expertise of Comcor to resolve, however simple shutdowns (for example low fuel quantity) may require less expertise. It is proposed that consideration be given to training local staff to accomplish simple restarts and only call in Comcor when more specialized expertise required. The main benefit of this arrangement would be the reduction in downtime due to eliminating the travel time and weekend exclusion. Depending on the cost to carry out this work with CKL staff or a local subcontractor, there may also be a cost savings in labour. If such an arrangement were pursued, it should also examine the viability of providing weekend coverage to further reduce downtime.

4.4 Downtime Analysis

The analysis of the generator downtime is based on review of the two most recent annual reports provided by Comcor to the City. These reports cover the period from October 1, 2017 to September 30, 2019. The reports include sections on the genset downtime over the period. Planned shutdown events are considered in this summary where a more extensive downtime was prompted by the results of the shutdown.

Downtime hour calculations are taken from the Genset Operation Summary appendices in the annual reports. For each day in the reporting period, if the Jenbacher Gross Output is 0, the daily downtime is counted as 24 hours. Otherwise the downtime is the difference between Genset Blower daily run time and 24 hours rounded to the nearest hour.

The downtime has been divided into the following categories:

A. Normal Equipment run-in –Minor mechanical issues related to normal operation.
B. Delays by contract or procedural constraints – These downtime hours are counted when the restart of the generator was delayed by waiting for a business hour service call or when waiting for expense approval.
C. Failures of aging equipment – Equipment that has reached end of life and must be replaced.
D. Poor fuel quality or quantity – These are events identified as fluctuations in the gas collection or associated wellfield issues including the connection of the wellfield expansion.
E. Power grid forced trips – These trips are caused by Hydro One deactivating the generator owing to transient power events at the WPCP.
F. Unforeseen complications – The events in this category are characterized when a downtime event reveals equipment incompatibilities or prompts significant ancillary activities.
G. Planned Outages – Standard maintenance activities are included in this category.
H. Other –Downtime unattributed in the Comcor annual reports

The downtime hours for the reporting period are summarized:

Table 7 - Reported Downtime Hours

	A	B	C	D	E	F	G	H	Total
2017-18	309	299	540	552	0	626	24	559	2909
2018-19	226	363	79	210	224	2354	231	103	3790
Total	535	662	619	762	224	2980	255	662	6699

Total possible runtime is 8760 hours/year. This is not the same as Availability which is the percentage of generated electricity against the theoretical maximum.

4.4.1 Downtime Reduction Strategies

It is unreasonable to expect the system to reach a state where generation downtime is never incurred. The nature of having a system without redundancy positions all components as critical and the interruption of any component manifests as system downtime. Therefore, the focus of this analysis is to identify those areas where downtime can be reduced as far as practical. Special emphasis is placed on those areas where small and comparatively inexpensive changes can have the greatest effect.

A – Equipment Run-in

Fewer category A mechanical issues were reported in 2018-19. This is consistent with equipment reaching a stable operating condition although faults of this nature can never be eliminated. The spare parts made available at the site are enabling technicians to repair or replace elements of the system

without delays. It is reasonable to assume the downtime associated with normal equipment issues will remain constant around 275 hours/year

B – Contract or Procedure Delays

During the 2017-18 reporting period some equipment restarts were performed by City staff with remote guidance by Comcor personnel. This did not carry into the 2018-19 period. Without local staff to address minor trip events, downtime is increased, especially in the latter portion of the period and associated with power grid trips. Comcor reported five (5) separate events where the grid tripped the generator and because the downtime occurred over a weekend, personnel were not dispatched until the following business day. Each of those events represents 48 hours directly attributable to a procedure delay.

Power grid trips are acknowledged separately but they have occurred at a rate of approximately 4 events/month for the last 4 months of the last reporting period. It is reasonable to expect one trip of the type to fall on a weekend each month. Having a local qualified staff member on-hand to restart from minor events could prevent up to 576 hours of weekend downtime from power grid trips. If these trips are limited to one hour by having local staff guided to perform a restart, that represents only 48 hours over the course of a year.

The other factor related to contract and procedure delays is the turn-around time on expense requests. High value expense requests are processed within a week. This is good practice and should be maintained but will incur approximately 200 hours/year of downtime.

C – Aging Equipment

As the generator equipment ages, the effect of aging equipment can be expected to increase. As a newer system, the downtime percentage attributed to equipment wearing out is 10% of the total downtime based on analysis of the reported downtime data. Keeping this consistent for our projections will provide a reasonable calculation value. When all other downtime factors are assessed, the predictable downtime (Categories A, B, C, D, E, & G) is 830 hours/year. The portion of this attributed to aging equipment is rounded to 83 hours/year.

D – Poor Fuel Quality/Quantity

The downtime attributed to wellfield and poor quality and quantity of gas has been identified by Comcor in the past. The installation of new wells in 2019 is a step already taken to mitigate this issue. A reduction in the downtime owing to fuel issues can be noted in the most recent annual report. Since a full period with the new wells on-line is not available, the full impact of the new wells or possible future additions to the wellfield cannot be reliably quantified. If the rate from the most recent reporting period is maintained the downtime owing to fuel issues will remain at approximately 200 hours/year.

E – Power Grid Trips

Trips of this nature are the only category that could be eliminated. The 2017-18 data shows that modification to the staging of loads at the WPCP was able to reduce these trips to 0 for the period. The trips have only resurfaced after Hydro One completed operations in May of 2019. A further conversation between the City of Kawartha Lakes, Comcor, and Hydro One may identify the cause of the interruptions and bring the downtime back to 0. Prior to that occurring, if city staff are trained as outlined above, the downtime for this category may still be reduced to 48 hours/year.

A report prepared by Wintek Engineering (WW20-128.03, dated March 20, 2020) provided additional analysis of trips during the past year. 34 trip events were analyzed using data automatically recorded during trip events. 80% of trips were due to abnormal reactive power flows. The second most prevalent trip cause was loss of utility power.

The trip-data available to Wintek was limited and prevented obtaining a full understanding of the trip events related to abnormal reactive power flows. However there was enough data to identify patterns and to propose three failure modes:

1) The generator was at low power output or in the process of starting up and caused abnormal reactive power flow. This mode could also occur if the generator was inactive and abnormal

conditions occurred at the WWTP. If the generator was already inactive, this would not count as a generator shutdown, just a logging of an abnormal event at the WWTP.

2) The generator was operating normally and shutdown. The data strongly points to the WWTP aerator and power-factor correction capacitors as causing an abnormal reactive power flow.

3) The generator suffers a low fuel pressure condition and temporarily becomes a load on the electrical grid, causing abnormal reactive power flow.

The Wintek report further explains that the power-factor correction system in the WWTP pre-dates the installation of the generator, and thus the controls were not designed to account for the generator influence on the system. Some basic tests were performed by Wintek during a recent site visit which proved that the power-factor correction system could induce a trip-event.

Several recommendations were included in the Wintek report to mitigate the effects of the WWTP power-factor correction system, ranging from replacing the system, to adjusting the control narratives, to disabling the system. The recommendations would require investigation and cost-benefit analysis.

It was also recommended that the data logging mechanism be adjusted to provide more data during trip events to further understand the issues.

Refer to the Wintek report for further technical explanation and the detailed list of recommendations.

F – Unforeseen Outages

In each reporting period the largest cause of downtime was the unforeseen complications. In 2018-19, this was primarily the outage caused by the leaking turbocharger. The outage began on Nov 9 when the Genset tripped on knocking. Engine cylinder liner wear and the leak from the turbocharger compounded to significant retrofit and repair work. The genset was offline for 45 days (1080 hours).

The major unforeseen event in 2017-18 was the shorting of the main breaker at the OCWA plant. It prevented the use of the flare and genset for 12 days (288 hours).

One method for controlling the outages is to conduct an obsolescence review of critical path components. At the outset of the generator operation, a recommended list of spare parts was provided to the City by Comcor. The approved list of spares did not include all the recommended items, but this has not contributed to excess downtime. The level of spares should be maintained to avoid adding to this category of downtime.

The spare parts inventory is reported annually. When the inventory is reviewed, an added check can be made to confirm continued applicability and the ability to procure replacements. This is especially critical on more complex items such as motors and pumps. The inability to replace the component may extend downtime. If modified or replacement components are required, the review will highlight those gaps and provide a chance to acquire replacements before being required for critical events. This method does not account for obsolete components that are not held in stock. For that reason, the possibility still exists that foreseen failures can occur. To mitigate this effect, the best case from the two data sets is used.

The data from 2017-18 indicate unforeseen downtime as accounting for 25% of all downtime. When the data from other outages is counted, this can be expected to account for 208 hours/year.

G – Planned Outages

Planned outages are the most reliable downtime events. The increase seen in the 2018-19 reporting period is accounted by the downtime required for connecting the wellfield expansion and outages requested by Hydro One. In other years, the downtime will be controlled by the maintenance schedule. These are typically short duration events and should be included at a rate of 24 hours/year.

H – Other Unaccounted Outages

There are hours of downtime not accounted in the Comcor reports. Assuming these hours are distributed at the same frequency as the balance of the downtime hours, this category of downtime

represents the error factor in the analysis. In the previous reporting periods this has represented as little as 3% of all downtime or as much as 24%. Aggregating the two years of data and determining the percentage of downtime contributed through categories A through G provides an error factor of 165 hours/year of category H downtime.

4.4.2 Production and Utilization Optimization

The following strategies are recommended for implementation to minimize the downtime of the generator:

- Train City of Kawartha Lakes staff to perform guided restarts.
- Continue well management and wellfield maintenance to improve fuel quality and quantity.
- Consult with Hydro One to identify root cause of grid interruption trips and mitigate effects through staff training.
- Maintain spare parts and identify critical components for obsolescence.

Implementing strategies discussed above may reduce the generator downtime as shown in the following table:

Table 8 - Theoretical Downtime Hours

	A	B	C	D	E	F	G	H	Total
Theoretical	275	200	83	200	48	208	24	165	1203

With downtime at 1203 hours/year, the total runtime on the plant may achieve 7557 hours or 86% of total possible generation time. At the measured daily generation rate of 245 kW, that represents a total of 1,851,465 kWh of generation potential for a plant Availability of 63%, nearly double the 2018-19 Availability of 38%.

4.5 Energy Use Review

4.5.1 Peak Use Times

Under the current billing structure generated power is more valuable when used to offset WWTP load versus when it is exported to the grid. Refer to the discussion of Global Adjustment in section 3.1 for explanation of this billing.

Ideally, when there is insufficient LFG to run at 100% continuously, the LFG would be temporarily stored for later use. The generator would be activated according to the WWTP real-time demands, as well as real-time knowledge of the current market rate for electricity.

Practically, this would be challenging system to implement. The facility does not currently have the capability to accumulate and store LFG and the generator is not equipped with the necessary control logic. A further hinderance is that the startup sequence of the generator is a manual operation which takes significant time accomplish. The startup time (30 minutes minimum, several hours maximum) would not be able to respond to real-time variation in WWTP load and electrical market price variation.

4.5.2 Efficiency Opportunities

As indicated in 4.5.1, intelligently scheduling generator uptime to match peak use times is impractical. The best use of LFG in generating electricity is to run the generator as continuously as possible, utilizing whatever level of gas is currently available. The particular generator chosen for this facility is ideally suited to low methane values, which maximizes the likelihood that the generator can be operated at a particular time.

Although there is little flexibility on scheduling when the generator can be operated, an alternate strategy to maximize the cost-benefit of the generated electricity would be intentionally schedule WWTP loads to, when possible, activate only when the generator is operational. This would increase the chance that the generated electricity is offsetting imported energy instead of being exported. As

described in section 3, exported electricity does not attract the same price as is paid for imported energy.

The viability of such an efficiency scheme is beyond the scope of this report, since it would involve an audit of WWTP to determine which loads may be candidates for such scheduling. It would also depend on whether or not such loads currently have the necessary controls to allow scheduling.

4.6 Landfill Gas Characteristics

Detailed analysis of the landfill gas was reviewed in Section 2. The landfill gas is below the CH_4 concentration originally predicted. The weighted concentration from Table 2 is 45% Ch_4, but this concentration may be improved through additional cover on recently filled areas. After the gas is extracted from the wellfield, it is processed, as described in Section 2.5, to remove moisture for improved combustion and to remove siloxane that can damage the generator.

4.7 Process SWOT Assessment

A SWOT analysis examines the factors that influence the successful implementation of a program or project. By categorizing the factors according to their position relative to the project and their effect on project success, the team can make informed decisions about how to leverage advantages and mitigate problems. The factors are segmented into four categories as follows:

- **S**trengths – positive factors internal to the project
- **W**eaknesses – negative factors internal to the project
- **O**pportunities – positive factors external to the project
- **T**hreats – negative factors external to the project



Figure 22 - SWOT diagram

The SWOT analysis in this report is conducted with the goal of maximizing generator availability; reaching the point where the generator is producing its rated power output as often as possible. Factors are determined as internal or external relative to the generator.

4.7.1 Strengths

Having a strong and knowledgeable partner in Comcor Environmental Limited (Comcor) is an asset to the City of Kawartha Lakes. Comcor bring technical experience and operational resources to the operation of the landfill generator. The knowledge base allows rapid response and recommendations during troubleshooting operations. Staff are familiar with the configuration of the installation and procedures. Comcor's relationship with the equipment and site positions them to make strong recommendations to address weaknesses and threats and identify additional opportunities to maximize the generator availability.

The generator itself is the optimal equipment for the site. The design report acknowledges the gas composition is typically 45% CH4 and may range from 35% to 50%. The Jenbacher JGC 208 will operate with CH4 concentrations as low as 30%.

4.7.2 Weaknesses

Over the past two reporting years the generator experienced a downtime percentage of 33% in 2017-18 and 43% in 2018-19. This could represent up to 928,550 kWh in 2019 at the current average generating level of 245 kW. A certain level of downtime is anticipated owing to regular maintenance and routine equipment fatigue. Mitigation of the downtime may be achieved by cross-trained personnel, reduction of grid interruption trips, well management and maintenance, and faster turn-around on requests for expenditure as discussed in Section 4.4.

When the system was commissioned, a recommended spare parts list was prepared and provided to the City of Kawartha Lakes for approval. The full list was not approved which opens the possibility of critical spare parts being unavailable when required. To date, this situation has not been encountered. To mitigate the possibility of future repairs being impeded by a missing critical component, a fund may be developed to spread out the purchase of the spare parts that were no approved on the initial list. This way costs can be managed while improving future responsiveness. The spare parts list should also be reviewed annually.

When the equipment has a downtime event during weekend hours, the service call is delayed to the next business day to prevent after-hours call outs. As discussed in the downtime reduction strategies, training of City of Kawartha Lakes staff to perform limited re-start procedures can mitigate the generation hours lost to genset trips that can otherwise be reset efficiently.

4.7.3 Opportunities

The amount of gas captured by the wells has already been a subject of review by the City of Kawartha Lakes and Comcor. This has resulted in additional wells added to the collection system. As discussed later in this report (Section 5.3.3), further expansion of the wellfield to concentrate collection in areas that are showing high gas production can improve the quantity of gas and increase the energy generated.

The landfill is expected to continue accepting waste until 2035 although future waste diversion programs may extend that date. As fill continues to be added, the potential for methane capture is extended. If no further waste is added to the landfill after 2035, the period of stable methane generation and collection potential will typically last for 20 years (ASTDR 2008). Continued investment to maintain and expand the well-field into newly opened and filled sections of the landfill will allow the generator to continue operation until 2055 barring significant mechanical failure.

Increasing the cover on the landfill will allow methane to be concentrated for collection. Current cover is done with re-useable steel plates. When a cell is permanently closed, the plates are replaced with soil cover and the cell is capped with a geomembrane. This will promote collection of the methane within the cell and increase the available fuel for the generator.

Selective and planned well installation can increase the collection of methane. As new material is added to the landfill, new wells can be added to take advantage of the methane generation. Coordination of the long-term methane collection plan and well-field expansions with the waste positioning will allow landfill cells to be optimized so wells can be added and brought on-line efficiently. This may allow smaller regular increases to the system rather than large sections coming on-line after longer intervals.

By implementing the increased operator training discussed in Section 4.3 generation potential is increased by the reduction of downtime owing to simple shutdown causes and basic re-start. By having staff locally who are trained to restart the generator system after it trips owing to low-gas conditions or power grid interruptions the generator can be returned to service within hours, maximizing the use of the landfill gas and the electricity generated.

4.7.4 Threats

A recurring note during review of the downtime records is the response time for expenditure requests. This has been noted particularly in relation to dry-ice blasting of cylinder liners. The policies and procedures of the City of Kawartha Lakes in relation to budget and procurements are independent of this report. Within the framework of the existing conditions, the team managing and maintaining the generator has researched alternative solutions to manage costs. During future budget cycles, it will be necessary to maintain or increase the budget level to ensure cuts to the program are not implemented that may extend reviews of expense requests or force prioritizing repairs.

An additional threat is the low concentration of CH_4 in the collected gas. Steps have been taken to concentrate the gas by improving cover conditions. Mechanical additions to the equipment to refine the landfill gas and concentrate will impact the energy efficiency of the installation and should not be considered at this time.

5. Economic Analysis

As part of this analysis we evaluated several scenarios:

- The Net Present Value (NPV) of the original business case
- The NPV of the original business case re-baselined using actual data for methane content and without the inflation of electricity prices
- The NPV of the actual realized performance
- The NPV of terminating electricity generation and decommissioning the system
- The NPV under different optimization scenarios

Each of these is described in the following subsections.

5.1 Overview of Main Assumptions

We assessed the system relative to financial projections on which the initial business case was based. Our initial step was to re-examine those projections based on actual experience since 2016. All calculations are presented in constant 2017 dollars with the discount rate assumed to be equal to the rate of inflation unless otherwise noted. Effective gas flow is the product of nominal gas flow (approximately 115 cfm) and plant availability

The electromechanical efficiency of the generating plant (i.e. the efficiency with which the generator converts contained energy in the LFG to kilowatt hours of electricity) was estimated using existing data from the site. The kilowatt hours exported were graphed against the contained methane and a simple regression used to derive the following equation:

$$Qe = 3.894M - 5722$$

Where,

Q_e = kWh exported

M = cubic metres of contained methane (calculated from the BTU records at the plant)

Optimization inputs are estimated to reflect the range of performance likely achievable rather than the best- or worst-case scenarios. Overall financial performance is measured using the modelled net present value (NPV) which is the sum of revenues and expenditures over the period from 2016 to 2035 discounted for the cost of capital and the rate of inflation. Because the rate of inflation and the cost of capital were assumed to be the same, the NPV in our analysis is the simple sum of costs and revenues expressed in 2017 dollars.

5.2 Modelled Baseline Scenarios

5.2.1 Original Business Case

The original business case was based on a discounted cash flow analysis assuming average gas flow of 115 cfm containing 50% methane and a plant availability of 80%. The pro forma analysis also assumed an initial realized price of 11.1¢/kWh increasing at an annual rate of 3% with annual operating costs of $140,000/a increasing at an annual rate of 2%. A single major engine overhaul/rebuild for $175,000 was assumed after 10 years of operations. These assumptions yielded a net present value (NPV) of $1,596,219 after 20 years (i.e. in 2035) including capital cost recovery. Ignoring capital costs and related interest (i.e. ignoring sunk costs) yielded an NPV of $2,718,101 over the same period.

5.2.2 Original Business Case Re-baselined

The original business case was based on the price of electricity increasing at an annual rate of 3% with annual operating costs increasing at an annual rate of 2%. The modelling of a long-term relative acceleration of electricity costs is not necessarily wrong, but it would require an extraordinarily strong case to be prudent. For the re-baselined business case we have assumed that both the realized price of electricity and the operating costs increase at the same rate. The initial assumptions were based on a throughput of 115 cfm and 50% methane content. Actual methane content has averaged about 40% and this lower value was used in the re-baselined analysis. Actual throughput has been lower than 115 cfm but this has been affected by the methane content and plant availability, so this assumption has been left unchanged. Annual operating costs were assumed to be $124,400 until 2021 with the costs then increasing to $137,348. An additional allowance of $15,000/a was assumed for call-outs and unexpected maintenance. Actual annual costs have been $156,400 with an additional $30,815/a for call-outs and unexpected maintenance. For the re-baselined case, we have taken the actual annual operating costs of $156,400 plus $23,000 for call-outs.

The re-baselined analysis yields an NPV of $549,862 more than $2,000,000 lower than the original business case.

Table 9 - Re-baselined Financial Projections

Parameter	Initial Estimate	Re-baselined	Difference in NPV
Gas flow	115	115	nc [Note 1]
Methane content (%)	50	40	($1,131,520)
Plant availability (%)	80	80	nc
Initial Price/kWh ($-approximate)	11.5	11.5	nc
Rate of increase in electricity cost (%)	1% net of inflation	0	($544,925)
Operating cost ($/a)	$149,361	$179,400	($600,779)
NPV	$2,718,101	$549,862	($2,168,239)[Note 2]

Notes:

1) Gas flow and methane content are not independent parameters as an increase in gas flow is accompanied by a decrease in methane content due to increased dilution. A limiting methane content is therefore inescapably accompanied by a limit in gas flow.
2) The differences in NPV for individual changes in baseline values do not add up to the total difference
3) All costs in 2017 dollars

The re-baselined estimate yields an NPV (excluding sunk costs) of approximately $549,862. This represents a reduction of approximately $2,277,224 compared to the initial estimates – most of which can be attributed to the reduced methane content in the landfill gas (40% vs the initial estimate of 50%). The assumed divergence between the annual increase in electricity cost vs. the annual increase in operating costs contributed $544,925 to the initial NPV estimates. The increase in operating costs also results in a significant ($600,779) reduction in NPV. We note that the NPV estimate is equally sensitive to changes in plant availability, gas flow, and methane content as all three of these parameters are interrelated and each affects revenue in the same manner.

5.2.3 Continue As-Is (i.e. Do Nothing)

The difference between initial assumptions/estimates and observed performance is summarized on the following table:

Table 10 - Initial Financial Projections vs. 2016-2019 Performance

Parameter	Initial Estimate	Re-baselined	2016-2019 Actual	Difference from Original Estimate(%)
Gas flow	115	115	80 (approx.)	-30%
Methane content (%)	50	40	40	-20%
Plant availability (%)	80	80	56	-33%
Price/kWh ($- approximate)	11.5	11.5	11.5	nc
Rate of increase in electricity cost (%)	3	2	2	Note 1
Operating cost ($/a)	$149,361	$179,400	187,215	+ 25%
Rate of increase in operating cost (%)	2	2	N/A	Note 1
NPV	$2,718,101	$549,862	($722,388)	($3,440,489)

Notes:

1) Insufficient data for a reliable estimate
2) All costs in 2017 dollars

The actual performance has fallen short of the revised baseline estimate primarily due to plant availability averaging about 56% compared to the baseline estimate of 80%. This results in a negative NPV of ($722,388). Therefore, the viability of the landfill gas generating plant hinges on the ability to achieve a marked improvement on the current trend. The elevated operating costs (compared to the revised baseline) are mostly correlated to the shortfall in plant availability.

5.2.4 Terminate Electricity Generation (i.e. Shut Down)

If no improvement to the existing trend is possible then the decommissioning of the generation plant would avoid future operating losses of $631,498 to 2035 (assuming that the system is decommissioned in 2020). Salvage value is assumed to be minimal and roughly equal to the decommissioning costs. The amount of operating losses avoided in this case is lower than the ($722,388) under the observed trend because this number (the $722,388) includes the years 2016-2019 for which operating losses are sunk costs.

In the event the generation plant was decommissioned, there would be on-going costs associated with the mandatory continued operation of the flare system and the well-field. The base cost to operate the flare and well-field is $43,612 (2017 dollars) each year. Each year there are additional extra costs which have ranged from $2,000 in 2016 to $21,770 (which includes an exceptional $15,600 repair to a pump drain trap requiring confined space entry) in 2018.

5.3 Modelled Scenarios to Improve System NPV

5.3.1 Attribution of Wellfield and Flare Operations and Maintenance

The City's current contract with Comcor includes monthly and annual reporting along with operation of the wellfield and flare. As emissions reporting is mandatory for large landfills in Ontario, a portion of these costs would be incurred by the City regardless of whether or not the generating plant is operating. This means that the costs avoided under the plant shut down alternative are overstated by

approximately $6,500/month (Comcor, personal communication). If we reduce the nominal operations and maintenance costs by the “sunk” $6,500/month this substantially increases the NPV of the plant to $525,611.

5.3.2 Increase Plant Availability

Improving plant availability offers the best opportunity to achieve meaningful increases in financial performance. The current 4-year average availability is 66.4% and the average over the past 2 years is even lower at 53.8%. At the current methane concentration delivered to the plant, each percent increase in plant availability adds $2,518 in annual revenue (based on a realized price of 0.115/kWh) and about $50,000 to the 20-year NPV.

The following strategies are recommended for implementation to minimize the downtime of the generator:

- Train City of Kawartha Lakes staff to perform guided restarts.
- Continue well management and wellfield maintenance to improve fuel quality and quantity.
- Consult with Hydro One to identify root cause of grid interruption trips and mitigate effects through staff training.
- Maintain spare parts and identify critical components for obsolescence.

Implementing strategies discussed above may reduce the generator downtime as shown in the following table:

Table 11 - Theoretical Downtime Distribution

	A	B	C	D	E	F	G	H	Total
Theoretical	275	200	83	200	48	208	24	165	1203

With downtime at 1203 hours/year, the total runtime on the plant may achieve 7557 hours or 86% of total possible generation time. At the measured daily generation rate of 245 kW, that represents a total of 1,851,465 kWh of generation potential for a plant Availability of 63%, nearly double the 2018-19 Availability of 38%.

Table 12 - Reported Downtime Hours

	A	B	C	D	E	F	G	H	Total
2017-18	309	299	540	552	0	626	24	559	2909
2018-19	226	363	79	210	224	2354	231	103	3790
Total	535	662	619	762	224	2980	255	662	6699

Total possible runtime hours are 8760 hours/year. This is not the same as Availability which is the percentage of generated electricity against the theoretical maximum.

We have assumed that these measures will result in a 33% reduction in plant downtime for an NPV increase of $520,024 to $1,045,635.

5.3.3 Wellfield Expansion

As discussed in Section 2.4, we suspect that the methane collection efficiency in the old landfill area is lower than previously predicted. Improved methane recovery may be obtained in this area by constructing a number of additional LFG collection wells that could be tied into the existing collection piping.

For the purpose of our modelling we have assumed the construction of an additional four vertical collector wells within the old landfill area and further assumed that these will provide at least one well with performance as good as that obtained from Collection Well GWT-2 which has produced >50% methane for most of the period since the commissioning of the generation facility, and currently supplies close to 10% of the total methane collected. The simulation assumes a construction cost of $30,000 for each well.

In reality, we would expect better results in the short term and the increase in methane content may also be expected to reduce the number of shut-downs in the generation plant. Over the longer term, the new wells will become depleted, but they may help bridge the interval of time before the new wells in the north landfill area reach peak methane generation. For the purpose of modelling we have assumed that the new wells would provide a 25% increase in methane collected in the first year declining to a 10% increase by the 4th year and continuing thereafter.

Under these assumptions, wellfield expansion in the old landfill area is predicted to increase NPV by $224,134 to $1,269,769.

5.3.4 Aggregate Effect

The combination of accounting for mandated costs, taking recommended measures to increase plant availability, and the construction of new vertical LFG collection wells in the old landfill area is predicted to increase the plant NPV from ($722,388) to $1,269,769 s shown on the following table:

Table 13 - Initial Financial Projections vs. 2016-2019 Performance

Parameter	NPV	Change in NPV relative to Actual Performance	Change in NPV relative to Rebaseline
Initial Case	$2,718,101		
Re-baselined Case	$549,862		
Actual Performance	($722,388)		
Shut-down	($631,498)		
Revised Attribution of O&M Costs	$525,611	$1,247,999	($24,251)
Revised Attribution plus Increased Plant Availability	$1,045,635	$1,768,023	$495,773
Revised Attribution plus Increased Plant Availability plus Wellfield Expansion	$1,269,769	$1,901,267	$719,907

Notes:

1) All costs in 2017 dollars

We note that the largest change in NPV results from the attribution of O&M costs that the City of Kawartha Lakes would be legally mandated to incur whether or not the electricity generation plant is maintained. Changes in operating procedures to reduce plant downtime offers the next largest increase, followed by the wellfield expansion. The relative effect of these measures is shown on the following figure:

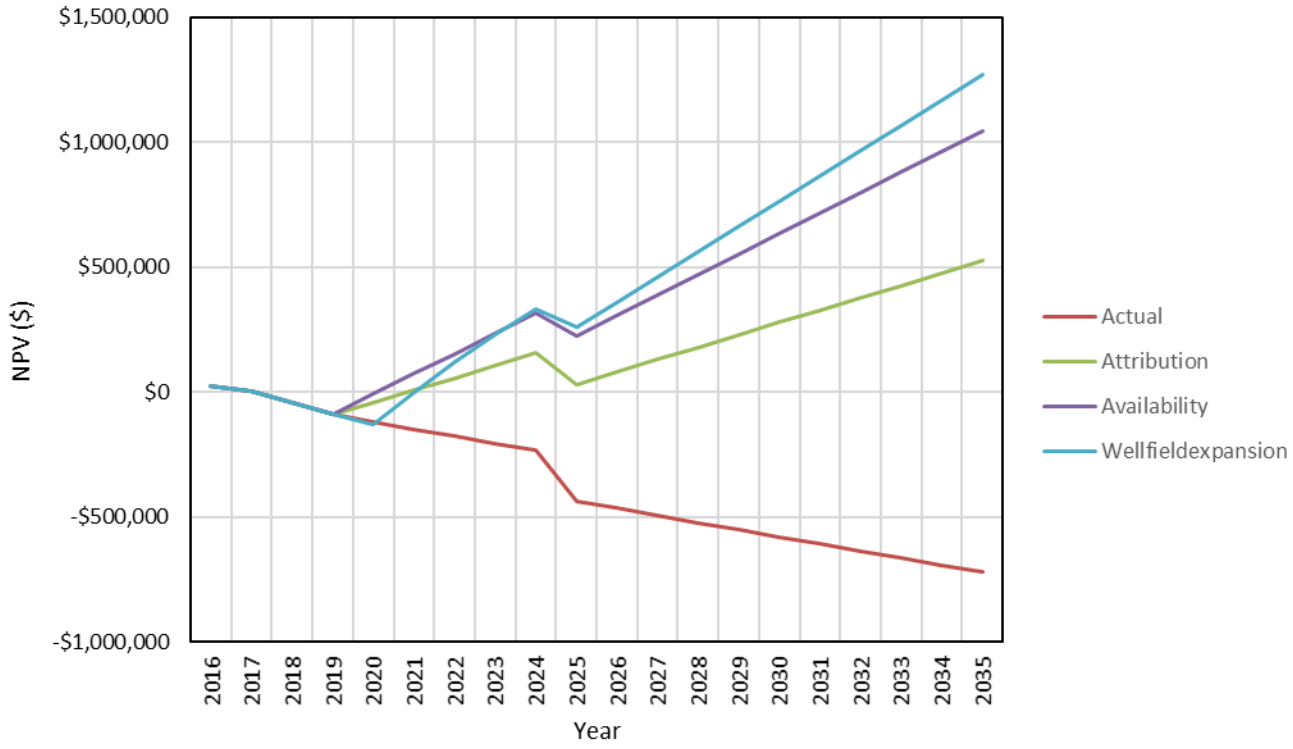


Figure 23 - Change in NPV vs. Time for Modelled Optimization Scenarios

As shown, the proposed measures yield a near-immediate improvement in financial performance. While the largest increase is due to the attribution of the "sunk" portion of O&M costs, the measures to improve the quantity and quality of the collected LFG and to improve plant availability represent a real increase in revenues to the City. Our modelling suggests that the relative contribution of the proposed collection wells in the old landfill area is marginal compared to the contribution provided by measures to improve plant availability. However, a simple comparison overlooks the fact that the two are inter-related since many of the generator trips are the caused by methane concentration falling too low. For this reason, we suggest that the recommended measures be taken in concert.

5.4 Sources of Uncertainty

While we have attempted to take a conservative approach in our analysis, there remain sources of uncertainty that are un-knowable at this stage. These include methane generation rates within the landfilled wastes, the achievable methane collection efficiency, electricity prices, inflation, future operations and maintenance costs, and the effectiveness of the recommended actions.

6. Environmental Aspects

The City of Kawartha Lakes is committed to environmentally sustainable projects and policies including waste diversion and emissions capture. The City's Healthy Environment Plan (2019) sets targets for emissions reductions and capture. Improvements to the wellfield and gas capture system will improve capture and provide additional fuel for the genset.

Without changes to the wellfield, at the projected output of 1,851,465 kWh/year generated (Section 4.4.2), 1,309 tonne of carbon are not required from other generation sources (www.epa.gov). The Healthy Environment Plan targets waste diversion increases from 39% to 70% by 2048 for a 20,110

tonne reduction to greenhouse gas. Operating the generator at optimal conditions, can increase the waste-related removal of carbon by 5%.

Continued operation of the genset will contribute to the environmental goals of the City of Kawartha Lakes.

7. Recommendations

Throughout this report several recommendations have been identified to improve the genset output and the value provided by operating the landfill gas generator. The recommendations are summarized below:

- It is recommended to have the operations manual amended to include data on the genset components. This will allow operators access to complete data.
- It is recommended to have City of Kawartha Lakes staff trained for low-risk restarts. This will allow downtime reductions owing to nuisance trips.
- The Wintek report made recommendations to mitigate the effects of the WWTP power-factor correction system, ranging from replacing the system, to adjusting the control narratives, to disabling the system. Implementing these recommendations will reduce the number of times the genset is tripped off owing to operating fluctuations at the WWTP.
- It is also recommended that the data logging mechanism for the power switch be adjusted to provide more data during trip events. This will provide additional data when evaluating the impacts of changes to the system.
- It is recommended to conduct an obsolescence review of critical path components. This will inform spare parts inventories to further mitigate or reduce downtime events.
- Further wellfield expansion is recommended to maximize the landfill gas collection and subsequent power generation. A test well added to the older landfill section in place of one of the shallow existing wells will quantify the increase to collection and generator output and provide justification for additional wells. This approximate cost will be $30,000.

7.1.1 Decision Points

In support the recommendations there will be decision points that will guide the optimization of the generator.

Immediate Timeline (3 to 6 months):

- Will city staff be trained to perform routine restarts?

Moderate Timeline (6 to 12 months)

- Will the City of Kawartha Lakes apply for the Climate Action Incentive Fund?
- Will the City of Kawartha Lakes apply for the Green Municipal Fund?
- Will an additional test well be dug in the old landfill?

Extended Timeline (12+ month)

- Will additional wells be added in the old landfill?
- Will the City of Kawartha Lakes proceed with applying for DGen status and review of Hydro One contract?

8. Summary

The landfill gas generator at Lindsay-Ops Landfill can provide useful energy for some time to come. The value can be enhanced with modifications to the wellfield and staff responsibilities. Reducing downtime through staff training, continued wellfield improvement and power factor correction system modifications will improve the net present value and provide the opportunity to increase the return on investment.

The performance envisaged in the original business case cannot be achieved because the actual LFG contains only 40% methane and the estimate assumed that electricity price would increase at greater than the rate of inflation. When we correct for these factors the re-baselined NPV falls to $549,862. The alternatives, to continue operations as-is or decommission the generator, will result in loss of sunk costs and loss of potential future revenues.

Actual performance has fallen considerably short of even the re-baselined value due largely to poor plant availability. However, the financial performance is better than the numbers suggest since costs related to the operation and maintenance of the LFG collection system would have to be incurred regardless. When we re-attribute this portion of the operating costs as a savings due to the plant, the NPV resets to $525,611.

Reviewing the contract with Hydro One will provide additional savings and possible additional revenues if the generator output is maximized. The operations contract does not represent a significant route to improved financial performance at this time but may be revisited in the future as circumstances change.

Further improvements to operational value may be realized through a series of measures to improve plant availability along with improving the quantity and quality of the collected LFG through the construction of a number of additional collector wells within the old landfill area. Primary benefits will be seen through staff training to recover from minor genset trips, increasing landfill gas collection, and rapid turn-around on expense approvals. These measures could reasonably be expected to increase plant availability by 63% and result in a further improvement of expected NPV of $520,024 to $1,045,635. Implementation of all measures will need to be coordinated to ensure the maximum benefit is achieved. Selective implementation will reduce the increases in NPV.

The operation of the generator also has the potential to offset 1,300 tonne of greenhouse emissions from other generation sources to operate the Waste Water Treatment Plant. The City of Kawartha Lakes has targeted reduced emissions as part of the Healthy Environment Plan and the generator is one of many paths to achieve the goal.

While it is not possible, in our opinion, to realize the originally envisaged financial performance, we believe that the recommended measures will offer a substantial improvement to the financial performance of the system and justifies continued operation of the Lindsay-Ops Landfill Gas Generator.

Respectfully Submitted,

THE GREER GALLOWAY GROUP INC.
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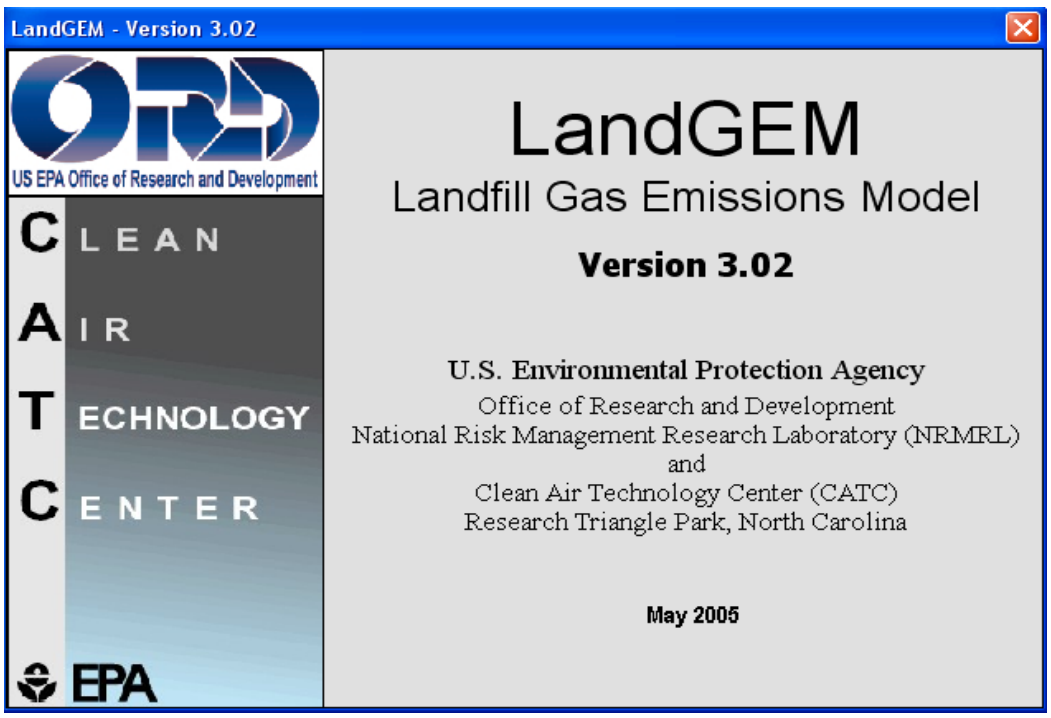
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Appendix A

LandGEM 3.02 Model Outputs



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

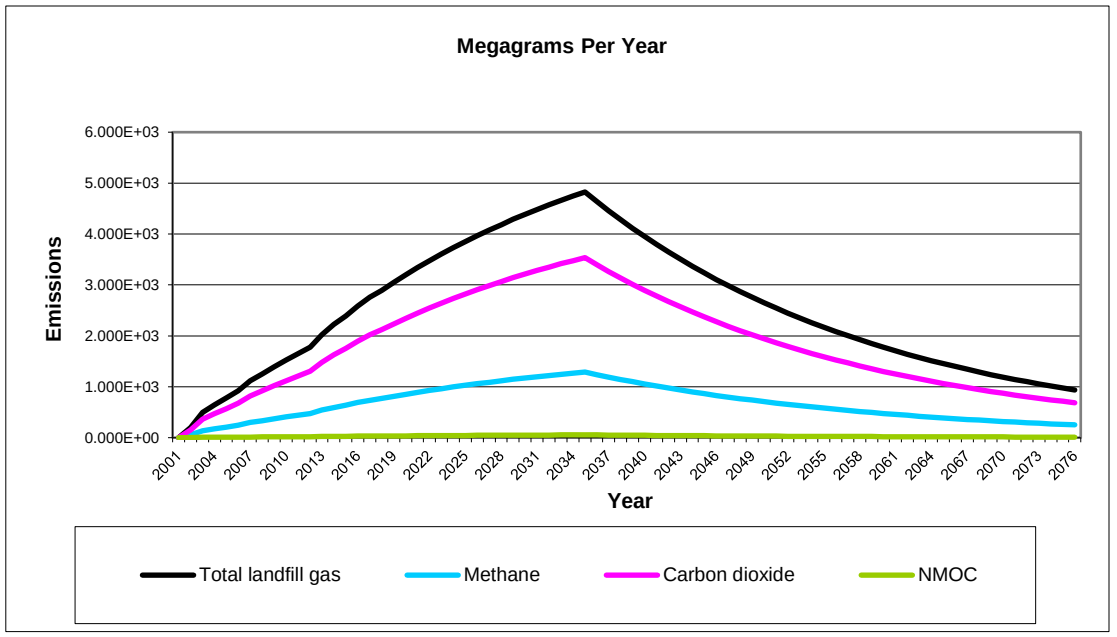
Pollutant Parameters

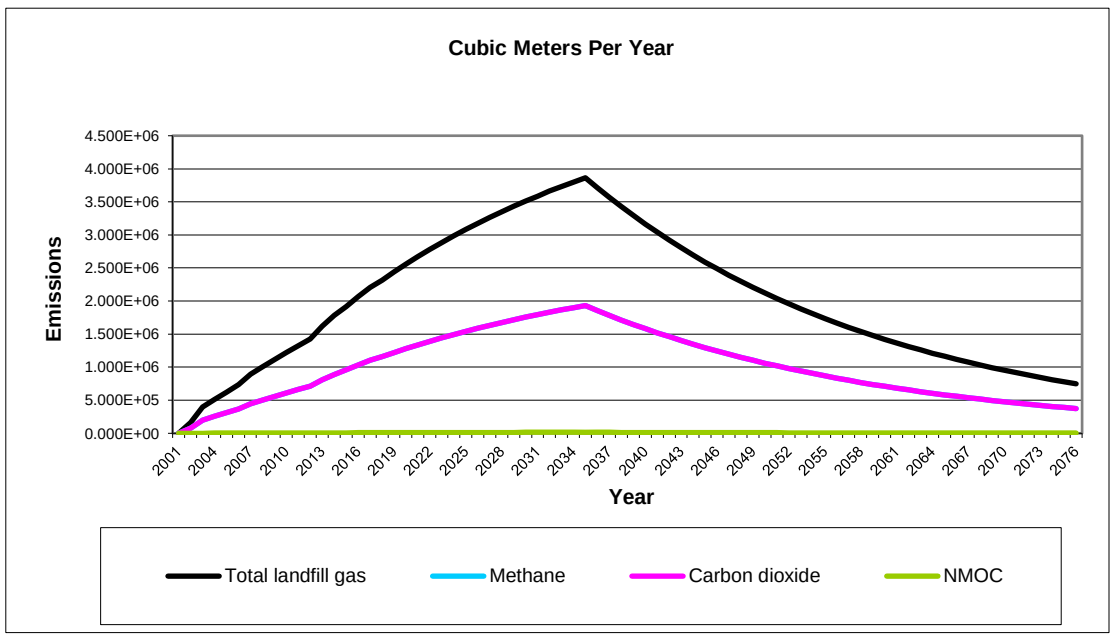
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

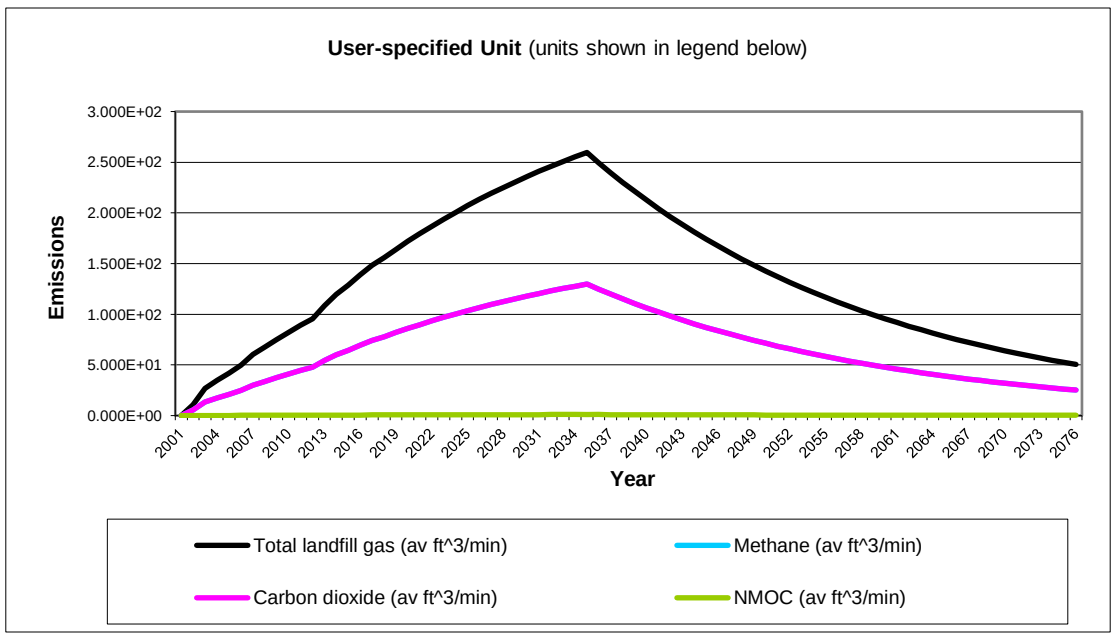
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
4.500E+06
4.000E+06
3.500E+06
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	2.010E+02	1.609E+05	1.081E+01	5.368E+01	8.046E+04	5.406E+00
2003	4.987E+02	3.993E+05	2.683E+01	1.332E+02	1.997E+05	1.341E+01
2004	6.431E+02	5.150E+05	3.460E+01	1.718E+02	2.575E+05	1.730E+01
2005	7.765E+02	6.218E+05	4.178E+01	2.074E+02	3.109E+05	2.089E+01
2006	9.206E+02	7.372E+05	4.953E+01	2.459E+02	3.686E+05	2.477E+01
2007	1.120E+03	8.966E+05	6.024E+01	2.991E+02	4.483E+05	3.012E+01
2008	1.253E+03	1.003E+06	6.740E+01	3.346E+02	5.016E+05	3.370E+01
2009	1.392E+03	1.115E+06	7.490E+01	3.718E+02	5.573E+05	3.745E+01
2010	1.526E+03	1.222E+06	8.210E+01	4.076E+02	6.109E+05	4.105E+01
2011	1.654E+03	1.325E+06	8.901E+01	4.419E+02	6.624E+05	4.451E+01
2012	1.778E+03	1.424E+06	9.566E+01	4.749E+02	7.119E+05	4.783E+01
2013	2.021E+03	1.618E+06	1.087E+02	5.397E+02	8.090E+05	5.436E+01
2014	2.224E+03	1.781E+06	1.196E+02	5.940E+02	8.904E+05	5.982E+01
2015	2.392E+03	1.915E+06	1.287E+02	6.390E+02	9.577E+05	6.435E+01
2016	2.584E+03	2.069E+06	1.390E+02	6.903E+02	1.035E+06	6.952E+01
2017	2.755E+03	2.206E+06	1.482E+02	7.359E+02	1.103E+06	7.412E+01
2018	2.894E+03	2.317E+06	1.557E+02	7.731E+02	1.159E+06	7.786E+01
2019	3.048E+03	2.440E+06	1.640E+02	8.141E+02	1.220E+06	8.198E+01
2020	3.195E+03	2.558E+06	1.719E+02	8.534E+02	1.279E+06	8.595E+01
2021	3.337E+03	2.672E+06	1.795E+02	8.913E+02	1.336E+06	8.976E+01
2022	3.473E+03	2.781E+06	1.869E+02	9.276E+02	1.390E+06	9.343E+01
2023	3.604E+03	2.886E+06	1.939E+02	9.626E+02	1.443E+06	9.694E+01
2024	3.729E+03	2.986E+06	2.006E+02	9.961E+02	1.493E+06	1.003E+02
2025	3.850E+03	3.083E+06	2.071E+02	1.028E+03	1.541E+06	1.036E+02
2026	3.966E+03	3.176E+06	2.134E+02	1.059E+03	1.588E+06	1.067E+02
2027	4.078E+03	3.265E+06	2.194E+02	1.089E+03	1.633E+06	1.097E+02
2028	4.185E+03	3.351E+06	2.251E+02	1.118E+03	1.675E+06	1.126E+02
2029	4.287E+03	3.433E+06	2.307E+02	1.145E+03	1.717E+06	1.153E+02
2030	4.386E+03	3.512E+06	2.360E+02	1.172E+03	1.756E+06	1.180E+02
2031	4.481E+03	3.588E+06	2.411E+02	1.197E+03	1.794E+06	1.206E+02
2032	4.573E+03	3.661E+06	2.460E+02	1.221E+03	1.831E+06	1.230E+02
2033	4.660E+03	3.732E+06	2.507E+02	1.245E+03	1.866E+06	1.254E+02
2034	4.744E+03	3.799E+06	2.553E+02	1.267E+03	1.900E+06	1.276E+02
2035	4.825E+03	3.864E+06	2.596E+02	1.289E+03	1.932E+06	1.298E+02
2036	4.636E+03	3.712E+06	2.494E+02	1.238E+03	1.856E+06	1.247E+02
2037	4.454E+03	3.567E+06	2.397E+02	1.190E+03	1.783E+06	1.198E+02
2038	4.280E+03	3.427E+06	2.303E+02	1.143E+03	1.714E+06	1.151E+02
2039	4.112E+03	3.293E+06	2.212E+02	1.098E+03	1.646E+06	1.106E+02
2040	3.951E+03	3.164E+06	2.126E+02	1.055E+03	1.582E+06	1.063E+02
2041	3.796E+03	3.039E+06	2.042E+02	1.014E+03	1.520E+06	1.021E+02
2042	3.647E+03	2.920E+06	1.962E+02	9.741E+02	1.460E+06	9.811E+01
2043	3.504E+03	2.806E+06	1.885E+02	9.359E+02	1.403E+06	9.426E+01
2044	3.367E+03	2.696E+06	1.811E+02	8.992E+02	1.348E+06	9.056E+01
2045	3.235E+03	2.590E+06	1.740E+02	8.640E+02	1.295E+06	8.701E+01
2046	3.108E+03	2.489E+06	1.672E+02	8.301E+02	1.244E+06	8.360E+01
2047	2.986E+03	2.391E+06	1.606E+02	7.976E+02	1.195E+06	8.032E+01
2048	2.869E+03	2.297E+06	1.543E+02	7.663E+02	1.149E+06	7.717E+01
2049	2.756E+03	2.207E+06	1.483E+02	7.362E+02	1.104E+06	7.415E+01
2050	2.648E+03	2.121E+06	1.425E+02	7.074E+02	1.060E+06	7.124E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.544E+03	2.037E+06	1.369E+02	6.796E+02	1.019E+06	6.845E+01
2052	2.445E+03	1.958E+06	1.315E+02	6.530E+02	9.788E+05	6.576E+01
2053	2.349E+03	1.881E+06	1.264E+02	6.274E+02	9.404E+05	6.318E+01
2054	2.257E+03	1.807E+06	1.214E+02	6.028E+02	9.035E+05	6.071E+01
2055	2.168E+03	1.736E+06	1.167E+02	5.791E+02	8.681E+05	5.833E+01
2056	2.083E+03	1.668E+06	1.121E+02	5.564E+02	8.341E+05	5.604E+01
2057	2.001E+03	1.603E+06	1.077E+02	5.346E+02	8.014E+05	5.384E+01
2058	1.923E+03	1.540E+06	1.035E+02	5.137E+02	7.699E+05	5.173E+01
2059	1.848E+03	1.479E+06	9.941E+01	4.935E+02	7.397E+05	4.970E+01
2060	1.775E+03	1.421E+06	9.551E+01	4.742E+02	7.107E+05	4.775E+01
2061	1.706E+03	1.366E+06	9.176E+01	4.556E+02	6.829E+05	4.588E+01
2062	1.639E+03	1.312E+06	8.817E+01	4.377E+02	6.561E+05	4.408E+01
2063	1.574E+03	1.261E+06	8.471E+01	4.205E+02	6.304E+05	4.235E+01
2064	1.513E+03	1.211E+06	8.139E+01	4.041E+02	6.056E+05	4.069E+01
2065	1.453E+03	1.164E+06	7.820E+01	3.882E+02	5.819E+05	3.910E+01
2066	1.396E+03	1.118E+06	7.513E+01	3.730E+02	5.591E+05	3.756E+01
2067	1.342E+03	1.074E+06	7.218E+01	3.584E+02	5.372E+05	3.609E+01
2068	1.289E+03	1.032E+06	6.935E+01	3.443E+02	5.161E+05	3.468E+01
2069	1.238E+03	9.917E+05	6.663E+01	3.308E+02	4.959E+05	3.332E+01
2070	1.190E+03	9.528E+05	6.402E+01	3.178E+02	4.764E+05	3.201E+01
2071	1.143E+03	9.155E+05	6.151E+01	3.054E+02	4.577E+05	3.076E+01
2072	1.098E+03	8.796E+05	5.910E+01	2.934E+02	4.398E+05	2.955E+01
2073	1.055E+03	8.451E+05	5.678E+01	2.819E+02	4.225E+05	2.839E+01
2074	1.014E+03	8.120E+05	5.456E+01	2.708E+02	4.060E+05	2.728E+01
2075	9.742E+02	7.801E+05	5.242E+01	2.602E+02	3.901E+05	2.621E+01
2076	9.360E+02	7.495E+05	5.036E+01	2.500E+02	3.748E+05	2.518E+01
2077	8.993E+02	7.201E+05	4.839E+01	2.402E+02	3.601E+05	2.419E+01
2078	8.641E+02	6.919E+05	4.649E+01	2.308E+02	3.460E+05	2.324E+01
2079	8.302E+02	6.648E+05	4.467E+01	2.218E+02	3.324E+05	2.233E+01
2080	7.976E+02	6.387E+05	4.291E+01	2.131E+02	3.194E+05	2.146E+01
2081	7.664E+02	6.137E+05	4.123E+01	2.047E+02	3.068E+05	2.062E+01
2082	7.363E+02	5.896E+05	3.962E+01	1.967E+02	2.948E+05	1.981E+01
2083	7.074E+02	5.665E+05	3.806E+01	1.890E+02	2.832E+05	1.903E+01
2084	6.797E+02	5.443E+05	3.657E+01	1.816E+02	2.721E+05	1.828E+01
2085	6.530E+02	5.229E+05	3.514E+01	1.744E+02	2.615E+05	1.757E+01
2086	6.274E+02	5.024E+05	3.376E+01	1.676E+02	2.512E+05	1.688E+01
2087	6.028E+02	4.827E+05	3.243E+01	1.610E+02	2.414E+05	1.622E+01
2088	5.792E+02	4.638E+05	3.116E+01	1.547E+02	2.319E+05	1.558E+01
2089	5.565E+02	4.456E+05	2.994E+01	1.486E+02	2.228E+05	1.497E+01
2090	5.347E+02	4.281E+05	2.877E+01	1.428E+02	2.141E+05	1.438E+01
2091	5.137E+02	4.114E+05	2.764E+01	1.372E+02	2.057E+05	1.382E+01
2092	4.936E+02	3.952E+05	2.655E+01	1.318E+02	1.976E+05	1.328E+01
2093	4.742E+02	3.797E+05	2.551E+01	1.267E+02	1.899E+05	1.276E+01
2094	4.556E+02	3.648E+05	2.451E+01	1.217E+02	1.824E+05	1.226E+01
2095	4.377E+02	3.505E+05	2.355E+01	1.169E+02	1.753E+05	1.178E+01
2096	4.206E+02	3.368E+05	2.263E+01	1.123E+02	1.684E+05	1.131E+01
2097	4.041E+02	3.236E+05	2.174E+01	1.079E+02	1.618E+05	1.087E+01
2098	3.882E+02	3.109E+05	2.089E+01	1.037E+02	1.554E+05	1.044E+01
2099	3.730E+02	2.987E+05	2.007E+01	9.964E+01	1.494E+05	1.003E+01
2100	3.584E+02	2.870E+05	1.928E+01	9.573E+01	1.435E+05	9.641E+00
2101	3.443E+02	2.757E+05	1.853E+01	9.198E+01	1.379E+05	9.263E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	3.308E+02	2.649E+05	1.780E+01	8.837E+01	1.325E+05	8.900E+00
2103	3.179E+02	2.545E+05	1.710E+01	8.491E+01	1.273E+05	8.551E+00
2104	3.054E+02	2.446E+05	1.643E+01	8.158E+01	1.223E+05	8.216E+00
2105	2.934E+02	2.350E+05	1.579E+01	7.838E+01	1.175E+05	7.894E+00
2106	2.819E+02	2.258E+05	1.517E+01	7.531E+01	1.129E+05	7.584E+00
2107	2.709E+02	2.169E+05	1.457E+01	7.235E+01	1.085E+05	7.287E+00
2108	2.603E+02	2.084E+05	1.400E+01	6.952E+01	1.042E+05	7.001E+00
2109	2.500E+02	2.002E+05	1.345E+01	6.679E+01	1.001E+05	6.727E+00
2110	2.402E+02	1.924E+05	1.293E+01	6.417E+01	9.619E+04	6.463E+00
2111	2.308E+02	1.848E+05	1.242E+01	6.166E+01	9.242E+04	6.209E+00
2112	2.218E+02	1.776E+05	1.193E+01	5.924E+01	8.879E+04	5.966E+00
2113	2.131E+02	1.706E+05	1.146E+01	5.691E+01	8.531E+04	5.732E+00
2114	2.047E+02	1.639E+05	1.101E+01	5.468E+01	8.197E+04	5.507E+00
2115	1.967E+02	1.575E+05	1.058E+01	5.254E+01	7.875E+04	5.291E+00
2116	1.890E+02	1.513E+05	1.017E+01	5.048E+01	7.566E+04	5.084E+00
2117	1.816E+02	1.454E+05	9.769E+00	4.850E+01	7.270E+04	4.884E+00
2118	1.745E+02	1.397E+05	9.386E+00	4.660E+01	6.985E+04	4.693E+00
2119	1.676E+02	1.342E+05	9.018E+00	4.477E+01	6.711E+04	4.509E+00
2120	1.610E+02	1.290E+05	8.664E+00	4.302E+01	6.448E+04	4.332E+00
2121	1.547E+02	1.239E+05	8.325E+00	4.133E+01	6.195E+04	4.162E+00
2122	1.487E+02	1.190E+05	7.998E+00	3.971E+01	5.952E+04	3.999E+00
2123	1.428E+02	1.144E+05	7.685E+00	3.815E+01	5.719E+04	3.842E+00
2124	1.372E+02	1.099E+05	7.383E+00	3.666E+01	5.494E+04	3.692E+00
2125	1.318E+02	1.056E+05	7.094E+00	3.522E+01	5.279E+04	3.547E+00
2126	1.267E+02	1.014E+05	6.816E+00	3.384E+01	5.072E+04	3.408E+00
2127	1.217E+02	9.746E+04	6.548E+00	3.251E+01	4.873E+04	3.274E+00
2128	1.169E+02	9.364E+04	6.292E+00	3.124E+01	4.682E+04	3.146E+00
2129	1.124E+02	8.997E+04	6.045E+00	3.001E+01	4.498E+04	3.022E+00
2130	1.079E+02	8.644E+04	5.808E+00	2.883E+01	4.322E+04	2.904E+00
2131	1.037E+02	8.305E+04	5.580E+00	2.770E+01	4.153E+04	2.790E+00
2132	9.965E+01	7.979E+04	5.361E+00	2.662E+01	3.990E+04	2.681E+00
2133	9.574E+01	7.666E+04	5.151E+00	2.557E+01	3.833E+04	2.576E+00
2134	9.199E+01	7.366E+04	4.949E+00	2.457E+01	3.683E+04	2.475E+00
2135	8.838E+01	7.077E+04	4.755E+00	2.361E+01	3.539E+04	2.378E+00
2136	8.491E+01	6.800E+04	4.569E+00	2.268E+01	3.400E+04	2.284E+00
2137	8.159E+01	6.533E+04	4.389E+00	2.179E+01	3.266E+04	2.195E+00
2138	7.839E+01	6.277E+04	4.217E+00	2.094E+01	3.138E+04	2.109E+00
2139	7.531E+01	6.031E+04	4.052E+00	2.012E+01	3.015E+04	2.026E+00
2140	7.236E+01	5.794E+04	3.893E+00	1.933E+01	2.897E+04	1.947E+00
2141	6.952E+01	5.567E+04	3.740E+00	1.857E+01	2.784E+04	1.870E+00

Results (Continued)

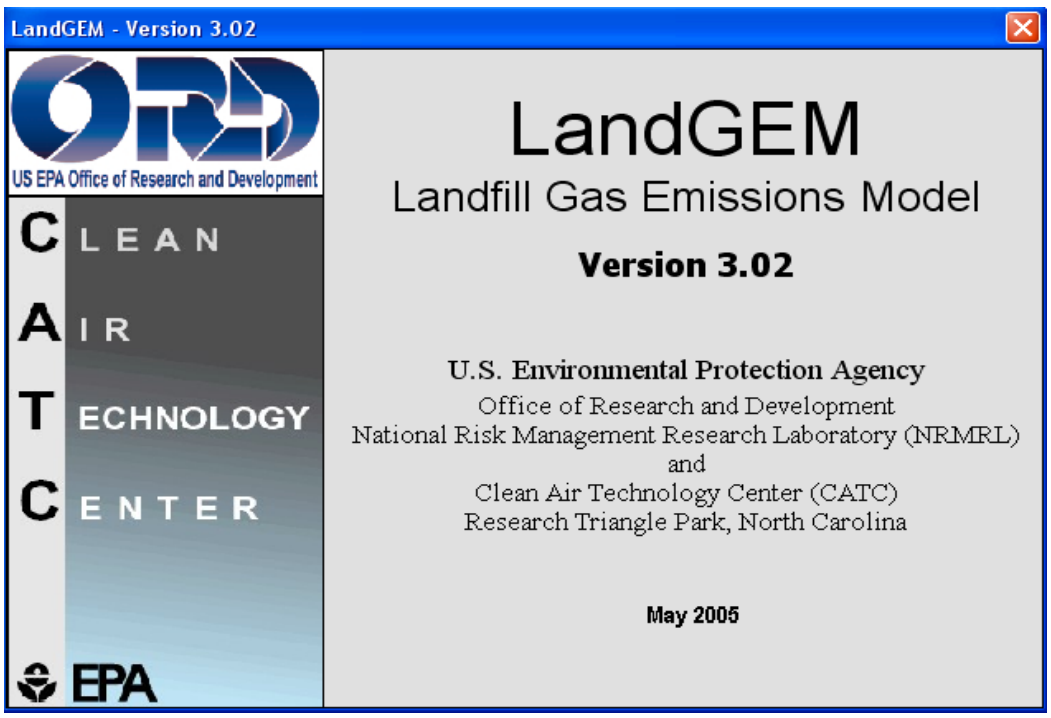
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	1.473E+02	8.046E+04	5.406E+00	2.307E+00	6.437E+02	4.325E-02
2003	3.655E+02	1.997E+05	1.341E+01	5.725E+00	1.597E+03	1.073E-01
2004	4.713E+02	2.575E+05	1.730E+01	7.384E+00	2.060E+03	1.384E-01
2005	5.691E+02	3.109E+05	2.089E+01	8.915E+00	2.487E+03	1.671E-01
2006	6.747E+02	3.686E+05	2.477E+01	1.057E+01	2.949E+03	1.981E-01
2007	8.206E+02	4.483E+05	3.012E+01	1.286E+01	3.586E+03	2.410E-01
2008	9.181E+02	5.016E+05	3.370E+01	1.438E+01	4.013E+03	2.696E-01
2009	1.020E+03	5.573E+05	3.745E+01	1.598E+01	4.459E+03	2.996E-01
2010	1.118E+03	6.109E+05	4.105E+01	1.752E+01	4.887E+03	3.284E-01
2011	1.213E+03	6.624E+05	4.451E+01	1.899E+01	5.299E+03	3.561E-01
2012	1.303E+03	7.119E+05	4.783E+01	2.041E+01	5.695E+03	3.826E-01
2013	1.481E+03	8.090E+05	5.436E+01	2.320E+01	6.472E+03	4.348E-01
2014	1.630E+03	8.904E+05	5.982E+01	2.553E+01	7.123E+03	4.786E-01
2015	1.753E+03	9.577E+05	6.435E+01	2.746E+01	7.662E+03	5.148E-01
2016	1.894E+03	1.035E+06	6.952E+01	2.967E+01	8.278E+03	5.562E-01
2017	2.019E+03	1.103E+06	7.412E+01	3.163E+01	8.825E+03	5.929E-01
2018	2.121E+03	1.159E+06	7.786E+01	3.323E+01	9.270E+03	6.228E-01
2019	2.234E+03	1.220E+06	8.198E+01	3.499E+01	9.762E+03	6.559E-01
2020	2.342E+03	1.279E+06	8.595E+01	3.668E+01	1.023E+04	6.876E-01
2021	2.445E+03	1.336E+06	8.976E+01	3.831E+01	1.069E+04	7.181E-01
2022	2.545E+03	1.390E+06	9.343E+01	3.987E+01	1.112E+04	7.474E-01
2023	2.641E+03	1.443E+06	9.694E+01	4.137E+01	1.154E+04	7.755E-01
2024	2.733E+03	1.493E+06	1.003E+02	4.282E+01	1.195E+04	8.026E-01
2025	2.822E+03	1.541E+06	1.036E+02	4.420E+01	1.233E+04	8.286E-01
2026	2.907E+03	1.588E+06	1.067E+02	4.553E+01	1.270E+04	8.535E-01
2027	2.988E+03	1.633E+06	1.097E+02	4.681E+01	1.306E+04	8.775E-01
2028	3.067E+03	1.675E+06	1.126E+02	4.804E+01	1.340E+04	9.006E-01
2029	3.142E+03	1.717E+06	1.153E+02	4.923E+01	1.373E+04	9.227E-01
2030	3.215E+03	1.756E+06	1.180E+02	5.036E+01	1.405E+04	9.440E-01
2031	3.284E+03	1.794E+06	1.206E+02	5.145E+01	1.435E+04	9.644E-01
2032	3.351E+03	1.831E+06	1.230E+02	5.250E+01	1.465E+04	9.841E-01
2033	3.415E+03	1.866E+06	1.254E+02	5.350E+01	1.493E+04	1.003E+00
2034	3.477E+03	1.900E+06	1.276E+02	5.447E+01	1.520E+04	1.021E+00
2035	3.536E+03	1.932E+06	1.298E+02	5.540E+01	1.546E+04	1.038E+00
2036	3.398E+03	1.856E+06	1.247E+02	5.323E+01	1.485E+04	9.978E-01
2037	3.265E+03	1.783E+06	1.198E+02	5.114E+01	1.427E+04	9.586E-01
2038	3.137E+03	1.714E+06	1.151E+02	4.914E+01	1.371E+04	9.210E-01
2039	3.014E+03	1.646E+06	1.106E+02	4.721E+01	1.317E+04	8.849E-01
2040	2.895E+03	1.582E+06	1.063E+02	4.536E+01	1.265E+04	8.502E-01
2041	2.782E+03	1.520E+06	1.021E+02	4.358E+01	1.216E+04	8.169E-01
2042	2.673E+03	1.460E+06	9.811E+01	4.187E+01	1.168E+04	7.849E-01
2043	2.568E+03	1.403E+06	9.426E+01	4.023E+01	1.122E+04	7.541E-01
2044	2.467E+03	1.348E+06	9.056E+01	3.865E+01	1.078E+04	7.245E-01
2045	2.371E+03	1.295E+06	8.701E+01	3.714E+01	1.036E+04	6.961E-01
2046	2.278E+03	1.244E+06	8.360E+01	3.568E+01	9.954E+03	6.688E-01
2047	2.188E+03	1.195E+06	8.032E+01	3.428E+01	9.564E+03	6.426E-01
2048	2.103E+03	1.149E+06	7.717E+01	3.294E+01	9.189E+03	6.174E-01
2049	2.020E+03	1.104E+06	7.415E+01	3.165E+01	8.828E+03	5.932E-01
2050	1.941E+03	1.060E+06	7.124E+01	3.040E+01	8.482E+03	5.699E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.865E+03	1.019E+06	6.845E+01	2.921E+01	8.150E+03	5.476E-01
2052	1.792E+03	9.788E+05	6.576E+01	2.807E+01	7.830E+03	5.261E-01
2053	1.721E+03	9.404E+05	6.318E+01	2.697E+01	7.523E+03	5.055E-01
2054	1.654E+03	9.035E+05	6.071E+01	2.591E+01	7.228E+03	4.857E-01
2055	1.589E+03	8.681E+05	5.833E+01	2.489E+01	6.945E+03	4.666E-01
2056	1.527E+03	8.341E+05	5.604E+01	2.392E+01	6.672E+03	4.483E-01
2057	1.467E+03	8.014E+05	5.384E+01	2.298E+01	6.411E+03	4.307E-01
2058	1.409E+03	7.699E+05	5.173E+01	2.208E+01	6.159E+03	4.139E-01
2059	1.354E+03	7.397E+05	4.970E+01	2.121E+01	5.918E+03	3.976E-01
2060	1.301E+03	7.107E+05	4.775E+01	2.038E+01	5.686E+03	3.820E-01
2061	1.250E+03	6.829E+05	4.588E+01	1.958E+01	5.463E+03	3.671E-01
2062	1.201E+03	6.561E+05	4.408E+01	1.881E+01	5.249E+03	3.527E-01
2063	1.154E+03	6.304E+05	4.235E+01	1.808E+01	5.043E+03	3.388E-01
2064	1.109E+03	6.056E+05	4.069E+01	1.737E+01	4.845E+03	3.255E-01
2065	1.065E+03	5.819E+05	3.910E+01	1.669E+01	4.655E+03	3.128E-01
2066	1.023E+03	5.591E+05	3.756E+01	1.603E+01	4.473E+03	3.005E-01
2067	9.833E+02	5.372E+05	3.609E+01	1.540E+01	4.297E+03	2.887E-01
2068	9.447E+02	5.161E+05	3.468E+01	1.480E+01	4.129E+03	2.774E-01
2069	9.077E+02	4.959E+05	3.332E+01	1.422E+01	3.967E+03	2.665E-01
2070	8.721E+02	4.764E+05	3.201E+01	1.366E+01	3.811E+03	2.561E-01
2071	8.379E+02	4.577E+05	3.076E+01	1.313E+01	3.662E+03	2.460E-01
2072	8.050E+02	4.398E+05	2.955E+01	1.261E+01	3.518E+03	2.364E-01
2073	7.735E+02	4.225E+05	2.839E+01	1.212E+01	3.380E+03	2.271E-01
2074	7.431E+02	4.060E+05	2.728E+01	1.164E+01	3.248E+03	2.182E-01
2075	7.140E+02	3.901E+05	2.621E+01	1.119E+01	3.120E+03	2.097E-01
2076	6.860E+02	3.748E+05	2.518E+01	1.075E+01	2.998E+03	2.014E-01
2077	6.591E+02	3.601E+05	2.419E+01	1.033E+01	2.881E+03	1.935E-01
2078	6.333E+02	3.460E+05	2.324E+01	9.920E+00	2.768E+03	1.860E-01
2079	6.084E+02	3.324E+05	2.233E+01	9.531E+00	2.659E+03	1.787E-01
2080	5.846E+02	3.194E+05	2.146E+01	9.158E+00	2.555E+03	1.717E-01
2081	5.617E+02	3.068E+05	2.062E+01	8.799E+00	2.455E+03	1.649E-01
2082	5.396E+02	2.948E+05	1.981E+01	8.454E+00	2.358E+03	1.585E-01
2083	5.185E+02	2.832E+05	1.903E+01	8.122E+00	2.266E+03	1.522E-01
2084	4.981E+02	2.721E+05	1.828E+01	7.804E+00	2.177E+03	1.463E-01
2085	4.786E+02	2.615E+05	1.757E+01	7.498E+00	2.092E+03	1.405E-01
2086	4.598E+02	2.512E+05	1.688E+01	7.204E+00	2.010E+03	1.350E-01
2087	4.418E+02	2.414E+05	1.622E+01	6.921E+00	1.931E+03	1.297E-01
2088	4.245E+02	2.319E+05	1.558E+01	6.650E+00	1.855E+03	1.246E-01
2089	4.078E+02	2.228E+05	1.497E+01	6.389E+00	1.782E+03	1.198E-01
2090	3.919E+02	2.141E+05	1.438E+01	6.139E+00	1.713E+03	1.151E-01
2091	3.765E+02	2.057E+05	1.382E+01	5.898E+00	1.645E+03	1.106E-01
2092	3.617E+02	1.976E+05	1.328E+01	5.667E+00	1.581E+03	1.062E-01
2093	3.475E+02	1.899E+05	1.276E+01	5.444E+00	1.519E+03	1.021E-01
2094	3.339E+02	1.824E+05	1.226E+01	5.231E+00	1.459E+03	9.805E-02
2095	3.208E+02	1.753E+05	1.178E+01	5.026E+00	1.402E+03	9.421E-02
2096	3.082E+02	1.684E+05	1.131E+01	4.829E+00	1.347E+03	9.051E-02
2097	2.962E+02	1.618E+05	1.087E+01	4.639E+00	1.294E+03	8.697E-02
2098	2.845E+02	1.554E+05	1.044E+01	4.458E+00	1.244E+03	8.356E-02
2099	2.734E+02	1.494E+05	1.003E+01	4.283E+00	1.195E+03	8.028E-02
2100	2.627E+02	1.435E+05	9.641E+00	4.115E+00	1.148E+03	7.713E-02
2101	2.524E+02	1.379E+05	9.263E+00	3.953E+00	1.103E+03	7.411E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	2.425E+02	1.325E+05	8.900E+00	3.798E+00	1.060E+03	7.120E-02
2103	2.330E+02	1.273E+05	8.551E+00	3.650E+00	1.018E+03	6.841E-02
2104	2.238E+02	1.223E+05	8.216E+00	3.506E+00	9.782E+02	6.573E-02
2105	2.151E+02	1.175E+05	7.894E+00	3.369E+00	9.399E+02	6.315E-02
2106	2.066E+02	1.129E+05	7.584E+00	3.237E+00	9.030E+02	6.067E-02
2107	1.985E+02	1.085E+05	7.287E+00	3.110E+00	8.676E+02	5.829E-02
2108	1.907E+02	1.042E+05	7.001E+00	2.988E+00	8.336E+02	5.601E-02
2109	1.833E+02	1.001E+05	6.727E+00	2.871E+00	8.009E+02	5.381E-02
2110	1.761E+02	9.619E+04	6.463E+00	2.758E+00	7.695E+02	5.170E-02
2111	1.692E+02	9.242E+04	6.209E+00	2.650E+00	7.393E+02	4.968E-02
2112	1.625E+02	8.879E+04	5.966E+00	2.546E+00	7.103E+02	4.773E-02
2113	1.562E+02	8.531E+04	5.732E+00	2.446E+00	6.825E+02	4.586E-02
2114	1.500E+02	8.197E+04	5.507E+00	2.350E+00	6.557E+02	4.406E-02
2115	1.442E+02	7.875E+04	5.291E+00	2.258E+00	6.300E+02	4.233E-02
2116	1.385E+02	7.566E+04	5.084E+00	2.170E+00	6.053E+02	4.067E-02
2117	1.331E+02	7.270E+04	4.884E+00	2.085E+00	5.816E+02	3.908E-02
2118	1.279E+02	6.985E+04	4.693E+00	2.003E+00	5.588E+02	3.754E-02
2119	1.228E+02	6.711E+04	4.509E+00	1.924E+00	5.369E+02	3.607E-02
2120	1.180E+02	6.448E+04	4.332E+00	1.849E+00	5.158E+02	3.466E-02
2121	1.134E+02	6.195E+04	4.162E+00	1.776E+00	4.956E+02	3.330E-02
2122	1.089E+02	5.952E+04	3.999E+00	1.707E+00	4.762E+02	3.199E-02
2123	1.047E+02	5.719E+04	3.842E+00	1.640E+00	4.575E+02	3.074E-02
2124	1.006E+02	5.494E+04	3.692E+00	1.576E+00	4.395E+02	2.953E-02
2125	9.663E+01	5.279E+04	3.547E+00	1.514E+00	4.223E+02	2.837E-02
2126	9.284E+01	5.072E+04	3.408E+00	1.454E+00	4.058E+02	2.726E-02
2127	8.920E+01	4.873E+04	3.274E+00	1.397E+00	3.898E+02	2.619E-02
2128	8.570E+01	4.682E+04	3.146E+00	1.343E+00	3.746E+02	2.517E-02
2129	8.234E+01	4.498E+04	3.022E+00	1.290E+00	3.599E+02	2.418E-02
2130	7.911E+01	4.322E+04	2.904E+00	1.239E+00	3.458E+02	2.323E-02
2131	7.601E+01	4.153E+04	2.790E+00	1.191E+00	3.322E+02	2.232E-02
2132	7.303E+01	3.990E+04	2.681E+00	1.144E+00	3.192E+02	2.145E-02
2133	7.017E+01	3.833E+04	2.576E+00	1.099E+00	3.067E+02	2.060E-02
2134	6.742E+01	3.683E+04	2.475E+00	1.056E+00	2.946E+02	1.980E-02
2135	6.477E+01	3.539E+04	2.378E+00	1.015E+00	2.831E+02	1.902E-02
2136	6.223E+01	3.400E+04	2.284E+00	9.749E-01	2.720E+02	1.827E-02
2137	5.979E+01	3.266E+04	2.195E+00	9.367E-01	2.613E+02	1.756E-02
2138	5.745E+01	3.138E+04	2.109E+00	9.000E-01	2.511E+02	1.687E-02
2139	5.520E+01	3.015E+04	2.026E+00	8.647E-01	2.412E+02	1.621E-02
2140	5.303E+01	2.897E+04	1.947E+00	8.308E-01	2.318E+02	1.557E-02
2141	5.095E+01	2.784E+04	1.870E+00	7.982E-01	2.227E+02	1.496E-02



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.096**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**127**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

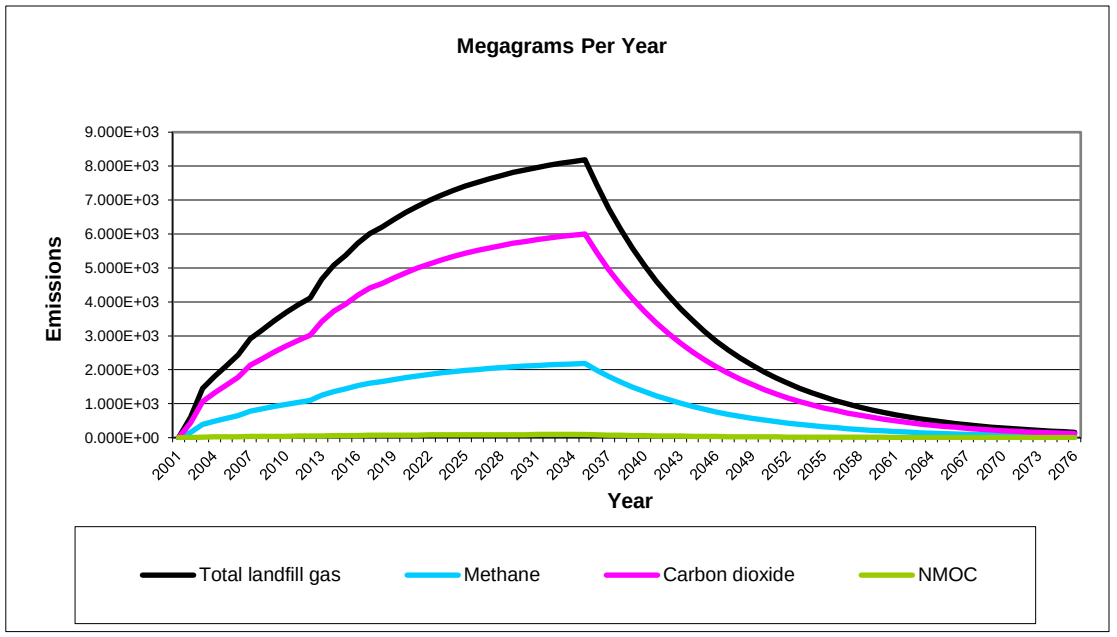
Pollutant Parameters

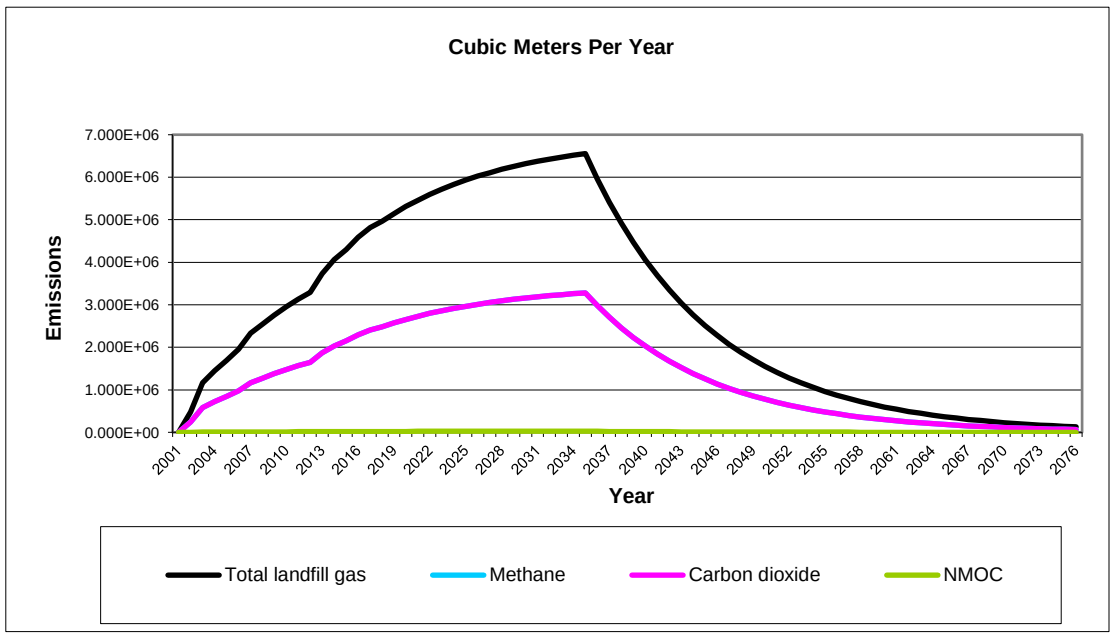
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

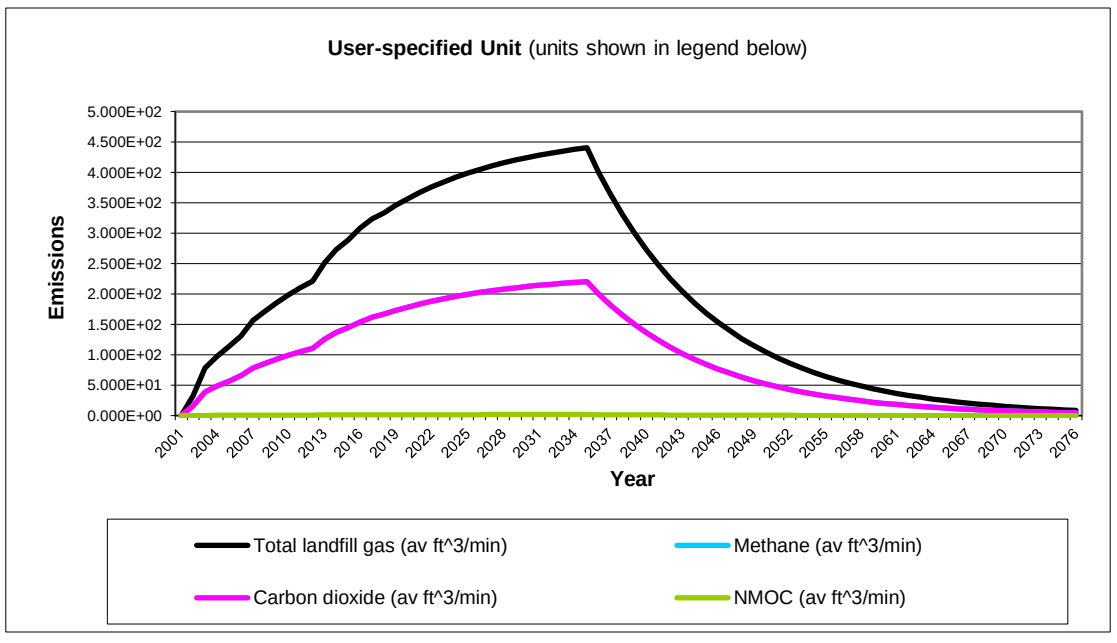
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
9.000E+03
8.000E+03
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
7.000E+06
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
5.000E+02
4.500E+02
4.000E+02
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	5.975E+02	4.784E+05	3.215E+01	1.596E+02	2.392E+05	1.607E+01
2003	1.451E+03	1.162E+06	7.808E+01	3.877E+02	5.811E+05	3.904E+01
2004	1.806E+03	1.446E+06	9.717E+01	4.824E+02	7.231E+05	4.859E+01
2005	2.112E+03	1.691E+06	1.136E+02	5.642E+02	8.457E+05	5.682E+01
2006	2.438E+03	1.952E+06	1.312E+02	6.512E+02	9.761E+05	6.558E+01
2007	2.914E+03	2.333E+06	1.568E+02	7.783E+02	1.167E+06	7.839E+01
2008	3.173E+03	2.541E+06	1.707E+02	8.476E+02	1.271E+06	8.537E+01
2009	3.443E+03	2.757E+06	1.852E+02	9.197E+02	1.379E+06	9.262E+01
2010	3.688E+03	2.953E+06	1.984E+02	9.851E+02	1.477E+06	9.921E+01
2011	3.911E+03	3.131E+06	2.104E+02	1.045E+03	1.566E+06	1.052E+02
2012	4.113E+03	3.293E+06	2.213E+02	1.099E+03	1.647E+06	1.106E+02
2013	4.665E+03	3.735E+06	2.510E+02	1.246E+03	1.868E+06	1.255E+02
2014	5.078E+03	4.066E+06	2.732E+02	1.356E+03	2.033E+06	1.366E+02
2015	5.372E+03	4.302E+06	2.890E+02	1.435E+03	2.151E+06	1.445E+02
2016	5.731E+03	4.589E+06	3.083E+02	1.531E+03	2.295E+06	1.542E+02
2017	6.016E+03	4.817E+06	3.237E+02	1.607E+03	2.409E+06	1.618E+02
2018	6.199E+03	4.964E+06	3.335E+02	1.656E+03	2.482E+06	1.668E+02
2019	6.426E+03	5.145E+06	3.457E+02	1.716E+03	2.573E+06	1.729E+02
2020	6.631E+03	5.310E+06	3.568E+02	1.771E+03	2.655E+06	1.784E+02
2021	6.818E+03	5.459E+06	3.668E+02	1.821E+03	2.730E+06	1.834E+02
2022	6.987E+03	5.595E+06	3.759E+02	1.866E+03	2.798E+06	1.880E+02
2023	7.142E+03	5.719E+06	3.842E+02	1.908E+03	2.859E+06	1.921E+02
2024	7.282E+03	5.831E+06	3.918E+02	1.945E+03	2.915E+06	1.959E+02
2025	7.409E+03	5.933E+06	3.986E+02	1.979E+03	2.966E+06	1.993E+02
2026	7.524E+03	6.025E+06	4.048E+02	2.010E+03	3.013E+06	2.024E+02
2027	7.629E+03	6.109E+06	4.105E+02	2.038E+03	3.055E+06	2.052E+02
2028	7.725E+03	6.185E+06	4.156E+02	2.063E+03	3.093E+06	2.078E+02
2029	7.811E+03	6.255E+06	4.203E+02	2.086E+03	3.127E+06	2.101E+02
2030	7.890E+03	6.318E+06	4.245E+02	2.107E+03	3.159E+06	2.122E+02
2031	7.961E+03	6.375E+06	4.283E+02	2.127E+03	3.188E+06	2.142E+02
2032	8.026E+03	6.427E+06	4.318E+02	2.144E+03	3.214E+06	2.159E+02
2033	8.085E+03	6.474E+06	4.350E+02	2.160E+03	3.237E+06	2.175E+02
2034	8.139E+03	6.517E+06	4.379E+02	2.174E+03	3.259E+06	2.189E+02
2035	8.188E+03	6.556E+06	4.405E+02	2.187E+03	3.278E+06	2.203E+02
2036	7.438E+03	5.956E+06	4.002E+02	1.987E+03	2.978E+06	2.001E+02
2037	6.757E+03	5.411E+06	3.636E+02	1.805E+03	2.705E+06	1.818E+02
2038	6.139E+03	4.916E+06	3.303E+02	1.640E+03	2.458E+06	1.651E+02
2039	5.577E+03	4.466E+06	3.000E+02	1.490E+03	2.233E+06	1.500E+02
2040	5.066E+03	4.057E+06	2.726E+02	1.353E+03	2.028E+06	1.363E+02
2041	4.603E+03	3.686E+06	2.476E+02	1.229E+03	1.843E+06	1.238E+02
2042	4.181E+03	3.348E+06	2.250E+02	1.117E+03	1.674E+06	1.125E+02
2043	3.799E+03	3.042E+06	2.044E+02	1.015E+03	1.521E+06	1.022E+02
2044	3.451E+03	2.763E+06	1.857E+02	9.218E+02	1.382E+06	9.283E+01
2045	3.135E+03	2.510E+06	1.687E+02	8.374E+02	1.255E+06	8.434E+01
2046	2.848E+03	2.281E+06	1.532E+02	7.607E+02	1.140E+06	7.662E+01
2047	2.587E+03	2.072E+06	1.392E+02	6.911E+02	1.036E+06	6.960E+01
2048	2.350E+03	1.882E+06	1.265E+02	6.278E+02	9.411E+05	6.323E+01
2049	2.135E+03	1.710E+06	1.149E+02	5.704E+02	8.549E+05	5.744E+01
2050	1.940E+03	1.553E+06	1.044E+02	5.182E+02	7.767E+05	5.219E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.762E+03	1.411E+06	9.482E+01	4.707E+02	7.056E+05	4.741E+01
2052	1.601E+03	1.282E+06	8.614E+01	4.276E+02	6.410E+05	4.307E+01
2053	1.454E+03	1.165E+06	7.825E+01	3.885E+02	5.823E+05	3.913E+01
2054	1.321E+03	1.058E+06	7.109E+01	3.529E+02	5.290E+05	3.555E+01
2055	1.200E+03	9.612E+05	6.458E+01	3.206E+02	4.806E+05	3.229E+01
2056	1.090E+03	8.732E+05	5.867E+01	2.913E+02	4.366E+05	2.934E+01
2057	9.907E+02	7.933E+05	5.330E+01	2.646E+02	3.966E+05	2.665E+01
2058	9.000E+02	7.207E+05	4.842E+01	2.404E+02	3.603E+05	2.421E+01
2059	8.176E+02	6.547E+05	4.399E+01	2.184E+02	3.274E+05	2.199E+01
2060	7.428E+02	5.948E+05	3.996E+01	1.984E+02	2.974E+05	1.998E+01
2061	6.748E+02	5.403E+05	3.630E+01	1.802E+02	2.702E+05	1.815E+01
2062	6.130E+02	4.909E+05	3.298E+01	1.637E+02	2.454E+05	1.649E+01
2063	5.569E+02	4.459E+05	2.996E+01	1.488E+02	2.230E+05	1.498E+01
2064	5.059E+02	4.051E+05	2.722E+01	1.351E+02	2.026E+05	1.361E+01
2065	4.596E+02	3.680E+05	2.473E+01	1.228E+02	1.840E+05	1.236E+01
2066	4.175E+02	3.343E+05	2.246E+01	1.115E+02	1.672E+05	1.123E+01
2067	3.793E+02	3.037E+05	2.041E+01	1.013E+02	1.519E+05	1.020E+01
2068	3.446E+02	2.759E+05	1.854E+01	9.205E+01	1.380E+05	9.270E+00
2069	3.131E+02	2.507E+05	1.684E+01	8.362E+01	1.253E+05	8.422E+00
2070	2.844E+02	2.277E+05	1.530E+01	7.597E+01	1.139E+05	7.651E+00
2071	2.584E+02	2.069E+05	1.390E+01	6.901E+01	1.034E+05	6.950E+00
2072	2.347E+02	1.880E+05	1.263E+01	6.270E+01	9.398E+04	6.314E+00
2073	2.132E+02	1.707E+05	1.147E+01	5.696E+01	8.537E+04	5.736E+00
2074	1.937E+02	1.551E+05	1.042E+01	5.174E+01	7.756E+04	5.211E+00
2075	1.760E+02	1.409E+05	9.468E+00	4.701E+01	7.046E+04	4.734E+00
2076	1.599E+02	1.280E+05	8.602E+00	4.270E+01	6.401E+04	4.301E+00
2077	1.452E+02	1.163E+05	7.814E+00	3.879E+01	5.815E+04	3.907E+00
2078	1.319E+02	1.057E+05	7.099E+00	3.524E+01	5.283E+04	3.549E+00
2079	1.199E+02	9.598E+04	6.449E+00	3.202E+01	4.799E+04	3.225E+00
2080	1.089E+02	8.720E+04	5.859E+00	2.909E+01	4.360E+04	2.929E+00
2081	9.893E+01	7.922E+04	5.323E+00	2.642E+01	3.961E+04	2.661E+00
2082	8.987E+01	7.197E+04	4.835E+00	2.401E+01	3.598E+04	2.418E+00
2083	8.165E+01	6.538E+04	4.393E+00	2.181E+01	3.269E+04	2.196E+00
2084	7.417E+01	5.939E+04	3.991E+00	1.981E+01	2.970E+04	1.995E+00
2085	6.738E+01	5.396E+04	3.625E+00	1.800E+01	2.698E+04	1.813E+00
2086	6.121E+01	4.902E+04	3.293E+00	1.635E+01	2.451E+04	1.647E+00
2087	5.561E+01	4.453E+04	2.992E+00	1.485E+01	2.227E+04	1.496E+00
2088	5.052E+01	4.045E+04	2.718E+00	1.349E+01	2.023E+04	1.359E+00
2089	4.590E+01	3.675E+04	2.469E+00	1.226E+01	1.838E+04	1.235E+00
2090	4.170E+01	3.339E+04	2.243E+00	1.114E+01	1.669E+04	1.122E+00
2091	3.788E+01	3.033E+04	2.038E+00	1.012E+01	1.517E+04	1.019E+00
2092	3.441E+01	2.755E+04	1.851E+00	9.192E+00	1.378E+04	9.257E-01
2093	3.126E+01	2.503E+04	1.682E+00	8.350E+00	1.252E+04	8.410E-01
2094	2.840E+01	2.274E+04	1.528E+00	7.586E+00	1.137E+04	7.640E-01
2095	2.580E+01	2.066E+04	1.388E+00	6.892E+00	1.033E+04	6.941E-01
2096	2.344E+01	1.877E+04	1.261E+00	6.261E+00	9.384E+03	6.305E-01
2097	2.129E+01	1.705E+04	1.146E+00	5.688E+00	8.525E+03	5.728E-01
2098	1.934E+01	1.549E+04	1.041E+00	5.167E+00	7.745E+03	5.204E-01
2099	1.757E+01	1.407E+04	9.455E-01	4.694E+00	7.036E+03	4.727E-01
2100	1.596E+01	1.278E+04	8.589E-01	4.264E+00	6.392E+03	4.295E-01
2101	1.450E+01	1.161E+04	7.803E-01	3.874E+00	5.807E+03	3.902E-01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	1.318E+01	1.055E+04	7.089E-01	3.519E+00	5.275E+03	3.544E-01
2103	1.197E+01	9.585E+03	6.440E-01	3.197E+00	4.792E+03	3.220E-01
2104	1.087E+01	8.707E+03	5.851E-01	2.905E+00	4.354E+03	2.925E-01
2105	9.879E+00	7.910E+03	5.315E-01	2.639E+00	3.955E+03	2.657E-01
2106	8.974E+00	7.186E+03	4.828E-01	2.397E+00	3.593E+03	2.414E-01
2107	8.153E+00	6.529E+03	4.387E-01	2.178E+00	3.264E+03	2.193E-01
2108	7.407E+00	5.931E+03	3.985E-01	1.978E+00	2.965E+03	1.992E-01
2109	6.729E+00	5.388E+03	3.620E-01	1.797E+00	2.694E+03	1.810E-01
2110	6.113E+00	4.895E+03	3.289E-01	1.633E+00	2.447E+03	1.644E-01
2111	5.553E+00	4.447E+03	2.988E-01	1.483E+00	2.223E+03	1.494E-01
2112	5.045E+00	4.040E+03	2.714E-01	1.348E+00	2.020E+03	1.357E-01
2113	4.583E+00	3.670E+03	2.466E-01	1.224E+00	1.835E+03	1.233E-01
2114	4.164E+00	3.334E+03	2.240E-01	1.112E+00	1.667E+03	1.120E-01
2115	3.782E+00	3.029E+03	2.035E-01	1.010E+00	1.514E+03	1.018E-01
2116	3.436E+00	2.752E+03	1.849E-01	9.179E-01	1.376E+03	9.244E-02
2117	3.122E+00	2.500E+03	1.680E-01	8.338E-01	1.250E+03	8.398E-02
2118	2.836E+00	2.271E+03	1.526E-01	7.575E-01	1.135E+03	7.629E-02
2119	2.576E+00	2.063E+03	1.386E-01	6.882E-01	1.032E+03	6.931E-02
2120	2.341E+00	1.874E+03	1.259E-01	6.252E-01	9.371E+02	6.296E-02
2121	2.126E+00	1.703E+03	1.144E-01	5.680E-01	8.513E+02	5.720E-02
2122	1.932E+00	1.547E+03	1.039E-01	5.160E-01	7.734E+02	5.196E-02
2123	1.755E+00	1.405E+03	9.442E-02	4.687E-01	7.026E+02	4.721E-02
2124	1.594E+00	1.277E+03	8.577E-02	4.258E-01	6.383E+02	4.289E-02
2125	1.448E+00	1.160E+03	7.792E-02	3.869E-01	5.799E+02	3.896E-02
2126	1.316E+00	1.054E+03	7.079E-02	3.514E-01	5.268E+02	3.539E-02
2127	1.195E+00	9.571E+02	6.431E-02	3.193E-01	4.786E+02	3.215E-02
2128	1.086E+00	8.695E+02	5.842E-02	2.900E-01	4.348E+02	2.921E-02
2129	9.865E-01	7.899E+02	5.307E-02	2.635E-01	3.950E+02	2.654E-02
2130	8.962E-01	7.176E+02	4.822E-02	2.394E-01	3.588E+02	2.411E-02
2131	8.141E-01	6.519E+02	4.380E-02	2.175E-01	3.260E+02	2.190E-02
2132	7.396E-01	5.923E+02	3.979E-02	1.976E-01	2.961E+02	1.990E-02
2133	6.719E-01	5.380E+02	3.615E-02	1.795E-01	2.690E+02	1.808E-02
2134	6.104E-01	4.888E+02	3.284E-02	1.630E-01	2.444E+02	1.642E-02
2135	5.545E-01	4.440E+02	2.984E-02	1.481E-01	2.220E+02	1.492E-02
2136	5.038E-01	4.034E+02	2.710E-02	1.346E-01	2.017E+02	1.355E-02
2137	4.577E-01	3.665E+02	2.462E-02	1.222E-01	1.832E+02	1.231E-02
2138	4.158E-01	3.329E+02	2.237E-02	1.111E-01	1.665E+02	1.118E-02
2139	3.777E-01	3.025E+02	2.032E-02	1.009E-01	1.512E+02	1.016E-02
2140	3.431E-01	2.748E+02	1.846E-02	9.166E-02	1.374E+02	9.231E-03
2141	3.117E-01	2.496E+02	1.677E-02	8.327E-02	1.248E+02	8.386E-03

Results (Continued)

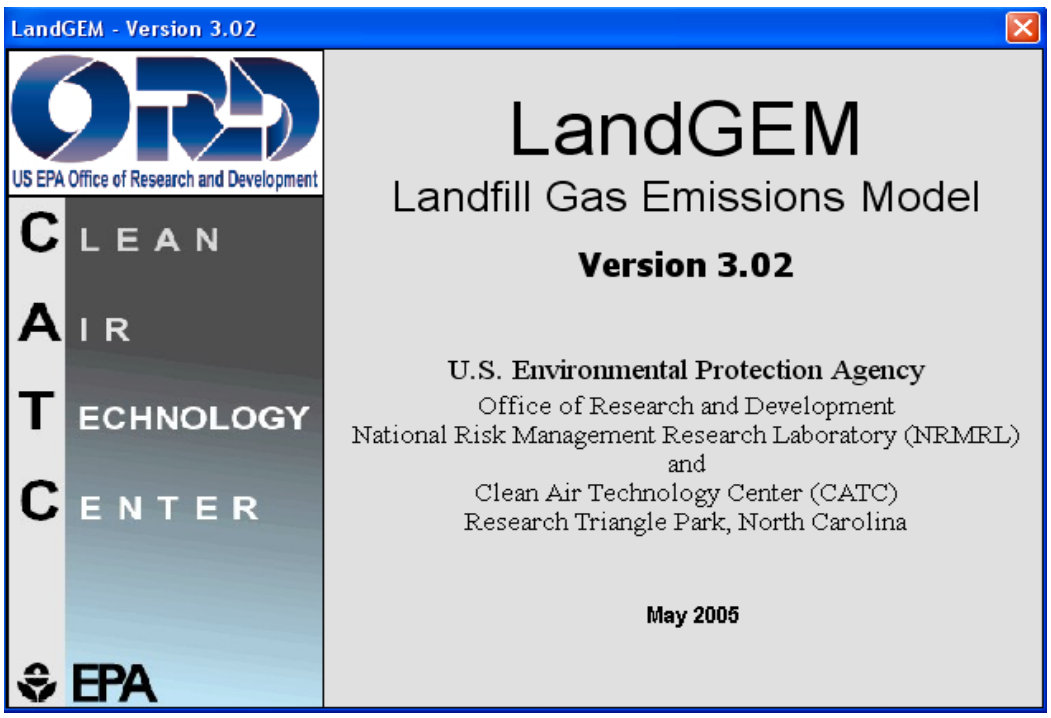
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	4.379E+02	2.392E+05	1.607E+01	6.860E+00	1.914E+03	1.286E-01
2003	1.064E+03	5.811E+05	3.904E+01	1.666E+01	4.649E+03	3.123E-01
2004	1.324E+03	7.231E+05	4.859E+01	2.074E+01	5.785E+03	3.887E-01
2005	1.548E+03	8.457E+05	5.682E+01	2.425E+01	6.766E+03	4.546E-01
2006	1.787E+03	9.761E+05	6.558E+01	2.799E+01	7.809E+03	5.247E-01
2007	2.136E+03	1.167E+06	7.839E+01	3.345E+01	9.333E+03	6.271E-01
2008	2.326E+03	1.271E+06	8.537E+01	3.643E+01	1.016E+04	6.829E-01
2009	2.523E+03	1.379E+06	9.262E+01	3.953E+01	1.103E+04	7.410E-01
2010	2.703E+03	1.477E+06	9.921E+01	4.234E+01	1.181E+04	7.937E-01
2011	2.866E+03	1.566E+06	1.052E+02	4.490E+01	1.253E+04	8.416E-01
2012	3.014E+03	1.647E+06	1.106E+02	4.722E+01	1.317E+04	8.851E-01
2013	3.419E+03	1.868E+06	1.255E+02	5.356E+01	1.494E+04	1.004E+00
2014	3.721E+03	2.033E+06	1.366E+02	5.830E+01	1.626E+04	1.093E+00
2015	3.937E+03	2.151E+06	1.445E+02	6.168E+01	1.721E+04	1.156E+00
2016	4.200E+03	2.295E+06	1.542E+02	6.580E+01	1.836E+04	1.233E+00
2017	4.409E+03	2.409E+06	1.618E+02	6.907E+01	1.927E+04	1.295E+00
2018	4.543E+03	2.482E+06	1.668E+02	7.117E+01	1.986E+04	1.334E+00
2019	4.709E+03	2.573E+06	1.729E+02	7.377E+01	2.058E+04	1.383E+00
2020	4.860E+03	2.655E+06	1.784E+02	7.613E+01	2.124E+04	1.427E+00
2021	4.997E+03	2.730E+06	1.834E+02	7.828E+01	2.184E+04	1.467E+00
2022	5.121E+03	2.798E+06	1.880E+02	8.022E+01	2.238E+04	1.504E+00
2023	5.234E+03	2.859E+06	1.921E+02	8.199E+01	2.287E+04	1.537E+00
2024	5.337E+03	2.915E+06	1.959E+02	8.360E+01	2.332E+04	1.567E+00
2025	5.430E+03	2.966E+06	1.993E+02	8.506E+01	2.373E+04	1.594E+00
2026	5.514E+03	3.013E+06	2.024E+02	8.639E+01	2.410E+04	1.619E+00
2027	5.591E+03	3.055E+06	2.052E+02	8.759E+01	2.444E+04	1.642E+00
2028	5.661E+03	3.093E+06	2.078E+02	8.869E+01	2.474E+04	1.662E+00
2029	5.725E+03	3.127E+06	2.101E+02	8.968E+01	2.502E+04	1.681E+00
2030	5.782E+03	3.159E+06	2.122E+02	9.058E+01	2.527E+04	1.698E+00
2031	5.835E+03	3.188E+06	2.142E+02	9.141E+01	2.550E+04	1.713E+00
2032	5.882E+03	3.214E+06	2.159E+02	9.215E+01	2.571E+04	1.727E+00
2033	5.926E+03	3.237E+06	2.175E+02	9.283E+01	2.590E+04	1.740E+00
2034	5.965E+03	3.259E+06	2.189E+02	9.344E+01	2.607E+04	1.752E+00
2035	6.001E+03	3.278E+06	2.203E+02	9.400E+01	2.623E+04	1.762E+00
2036	5.451E+03	2.978E+06	2.001E+02	8.540E+01	2.382E+04	1.601E+00
2037	4.952E+03	2.705E+06	1.818E+02	7.758E+01	2.164E+04	1.454E+00
2038	4.499E+03	2.458E+06	1.651E+02	7.048E+01	1.966E+04	1.321E+00
2039	4.087E+03	2.233E+06	1.500E+02	6.403E+01	1.786E+04	1.200E+00
2040	3.713E+03	2.028E+06	1.363E+02	5.817E+01	1.623E+04	1.090E+00
2041	3.373E+03	1.843E+06	1.238E+02	5.284E+01	1.474E+04	9.905E-01
2042	3.064E+03	1.674E+06	1.125E+02	4.801E+01	1.339E+04	8.999E-01
2043	2.784E+03	1.521E+06	1.022E+02	4.361E+01	1.217E+04	8.175E-01
2044	2.529E+03	1.382E+06	9.283E+01	3.962E+01	1.105E+04	7.427E-01
2045	2.298E+03	1.255E+06	8.434E+01	3.599E+01	1.004E+04	6.747E-01
2046	2.087E+03	1.140E+06	7.662E+01	3.270E+01	9.122E+03	6.129E-01
2047	1.896E+03	1.036E+06	6.960E+01	2.971E+01	8.287E+03	5.568E-01
2048	1.723E+03	9.411E+05	6.323E+01	2.699E+01	7.529E+03	5.059E-01
2049	1.565E+03	8.549E+05	5.744E+01	2.452E+01	6.840E+03	4.595E-01
2050	1.422E+03	7.767E+05	5.219E+01	2.227E+01	6.213E+03	4.175E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.292E+03	7.056E+05	4.741E+01	2.023E+01	5.645E+03	3.793E-01
2052	1.173E+03	6.410E+05	4.307E+01	1.838E+01	5.128E+03	3.446E-01
2053	1.066E+03	5.823E+05	3.913E+01	1.670E+01	4.659E+03	3.130E-01
2054	9.684E+02	5.290E+05	3.555E+01	1.517E+01	4.232E+03	2.844E-01
2055	8.797E+02	4.806E+05	3.229E+01	1.378E+01	3.845E+03	2.583E-01
2056	7.992E+02	4.366E+05	2.934E+01	1.252E+01	3.493E+03	2.347E-01
2057	7.261E+02	3.966E+05	2.665E+01	1.137E+01	3.173E+03	2.132E-01
2058	6.596E+02	3.603E+05	2.421E+01	1.033E+01	2.883E+03	1.937E-01
2059	5.992E+02	3.274E+05	2.199E+01	9.387E+00	2.619E+03	1.760E-01
2060	5.444E+02	2.974E+05	1.998E+01	8.528E+00	2.379E+03	1.599E-01
2061	4.945E+02	2.702E+05	1.815E+01	7.747E+00	2.161E+03	1.452E-01
2062	4.493E+02	2.454E+05	1.649E+01	7.038E+00	1.963E+03	1.319E-01
2063	4.081E+02	2.230E+05	1.498E+01	6.394E+00	1.784E+03	1.199E-01
2064	3.708E+02	2.026E+05	1.361E+01	5.809E+00	1.620E+03	1.089E-01
2065	3.368E+02	1.840E+05	1.236E+01	5.277E+00	1.472E+03	9.891E-02
2066	3.060E+02	1.672E+05	1.123E+01	4.794E+00	1.337E+03	8.986E-02
2067	2.780E+02	1.519E+05	1.020E+01	4.355E+00	1.215E+03	8.163E-02
2068	2.526E+02	1.380E+05	9.270E+00	3.956E+00	1.104E+03	7.416E-02
2069	2.294E+02	1.253E+05	8.422E+00	3.594E+00	1.003E+03	6.737E-02
2070	2.084E+02	1.139E+05	7.651E+00	3.265E+00	9.109E+02	6.121E-02
2071	1.894E+02	1.034E+05	6.950E+00	2.966E+00	8.276E+02	5.560E-02
2072	1.720E+02	9.398E+04	6.314E+00	2.695E+00	7.518E+02	5.051E-02
2073	1.563E+02	8.537E+04	5.736E+00	2.448E+00	6.830E+02	4.589E-02
2074	1.420E+02	7.756E+04	5.211E+00	2.224E+00	6.205E+02	4.169E-02
2075	1.290E+02	7.046E+04	4.734E+00	2.020E+00	5.637E+02	3.787E-02
2076	1.172E+02	6.401E+04	4.301E+00	1.836E+00	5.121E+02	3.441E-02
2077	1.064E+02	5.815E+04	3.907E+00	1.668E+00	4.652E+02	3.126E-02
2078	9.670E+01	5.283E+04	3.549E+00	1.515E+00	4.226E+02	2.840E-02
2079	8.785E+01	4.799E+04	3.225E+00	1.376E+00	3.839E+02	2.580E-02
2080	7.981E+01	4.360E+04	2.929E+00	1.250E+00	3.488E+02	2.344E-02
2081	7.250E+01	3.961E+04	2.661E+00	1.136E+00	3.169E+02	2.129E-02
2082	6.587E+01	3.598E+04	2.418E+00	1.032E+00	2.879E+02	1.934E-02
2083	5.984E+01	3.269E+04	2.196E+00	9.374E-01	2.615E+02	1.757E-02
2084	5.436E+01	2.970E+04	1.995E+00	8.516E-01	2.376E+02	1.596E-02
2085	4.938E+01	2.698E+04	1.813E+00	7.736E-01	2.158E+02	1.450E-02
2086	4.486E+01	2.451E+04	1.647E+00	7.028E-01	1.961E+02	1.317E-02
2087	4.076E+01	2.227E+04	1.496E+00	6.385E-01	1.781E+02	1.197E-02
2088	3.703E+01	2.023E+04	1.359E+00	5.800E-01	1.618E+02	1.087E-02
2089	3.364E+01	1.838E+04	1.235E+00	5.269E-01	1.470E+02	9.877E-03
2090	3.056E+01	1.669E+04	1.122E+00	4.787E-01	1.335E+02	8.973E-03
2091	2.776E+01	1.517E+04	1.019E+00	4.349E-01	1.213E+02	8.152E-03
2092	2.522E+01	1.378E+04	9.257E-01	3.951E-01	1.102E+02	7.406E-03
2093	2.291E+01	1.252E+04	8.410E-01	3.589E-01	1.001E+02	6.728E-03
2094	2.081E+01	1.137E+04	7.640E-01	3.261E-01	9.096E+01	6.112E-03
2095	1.891E+01	1.033E+04	6.941E-01	2.962E-01	8.264E+01	5.552E-03
2096	1.718E+01	9.384E+03	6.305E-01	2.691E-01	7.507E+01	5.044E-03
2097	1.561E+01	8.525E+03	5.728E-01	2.445E-01	6.820E+01	4.582E-03
2098	1.418E+01	7.745E+03	5.204E-01	2.221E-01	6.196E+01	4.163E-03
2099	1.288E+01	7.036E+03	4.727E-01	2.018E-01	5.629E+01	3.782E-03
2100	1.170E+01	6.392E+03	4.295E-01	1.833E-01	5.114E+01	3.436E-03
2101	1.063E+01	5.807E+03	3.902E-01	1.665E-01	4.645E+01	3.121E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	9.656E+00	5.275E+03	3.544E-01	1.513E-01	4.220E+01	2.836E-03
2103	8.772E+00	4.792E+03	3.220E-01	1.374E-01	3.834E+01	2.576E-03
2104	7.969E+00	4.354E+03	2.925E-01	1.248E-01	3.483E+01	2.340E-03
2105	7.240E+00	3.955E+03	2.657E-01	1.134E-01	3.164E+01	2.126E-03
2106	6.577E+00	3.593E+03	2.414E-01	1.030E-01	2.875E+01	1.931E-03
2107	5.975E+00	3.264E+03	2.193E-01	9.361E-02	2.611E+01	1.755E-03
2108	5.428E+00	2.965E+03	1.992E-01	8.504E-02	2.372E+01	1.594E-03
2109	4.931E+00	2.694E+03	1.810E-01	7.725E-02	2.155E+01	1.448E-03
2110	4.480E+00	2.447E+03	1.644E-01	7.018E-02	1.958E+01	1.316E-03
2111	4.070E+00	2.223E+03	1.494E-01	6.376E-02	1.779E+01	1.195E-03
2112	3.697E+00	2.020E+03	1.357E-01	5.792E-02	1.616E+01	1.086E-03
2113	3.359E+00	1.835E+03	1.233E-01	5.262E-02	1.468E+01	9.863E-04
2114	3.051E+00	1.667E+03	1.120E-01	4.780E-02	1.334E+01	8.961E-04
2115	2.772E+00	1.514E+03	1.018E-01	4.343E-02	1.212E+01	8.140E-04
2116	2.518E+00	1.376E+03	9.244E-02	3.945E-02	1.101E+01	7.395E-04
2117	2.288E+00	1.250E+03	8.398E-02	3.584E-02	9.999E+00	6.718E-04
2118	2.078E+00	1.135E+03	7.629E-02	3.256E-02	9.084E+00	6.103E-04
2119	1.888E+00	1.032E+03	6.931E-02	2.958E-02	8.252E+00	5.545E-04
2120	1.715E+00	9.371E+02	6.296E-02	2.687E-02	7.497E+00	5.037E-04
2121	1.558E+00	8.513E+02	5.720E-02	2.441E-02	6.811E+00	4.576E-04
2122	1.416E+00	7.734E+02	5.196E-02	2.218E-02	6.187E+00	4.157E-04
2123	1.286E+00	7.026E+02	4.721E-02	2.015E-02	5.621E+00	3.777E-04
2124	1.168E+00	6.383E+02	4.289E-02	1.830E-02	5.106E+00	3.431E-04
2125	1.061E+00	5.799E+02	3.896E-02	1.663E-02	4.639E+00	3.117E-04
2126	9.643E-01	5.268E+02	3.539E-02	1.511E-02	4.214E+00	2.832E-04
2127	8.760E-01	4.786E+02	3.215E-02	1.372E-02	3.829E+00	2.572E-04
2128	7.958E-01	4.348E+02	2.921E-02	1.247E-02	3.478E+00	2.337E-04
2129	7.230E-01	3.950E+02	2.654E-02	1.133E-02	3.160E+00	2.123E-04
2130	6.568E-01	3.588E+02	2.411E-02	1.029E-02	2.870E+00	1.929E-04
2131	5.967E-01	3.260E+02	2.190E-02	9.347E-03	2.608E+00	1.752E-04
2132	5.421E-01	2.961E+02	1.990E-02	8.492E-03	2.369E+00	1.592E-04
2133	4.924E-01	2.690E+02	1.808E-02	7.714E-03	2.152E+00	1.446E-04
2134	4.474E-01	2.444E+02	1.642E-02	7.008E-03	1.955E+00	1.314E-04
2135	4.064E-01	2.220E+02	1.492E-02	6.367E-03	1.776E+00	1.193E-04
2136	3.692E-01	2.017E+02	1.355E-02	5.784E-03	1.614E+00	1.084E-04
2137	3.354E-01	1.832E+02	1.231E-02	5.254E-03	1.466E+00	9.849E-05
2138	3.047E-01	1.665E+02	1.118E-02	4.774E-03	1.332E+00	8.948E-05
2139	2.768E-01	1.512E+02	1.016E-02	4.337E-03	1.210E+00	8.129E-05
2140	2.515E-01	1.374E+02	9.231E-03	3.940E-03	1.099E+00	7.385E-05
2141	2.285E-01	1.248E+02	8.386E-03	3.579E-03	9.985E-01	6.709E-05



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.060**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**110**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

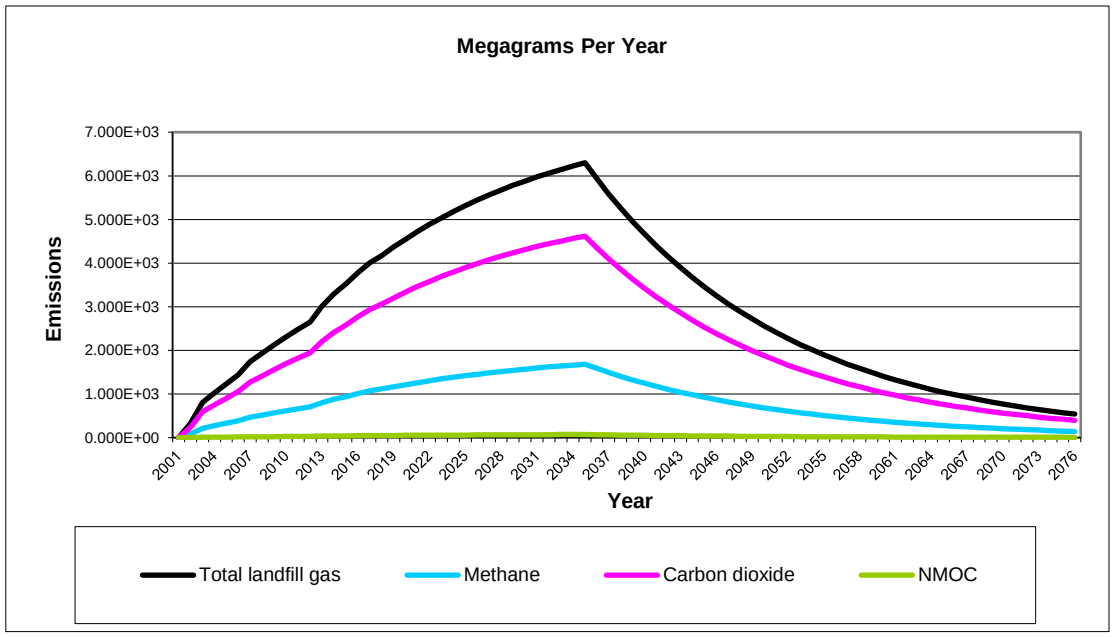
Pollutant Parameters

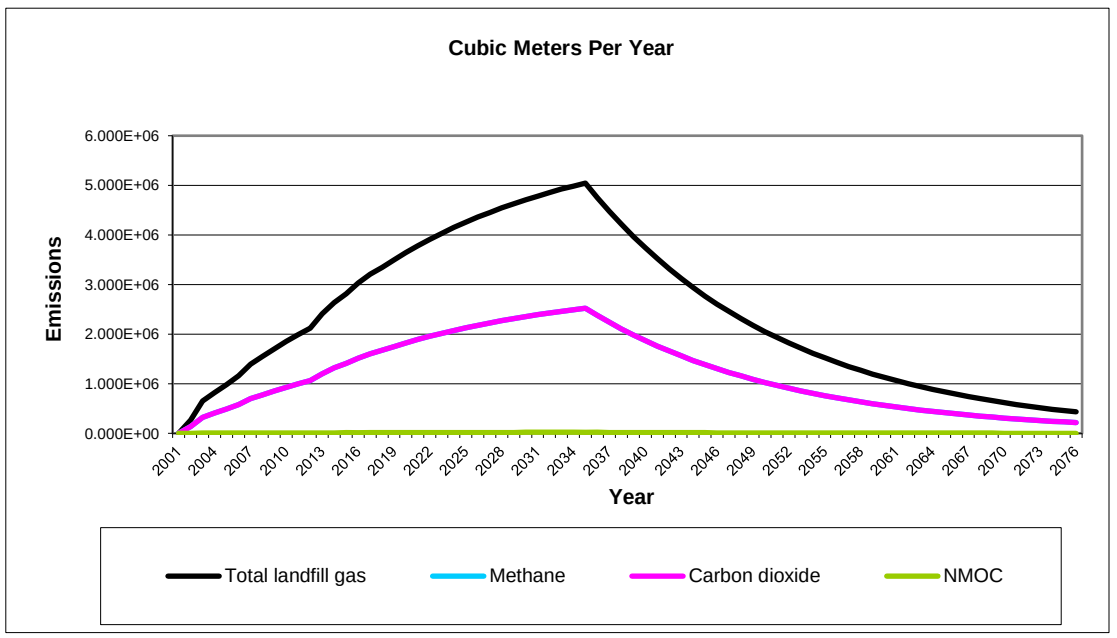
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

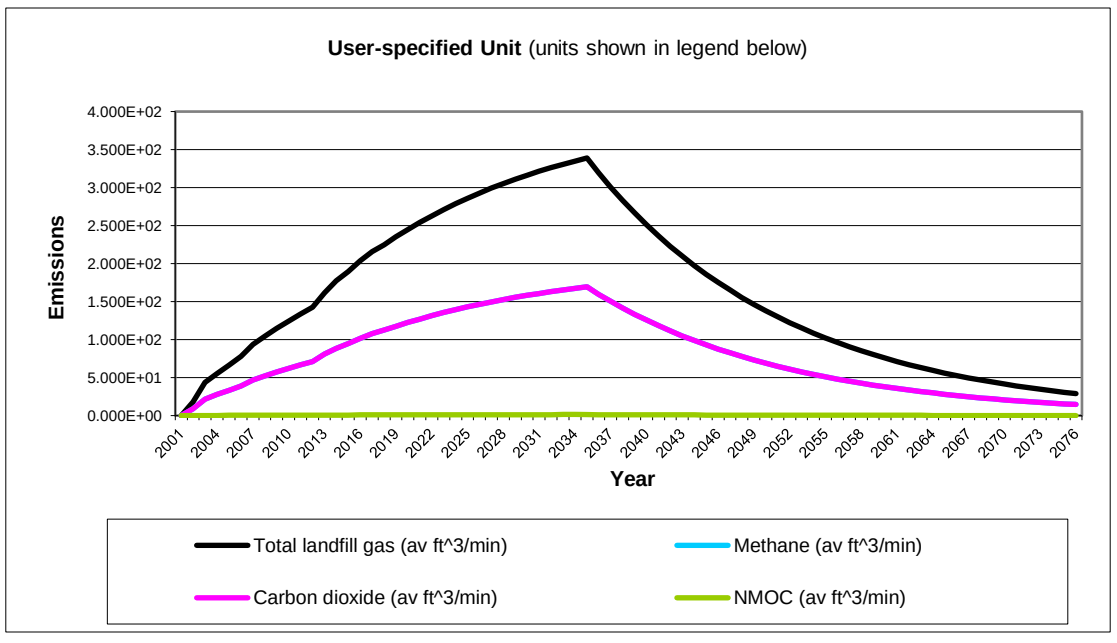
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
4.000E+02
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	3.286E+02	2.632E+05	1.768E+01	8.778E+01	1.316E+05	8.841E+00
2003	8.092E+02	6.480E+05	4.354E+01	2.162E+02	3.240E+05	2.177E+01
2004	1.030E+03	8.250E+05	5.543E+01	2.752E+02	4.125E+05	2.772E+01
2005	1.230E+03	9.847E+05	6.616E+01	3.285E+02	4.923E+05	3.308E+01
2006	1.444E+03	1.156E+06	7.767E+01	3.856E+02	5.780E+05	3.883E+01
2007	1.744E+03	1.397E+06	9.383E+01	4.659E+02	6.983E+05	4.692E+01
2008	1.932E+03	1.547E+06	1.039E+02	5.160E+02	7.735E+05	5.197E+01
2009	2.128E+03	1.704E+06	1.145E+02	5.683E+02	8.518E+05	5.723E+01
2010	2.312E+03	1.851E+06	1.244E+02	6.175E+02	9.256E+05	6.219E+01
2011	2.485E+03	1.990E+06	1.337E+02	6.638E+02	9.950E+05	6.686E+01
2012	2.649E+03	2.121E+06	1.425E+02	7.075E+02	1.060E+06	7.125E+01
2013	3.005E+03	2.406E+06	1.617E+02	8.027E+02	1.203E+06	8.084E+01
2014	3.292E+03	2.636E+06	1.771E+02	8.794E+02	1.318E+06	8.856E+01
2015	3.518E+03	2.817E+06	1.893E+02	9.397E+02	1.409E+06	9.464E+01
2016	3.781E+03	3.028E+06	2.034E+02	1.010E+03	1.514E+06	1.017E+02
2017	4.006E+03	3.208E+06	2.155E+02	1.070E+03	1.604E+06	1.078E+02
2018	4.177E+03	3.344E+06	2.247E+02	1.116E+03	1.672E+06	1.124E+02
2019	4.370E+03	3.499E+06	2.351E+02	1.167E+03	1.750E+06	1.176E+02
2020	4.552E+03	3.645E+06	2.449E+02	1.216E+03	1.823E+06	1.225E+02
2021	4.723E+03	3.782E+06	2.541E+02	1.262E+03	1.891E+06	1.271E+02
2022	4.885E+03	3.912E+06	2.628E+02	1.305E+03	1.956E+06	1.314E+02
2023	5.037E+03	4.033E+06	2.710E+02	1.345E+03	2.017E+06	1.355E+02
2024	5.180E+03	4.148E+06	2.787E+02	1.384E+03	2.074E+06	1.394E+02
2025	5.315E+03	4.256E+06	2.860E+02	1.420E+03	2.128E+06	1.430E+02
2026	5.442E+03	4.358E+06	2.928E+02	1.454E+03	2.179E+06	1.464E+02
2027	5.562E+03	4.454E+06	2.992E+02	1.486E+03	2.227E+06	1.496E+02
2028	5.675E+03	4.544E+06	3.053E+02	1.516E+03	2.272E+06	1.527E+02
2029	5.781E+03	4.629E+06	3.110E+02	1.544E+03	2.314E+06	1.555E+02
2030	5.881E+03	4.709E+06	3.164E+02	1.571E+03	2.354E+06	1.582E+02
2031	5.975E+03	4.784E+06	3.215E+02	1.596E+03	2.392E+06	1.607E+02
2032	6.063E+03	4.855E+06	3.262E+02	1.620E+03	2.428E+06	1.631E+02
2033	6.147E+03	4.922E+06	3.307E+02	1.642E+03	2.461E+06	1.654E+02
2034	6.225E+03	4.985E+06	3.349E+02	1.663E+03	2.493E+06	1.675E+02
2035	6.300E+03	5.044E+06	3.389E+02	1.683E+03	2.522E+06	1.695E+02
2036	5.933E+03	4.751E+06	3.192E+02	1.585E+03	2.375E+06	1.596E+02
2037	5.587E+03	4.474E+06	3.006E+02	1.492E+03	2.237E+06	1.503E+02
2038	5.262E+03	4.213E+06	2.831E+02	1.405E+03	2.107E+06	1.415E+02
2039	4.955E+03	3.968E+06	2.666E+02	1.324E+03	1.984E+06	1.333E+02
2040	4.667E+03	3.737E+06	2.511E+02	1.247E+03	1.868E+06	1.255E+02
2041	4.395E+03	3.519E+06	2.365E+02	1.174E+03	1.760E+06	1.182E+02
2042	4.139E+03	3.314E+06	2.227E+02	1.106E+03	1.657E+06	1.113E+02
2043	3.898E+03	3.121E+06	2.097E+02	1.041E+03	1.561E+06	1.049E+02
2044	3.671E+03	2.940E+06	1.975E+02	9.806E+02	1.470E+06	9.876E+01
2045	3.457E+03	2.768E+06	1.860E+02	9.235E+02	1.384E+06	9.300E+01
2046	3.256E+03	2.607E+06	1.752E+02	8.697E+02	1.304E+06	8.759E+01
2047	3.066E+03	2.455E+06	1.650E+02	8.190E+02	1.228E+06	8.249E+01
2048	2.888E+03	2.312E+06	1.554E+02	7.713E+02	1.156E+06	7.768E+01
2049	2.720E+03	2.178E+06	1.463E+02	7.264E+02	1.089E+06	7.316E+01
2050	2.561E+03	2.051E+06	1.378E+02	6.841E+02	1.025E+06	6.890E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.412E+03	1.931E+06	1.298E+02	6.443E+02	9.657E+05	6.489E+01
2052	2.272E+03	1.819E+06	1.222E+02	6.068E+02	9.095E+05	6.111E+01
2053	2.139E+03	1.713E+06	1.151E+02	5.714E+02	8.565E+05	5.755E+01
2054	2.015E+03	1.613E+06	1.084E+02	5.381E+02	8.066E+05	5.420E+01
2055	1.897E+03	1.519E+06	1.021E+02	5.068E+02	7.597E+05	5.104E+01
2056	1.787E+03	1.431E+06	9.614E+01	4.773E+02	7.154E+05	4.807E+01
2057	1.683E+03	1.348E+06	9.054E+01	4.495E+02	6.738E+05	4.527E+01
2058	1.585E+03	1.269E+06	8.527E+01	4.233E+02	6.345E+05	4.263E+01
2059	1.493E+03	1.195E+06	8.030E+01	3.987E+02	5.976E+05	4.015E+01
2060	1.406E+03	1.126E+06	7.563E+01	3.755E+02	5.628E+05	3.781E+01
2061	1.324E+03	1.060E+06	7.122E+01	3.536E+02	5.300E+05	3.561E+01
2062	1.247E+03	9.983E+05	6.707E+01	3.330E+02	4.991E+05	3.354E+01
2063	1.174E+03	9.401E+05	6.317E+01	3.136E+02	4.701E+05	3.158E+01
2064	1.106E+03	8.854E+05	5.949E+01	2.953E+02	4.427E+05	2.974E+01
2065	1.041E+03	8.338E+05	5.602E+01	2.781E+02	4.169E+05	2.801E+01
2066	9.807E+02	7.853E+05	5.276E+01	2.619E+02	3.926E+05	2.638E+01
2067	9.236E+02	7.395E+05	4.969E+01	2.467E+02	3.698E+05	2.484E+01
2068	8.698E+02	6.965E+05	4.680E+01	2.323E+02	3.482E+05	2.340E+01
2069	8.191E+02	6.559E+05	4.407E+01	2.188E+02	3.280E+05	2.204E+01
2070	7.714E+02	6.177E+05	4.150E+01	2.061E+02	3.089E+05	2.075E+01
2071	7.265E+02	5.817E+05	3.909E+01	1.941E+02	2.909E+05	1.954E+01
2072	6.842E+02	5.479E+05	3.681E+01	1.828E+02	2.739E+05	1.841E+01
2073	6.443E+02	5.160E+05	3.467E+01	1.721E+02	2.580E+05	1.733E+01
2074	6.068E+02	4.859E+05	3.265E+01	1.621E+02	2.430E+05	1.632E+01
2075	5.715E+02	4.576E+05	3.075E+01	1.526E+02	2.288E+05	1.537E+01
2076	5.382E+02	4.310E+05	2.896E+01	1.438E+02	2.155E+05	1.448E+01
2077	5.069E+02	4.059E+05	2.727E+01	1.354E+02	2.029E+05	1.364E+01
2078	4.773E+02	3.822E+05	2.568E+01	1.275E+02	1.911E+05	1.284E+01
2079	4.495E+02	3.600E+05	2.419E+01	1.201E+02	1.800E+05	1.209E+01
2080	4.234E+02	3.390E+05	2.278E+01	1.131E+02	1.695E+05	1.139E+01
2081	3.987E+02	3.193E+05	2.145E+01	1.065E+02	1.596E+05	1.073E+01
2082	3.755E+02	3.007E+05	2.020E+01	1.003E+02	1.503E+05	1.010E+01
2083	3.536E+02	2.832E+05	1.903E+01	9.446E+01	1.416E+05	9.513E+00
2084	3.330E+02	2.667E+05	1.792E+01	8.896E+01	1.333E+05	8.959E+00
2085	3.136E+02	2.511E+05	1.687E+01	8.378E+01	1.256E+05	8.437E+00
2086	2.954E+02	2.365E+05	1.589E+01	7.890E+01	1.183E+05	7.946E+00
2087	2.782E+02	2.227E+05	1.497E+01	7.430E+01	1.114E+05	7.483E+00
2088	2.620E+02	2.098E+05	1.409E+01	6.997E+01	1.049E+05	7.047E+00
2089	2.467E+02	1.976E+05	1.327E+01	6.590E+01	9.878E+04	6.637E+00
2090	2.323E+02	1.861E+05	1.250E+01	6.206E+01	9.303E+04	6.250E+00
2091	2.188E+02	1.752E+05	1.177E+01	5.845E+01	8.761E+04	5.886E+00
2092	2.061E+02	1.650E+05	1.109E+01	5.504E+01	8.251E+04	5.544E+00
2093	1.941E+02	1.554E+05	1.044E+01	5.184E+01	7.770E+04	5.221E+00
2094	1.828E+02	1.464E+05	9.833E+00	4.882E+01	7.318E+04	4.917E+00
2095	1.721E+02	1.378E+05	9.261E+00	4.598E+01	6.892E+04	4.630E+00
2096	1.621E+02	1.298E+05	8.722E+00	4.330E+01	6.490E+04	4.361E+00
2097	1.527E+02	1.222E+05	8.214E+00	4.078E+01	6.112E+04	4.107E+00
2098	1.438E+02	1.151E+05	7.735E+00	3.840E+01	5.756E+04	3.868E+00
2099	1.354E+02	1.084E+05	7.285E+00	3.617E+01	5.421E+04	3.642E+00
2100	1.275E+02	1.021E+05	6.861E+00	3.406E+01	5.105E+04	3.430E+00
2101	1.201E+02	9.616E+04	6.461E+00	3.208E+01	4.808E+04	3.231E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2102	1.131E+02	9.056E+04	6.085E+00	3.021E+01	4.528E+04	3.042E+00
2103	1.065E+02	8.529E+04	5.730E+00	2.845E+01	4.264E+04	2.865E+00
2104	1.003E+02	8.032E+04	5.397E+00	2.679E+01	4.016E+04	2.698E+00
2105	9.446E+01	7.564E+04	5.082E+00	2.523E+01	3.782E+04	2.541E+00
2106	8.896E+01	7.124E+04	4.786E+00	2.376E+01	3.562E+04	2.393E+00
2107	8.378E+01	6.709E+04	4.508E+00	2.238E+01	3.354E+04	2.254E+00
2108	7.890E+01	6.318E+04	4.245E+00	2.108E+01	3.159E+04	2.123E+00
2109	7.431E+01	5.950E+04	3.998E+00	1.985E+01	2.975E+04	1.999E+00
2110	6.998E+01	5.604E+04	3.765E+00	1.869E+01	2.802E+04	1.883E+00
2111	6.591E+01	5.277E+04	3.546E+00	1.760E+01	2.639E+04	1.773E+00
2112	6.207E+01	4.970E+04	3.339E+00	1.658E+01	2.485E+04	1.670E+00
2113	5.845E+01	4.681E+04	3.145E+00	1.561E+01	2.340E+04	1.572E+00
2114	5.505E+01	4.408E+04	2.962E+00	1.470E+01	2.204E+04	1.481E+00
2115	5.184E+01	4.151E+04	2.789E+00	1.385E+01	2.076E+04	1.395E+00
2116	4.882E+01	3.910E+04	2.627E+00	1.304E+01	1.955E+04	1.313E+00
2117	4.598E+01	3.682E+04	2.474E+00	1.228E+01	1.841E+04	1.237E+00
2118	4.330E+01	3.468E+04	2.330E+00	1.157E+01	1.734E+04	1.165E+00
2119	4.078E+01	3.266E+04	2.194E+00	1.089E+01	1.633E+04	1.097E+00
2120	3.841E+01	3.075E+04	2.066E+00	1.026E+01	1.538E+04	1.033E+00
2121	3.617E+01	2.896E+04	1.946E+00	9.661E+00	1.448E+04	9.730E-01
2122	3.406E+01	2.728E+04	1.833E+00	9.099E+00	1.364E+04	9.164E-01
2123	3.208E+01	2.569E+04	1.726E+00	8.569E+00	1.284E+04	8.630E-01
2124	3.021E+01	2.419E+04	1.625E+00	8.070E+00	1.210E+04	8.127E-01
2125	2.845E+01	2.278E+04	1.531E+00	7.600E+00	1.139E+04	7.654E-01
2126	2.680E+01	2.146E+04	1.442E+00	7.157E+00	1.073E+04	7.208E-01
2127	2.523E+01	2.021E+04	1.358E+00	6.741E+00	1.010E+04	6.789E-01
2128	2.377E+01	1.903E+04	1.279E+00	6.348E+00	9.515E+03	6.393E-01
2129	2.238E+01	1.792E+04	1.204E+00	5.978E+00	8.961E+03	6.021E-01
2130	2.108E+01	1.688E+04	1.134E+00	5.630E+00	8.439E+03	5.670E-01
2131	1.985E+01	1.590E+04	1.068E+00	5.302E+00	7.948E+03	5.340E-01
2132	1.869E+01	1.497E+04	1.006E+00	4.993E+00	7.485E+03	5.029E-01
2133	1.761E+01	1.410E+04	9.472E-01	4.703E+00	7.049E+03	4.736E-01
2134	1.658E+01	1.328E+04	8.921E-01	4.429E+00	6.638E+03	4.460E-01
2135	1.561E+01	1.250E+04	8.401E-01	4.171E+00	6.252E+03	4.201E-01
2136	1.471E+01	1.178E+04	7.912E-01	3.928E+00	5.888E+03	3.956E-01
2137	1.385E+01	1.109E+04	7.451E-01	3.699E+00	5.545E+03	3.726E-01
2138	1.304E+01	1.044E+04	7.017E-01	3.484E+00	5.222E+03	3.509E-01
2139	1.228E+01	9.836E+03	6.609E-01	3.281E+00	4.918E+03	3.304E-01
2140	1.157E+01	9.263E+03	6.224E-01	3.090E+00	4.631E+03	3.112E-01
2141	1.089E+01	8.724E+03	5.861E-01	2.910E+00	4.362E+03	2.931E-01

Results (Continued)

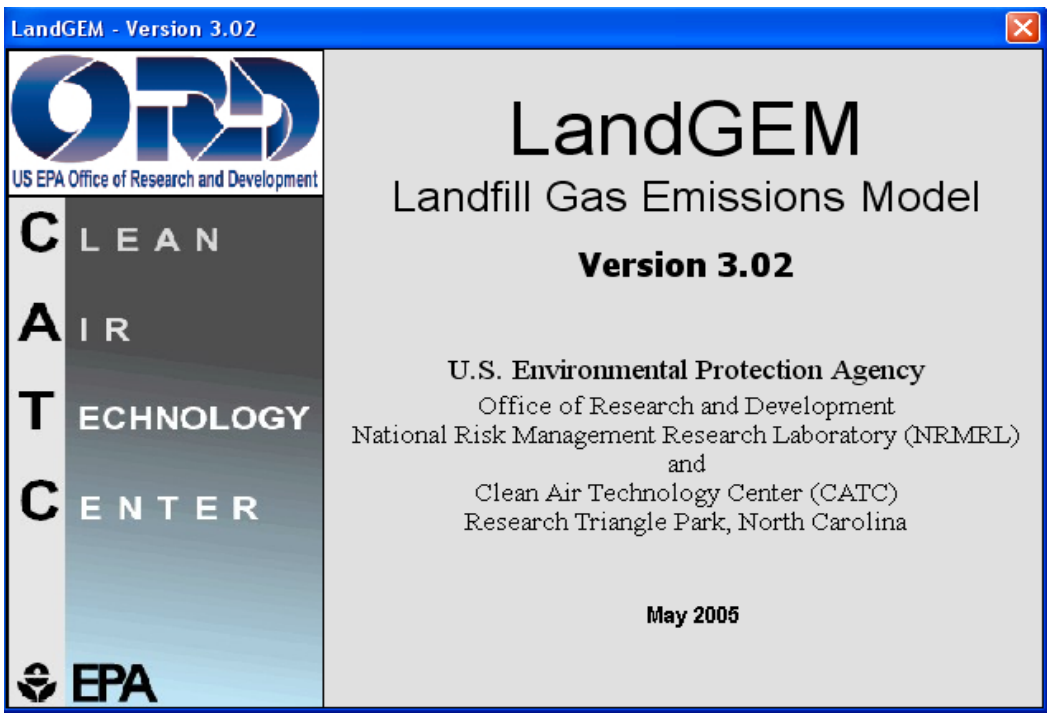
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	2.409E+02	1.316E+05	8.841E+00	3.773E+00	1.053E+03	7.073E-02
2003	5.931E+02	3.240E+05	2.177E+01	9.291E+00	2.592E+03	1.742E-01
2004	7.551E+02	4.125E+05	2.772E+01	1.183E+01	3.300E+03	2.217E-01
2005	9.012E+02	4.923E+05	3.308E+01	1.412E+01	3.939E+03	2.646E-01
2006	1.058E+03	5.780E+05	3.883E+01	1.657E+01	4.624E+03	3.107E-01
2007	1.278E+03	6.983E+05	4.692E+01	2.002E+01	5.586E+03	3.753E-01
2008	1.416E+03	7.735E+05	5.197E+01	2.218E+01	6.188E+03	4.158E-01
2009	1.559E+03	8.518E+05	5.723E+01	2.443E+01	6.814E+03	4.579E-01
2010	1.694E+03	9.256E+05	6.219E+01	2.654E+01	7.405E+03	4.975E-01
2011	1.821E+03	9.950E+05	6.686E+01	2.853E+01	7.960E+03	5.348E-01
2012	1.941E+03	1.060E+06	7.125E+01	3.041E+01	8.484E+03	5.700E-01
2013	2.202E+03	1.203E+06	8.084E+01	3.450E+01	9.625E+03	6.467E-01
2014	2.413E+03	1.318E+06	8.856E+01	3.780E+01	1.054E+04	7.085E-01
2015	2.578E+03	1.409E+06	9.464E+01	4.039E+01	1.127E+04	7.571E-01
2016	2.771E+03	1.514E+06	1.017E+02	4.341E+01	1.211E+04	8.137E-01
2017	2.936E+03	1.604E+06	1.078E+02	4.599E+01	1.283E+04	8.621E-01
2018	3.061E+03	1.672E+06	1.124E+02	4.795E+01	1.338E+04	8.988E-01
2019	3.203E+03	1.750E+06	1.176E+02	5.017E+01	1.400E+04	9.404E-01
2020	3.336E+03	1.823E+06	1.225E+02	5.226E+01	1.458E+04	9.796E-01
2021	3.462E+03	1.891E+06	1.271E+02	5.423E+01	1.513E+04	1.017E+00
2022	3.580E+03	1.956E+06	1.314E+02	5.609E+01	1.565E+04	1.051E+00
2023	3.692E+03	2.017E+06	1.355E+02	5.783E+01	1.613E+04	1.084E+00
2024	3.797E+03	2.074E+06	1.394E+02	5.948E+01	1.659E+04	1.115E+00
2025	3.895E+03	2.128E+06	1.430E+02	6.102E+01	1.702E+04	1.144E+00
2026	3.989E+03	2.179E+06	1.464E+02	6.248E+01	1.743E+04	1.171E+00
2027	4.076E+03	2.227E+06	1.496E+02	6.386E+01	1.781E+04	1.197E+00
2028	4.159E+03	2.272E+06	1.527E+02	6.515E+01	1.818E+04	1.221E+00
2029	4.237E+03	2.314E+06	1.555E+02	6.637E+01	1.852E+04	1.244E+00
2030	4.310E+03	2.354E+06	1.582E+02	6.752E+01	1.884E+04	1.266E+00
2031	4.379E+03	2.392E+06	1.607E+02	6.860E+01	1.914E+04	1.286E+00
2032	4.444E+03	2.428E+06	1.631E+02	6.961E+01	1.942E+04	1.305E+00
2033	4.505E+03	2.461E+06	1.654E+02	7.057E+01	1.969E+04	1.323E+00
2034	4.563E+03	2.493E+06	1.675E+02	7.148E+01	1.994E+04	1.340E+00
2035	4.617E+03	2.522E+06	1.695E+02	7.233E+01	2.018E+04	1.356E+00
2036	4.348E+03	2.375E+06	1.596E+02	6.811E+01	1.900E+04	1.277E+00
2037	4.095E+03	2.237E+06	1.503E+02	6.415E+01	1.790E+04	1.202E+00
2038	3.856E+03	2.107E+06	1.415E+02	6.041E+01	1.685E+04	1.132E+00
2039	3.632E+03	1.984E+06	1.333E+02	5.689E+01	1.587E+04	1.066E+00
2040	3.420E+03	1.868E+06	1.255E+02	5.358E+01	1.495E+04	1.004E+00
2041	3.221E+03	1.760E+06	1.182E+02	5.046E+01	1.408E+04	9.459E-01
2042	3.033E+03	1.657E+06	1.113E+02	4.752E+01	1.326E+04	8.908E-01
2043	2.857E+03	1.561E+06	1.049E+02	4.475E+01	1.249E+04	8.389E-01
2044	2.690E+03	1.470E+06	9.876E+01	4.215E+01	1.176E+04	7.900E-01
2045	2.534E+03	1.384E+06	9.300E+01	3.969E+01	1.107E+04	7.440E-01
2046	2.386E+03	1.304E+06	8.759E+01	3.738E+01	1.043E+04	7.007E-01
2047	2.247E+03	1.228E+06	8.249E+01	3.520E+01	9.821E+03	6.599E-01
2048	2.116E+03	1.156E+06	7.768E+01	3.315E+01	9.249E+03	6.215E-01
2049	1.993E+03	1.089E+06	7.316E+01	3.122E+01	8.711E+03	5.853E-01
2050	1.877E+03	1.025E+06	6.890E+01	2.941E+01	8.204E+03	5.512E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.768E+03	9.657E+05	6.489E+01	2.769E+01	7.726E+03	5.191E-01
2052	1.665E+03	9.095E+05	6.111E+01	2.608E+01	7.276E+03	4.889E-01
2053	1.568E+03	8.565E+05	5.755E+01	2.456E+01	6.852E+03	4.604E-01
2054	1.477E+03	8.066E+05	5.420E+01	2.313E+01	6.453E+03	4.336E-01
2055	1.391E+03	7.597E+05	5.104E+01	2.178E+01	6.077E+03	4.083E-01
2056	1.310E+03	7.154E+05	4.807E+01	2.052E+01	5.723E+03	3.846E-01
2057	1.233E+03	6.738E+05	4.527E+01	1.932E+01	5.390E+03	3.622E-01
2058	1.162E+03	6.345E+05	4.263E+01	1.820E+01	5.076E+03	3.411E-01
2059	1.094E+03	5.976E+05	4.015E+01	1.714E+01	4.781E+03	3.212E-01
2060	1.030E+03	5.628E+05	3.781E+01	1.614E+01	4.502E+03	3.025E-01
2061	9.702E+02	5.300E+05	3.561E+01	1.520E+01	4.240E+03	2.849E-01
2062	9.137E+02	4.991E+05	3.354E+01	1.431E+01	3.993E+03	2.683E-01
2063	8.605E+02	4.701E+05	3.158E+01	1.348E+01	3.761E+03	2.527E-01
2064	8.104E+02	4.427E+05	2.974E+01	1.269E+01	3.542E+03	2.380E-01
2065	7.632E+02	4.169E+05	2.801E+01	1.196E+01	3.335E+03	2.241E-01
2066	7.187E+02	3.926E+05	2.638E+01	1.126E+01	3.141E+03	2.110E-01
2067	6.769E+02	3.698E+05	2.484E+01	1.060E+01	2.958E+03	1.988E-01
2068	6.374E+02	3.482E+05	2.340E+01	9.986E+00	2.786E+03	1.872E-01
2069	6.003E+02	3.280E+05	2.204E+01	9.404E+00	2.624E+03	1.763E-01
2070	5.654E+02	3.089E+05	2.075E+01	8.857E+00	2.471E+03	1.660E-01
2071	5.324E+02	2.909E+05	1.954E+01	8.341E+00	2.327E+03	1.563E-01
2072	5.014E+02	2.739E+05	1.841E+01	7.855E+00	2.191E+03	1.472E-01
2073	4.722E+02	2.580E+05	1.733E+01	7.398E+00	2.064E+03	1.387E-01
2074	4.447E+02	2.430E+05	1.632E+01	6.967E+00	1.944E+03	1.306E-01
2075	4.188E+02	2.288E+05	1.537E+01	6.561E+00	1.830E+03	1.230E-01
2076	3.944E+02	2.155E+05	1.448E+01	6.179E+00	1.724E+03	1.158E-01
2077	3.715E+02	2.029E+05	1.364E+01	5.819E+00	1.623E+03	1.091E-01
2078	3.498E+02	1.911E+05	1.284E+01	5.480E+00	1.529E+03	1.027E-01
2079	3.295E+02	1.800E+05	1.209E+01	5.161E+00	1.440E+03	9.675E-02
2080	3.103E+02	1.695E+05	1.139E+01	4.861E+00	1.356E+03	9.111E-02
2081	2.922E+02	1.596E+05	1.073E+01	4.578E+00	1.277E+03	8.581E-02
2082	2.752E+02	1.503E+05	1.010E+01	4.311E+00	1.203E+03	8.081E-02
2083	2.592E+02	1.416E+05	9.513E+00	4.060E+00	1.133E+03	7.610E-02
2084	2.441E+02	1.333E+05	8.959E+00	3.824E+00	1.067E+03	7.167E-02
2085	2.299E+02	1.256E+05	8.437E+00	3.601E+00	1.005E+03	6.750E-02
2086	2.165E+02	1.183E+05	7.946E+00	3.391E+00	9.461E+02	6.357E-02
2087	2.039E+02	1.114E+05	7.483E+00	3.194E+00	8.910E+02	5.986E-02
2088	1.920E+02	1.049E+05	7.047E+00	3.008E+00	8.391E+02	5.638E-02
2089	1.808E+02	9.878E+04	6.637E+00	2.833E+00	7.902E+02	5.310E-02
2090	1.703E+02	9.303E+04	6.250E+00	2.668E+00	7.442E+02	5.000E-02
2091	1.604E+02	8.761E+04	5.886E+00	2.512E+00	7.009E+02	4.709E-02
2092	1.510E+02	8.251E+04	5.544E+00	2.366E+00	6.601E+02	4.435E-02
2093	1.422E+02	7.770E+04	5.221E+00	2.228E+00	6.216E+02	4.177E-02
2094	1.340E+02	7.318E+04	4.917E+00	2.098E+00	5.854E+02	3.933E-02
2095	1.261E+02	6.892E+04	4.630E+00	1.976E+00	5.513E+02	3.704E-02
2096	1.188E+02	6.490E+04	4.361E+00	1.861E+00	5.192E+02	3.489E-02
2097	1.119E+02	6.112E+04	4.107E+00	1.753E+00	4.890E+02	3.285E-02
2098	1.054E+02	5.756E+04	3.868E+00	1.651E+00	4.605E+02	3.094E-02
2099	9.923E+01	5.421E+04	3.642E+00	1.555E+00	4.337E+02	2.914E-02
2100	9.345E+01	5.105E+04	3.430E+00	1.464E+00	4.084E+02	2.744E-02
2101	8.801E+01	4.808E+04	3.231E+00	1.379E+00	3.846E+02	2.584E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	8.289E+01	4.528E+04	3.042E+00	1.298E+00	3.622E+02	2.434E-02
2103	7.806E+01	4.264E+04	2.865E+00	1.223E+00	3.411E+02	2.292E-02
2104	7.351E+01	4.016E+04	2.698E+00	1.152E+00	3.213E+02	2.159E-02
2105	6.923E+01	3.782E+04	2.541E+00	1.085E+00	3.026E+02	2.033E-02
2106	6.520E+01	3.562E+04	2.393E+00	1.021E+00	2.850E+02	1.915E-02
2107	6.140E+01	3.354E+04	2.254E+00	9.619E-01	2.684E+02	1.803E-02
2108	5.783E+01	3.159E+04	2.123E+00	9.059E-01	2.527E+02	1.698E-02
2109	5.446E+01	2.975E+04	1.999E+00	8.531E-01	2.380E+02	1.599E-02
2110	5.129E+01	2.802E+04	1.883E+00	8.035E-01	2.242E+02	1.506E-02
2111	4.830E+01	2.639E+04	1.773E+00	7.567E-01	2.111E+02	1.418E-02
2112	4.549E+01	2.485E+04	1.670E+00	7.126E-01	1.988E+02	1.336E-02
2113	4.284E+01	2.340E+04	1.572E+00	6.711E-01	1.872E+02	1.258E-02
2114	4.035E+01	2.204E+04	1.481E+00	6.320E-01	1.763E+02	1.185E-02
2115	3.800E+01	2.076E+04	1.395E+00	5.952E-01	1.661E+02	1.116E-02
2116	3.578E+01	1.955E+04	1.313E+00	5.606E-01	1.564E+02	1.051E-02
2117	3.370E+01	1.841E+04	1.237E+00	5.279E-01	1.473E+02	9.896E-03
2118	3.174E+01	1.734E+04	1.165E+00	4.972E-01	1.387E+02	9.319E-03
2119	2.989E+01	1.633E+04	1.097E+00	4.682E-01	1.306E+02	8.777E-03
2120	2.815E+01	1.538E+04	1.033E+00	4.409E-01	1.230E+02	8.265E-03
2121	2.651E+01	1.448E+04	9.730E-01	4.153E-01	1.159E+02	7.784E-03
2122	2.496E+01	1.364E+04	9.164E-01	3.911E-01	1.091E+02	7.331E-03
2123	2.351E+01	1.284E+04	8.630E-01	3.683E-01	1.028E+02	6.904E-03
2124	2.214E+01	1.210E+04	8.127E-01	3.469E-01	9.677E+01	6.502E-03
2125	2.085E+01	1.139E+04	7.654E-01	3.267E-01	9.113E+01	6.123E-03
2126	1.964E+01	1.073E+04	7.208E-01	3.076E-01	8.583E+01	5.767E-03
2127	1.849E+01	1.010E+04	6.789E-01	2.897E-01	8.083E+01	5.431E-03
2128	1.742E+01	9.515E+03	6.393E-01	2.729E-01	7.612E+01	5.115E-03
2129	1.640E+01	8.961E+03	6.021E-01	2.570E-01	7.169E+01	4.817E-03
2130	1.545E+01	8.439E+03	5.670E-01	2.420E-01	6.751E+01	4.536E-03
2131	1.455E+01	7.948E+03	5.340E-01	2.279E-01	6.358E+01	4.272E-03
2132	1.370E+01	7.485E+03	5.029E-01	2.146E-01	5.988E+01	4.023E-03
2133	1.290E+01	7.049E+03	4.736E-01	2.021E-01	5.639E+01	3.789E-03
2134	1.215E+01	6.638E+03	4.460E-01	1.904E-01	5.311E+01	3.568E-03
2135	1.144E+01	6.252E+03	4.201E-01	1.793E-01	5.001E+01	3.360E-03
2136	1.078E+01	5.888E+03	3.956E-01	1.688E-01	4.710E+01	3.165E-03
2137	1.015E+01	5.545E+03	3.726E-01	1.590E-01	4.436E+01	2.980E-03
2138	9.559E+00	5.222E+03	3.509E-01	1.497E-01	4.178E+01	2.807E-03
2139	9.002E+00	4.918E+03	3.304E-01	1.410E-01	3.934E+01	2.643E-03
2140	8.478E+00	4.631E+03	3.112E-01	1.328E-01	3.705E+01	2.490E-03
2141	7.984E+00	4.362E+03	2.931E-01	1.251E-01	3.489E+01	2.345E-03



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.096**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**127**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

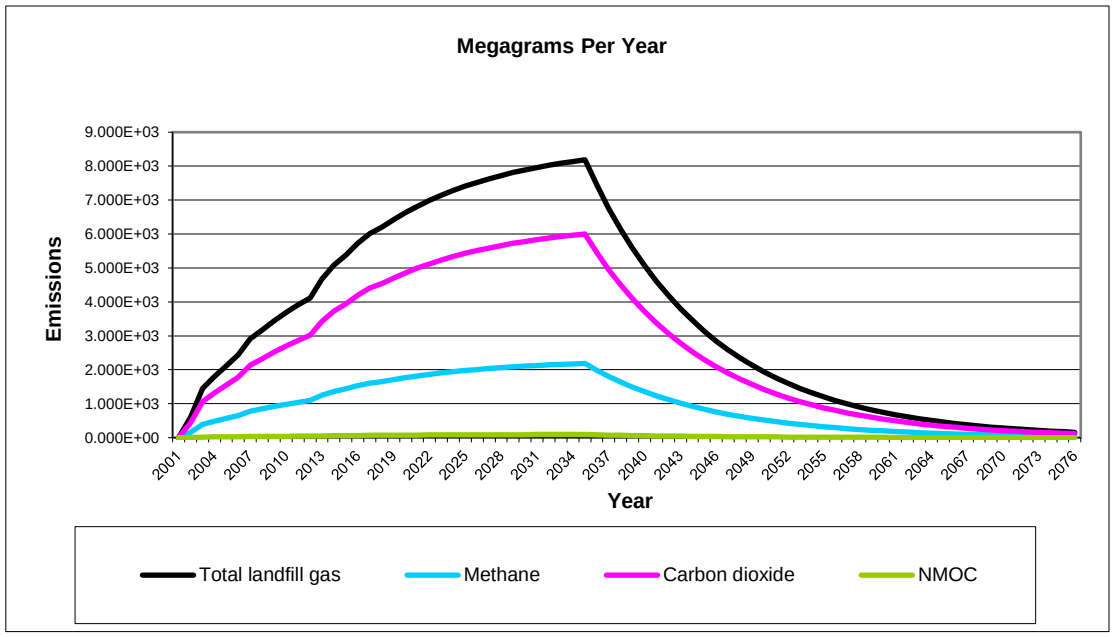
Pollutant Parameters

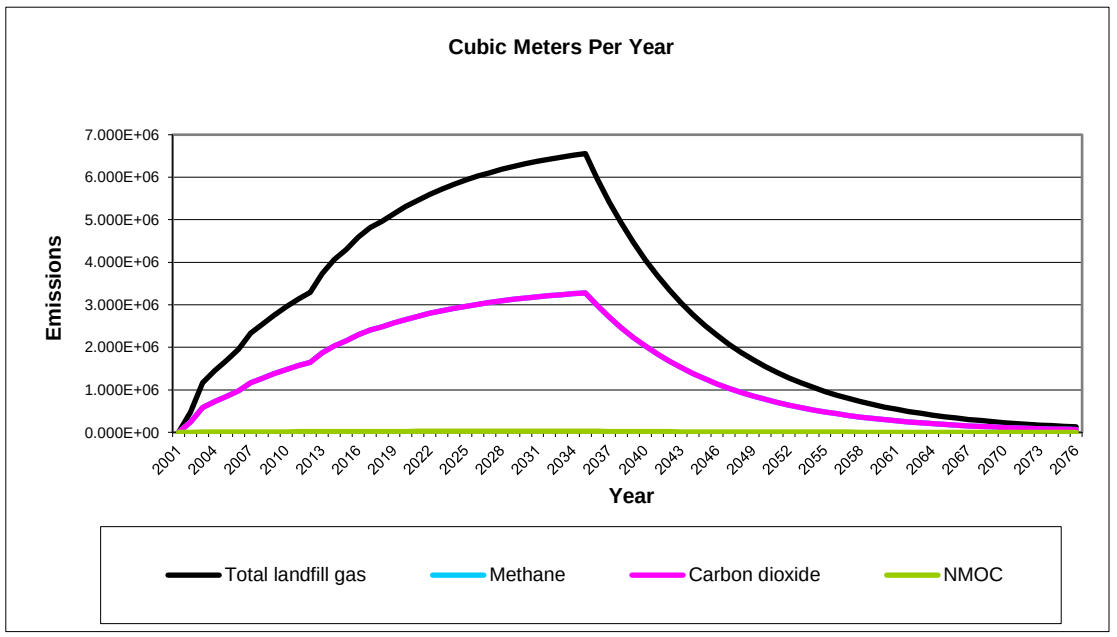
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

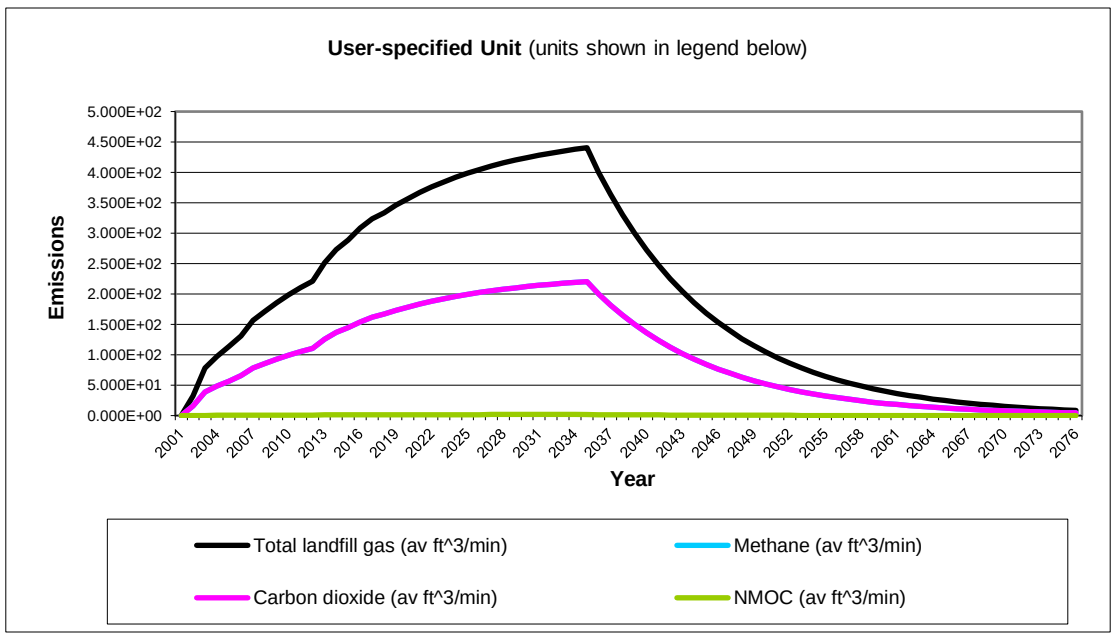
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
9.000E+03
8.000E+03
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
7.000E+06
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
5.000E+02
4.500E+02
4.000E+02
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	5.975E+02	4.784E+05	3.215E+01	1.596E+02	2.392E+05	1.607E+01
2003	1.451E+03	1.162E+06	7.808E+01	3.877E+02	5.811E+05	3.904E+01
2004	1.806E+03	1.446E+06	9.717E+01	4.824E+02	7.231E+05	4.859E+01
2005	2.112E+03	1.691E+06	1.136E+02	5.642E+02	8.457E+05	5.682E+01
2006	2.438E+03	1.952E+06	1.312E+02	6.512E+02	9.761E+05	6.558E+01
2007	2.914E+03	2.333E+06	1.568E+02	7.783E+02	1.167E+06	7.839E+01
2008	3.173E+03	2.541E+06	1.707E+02	8.476E+02	1.271E+06	8.537E+01
2009	3.443E+03	2.757E+06	1.852E+02	9.197E+02	1.379E+06	9.262E+01
2010	3.688E+03	2.953E+06	1.984E+02	9.851E+02	1.477E+06	9.921E+01
2011	3.911E+03	3.131E+06	2.104E+02	1.045E+03	1.566E+06	1.052E+02
2012	4.113E+03	3.293E+06	2.213E+02	1.099E+03	1.647E+06	1.106E+02
2013	4.665E+03	3.735E+06	2.510E+02	1.246E+03	1.868E+06	1.255E+02
2014	5.078E+03	4.066E+06	2.732E+02	1.356E+03	2.033E+06	1.366E+02
2015	5.372E+03	4.302E+06	2.890E+02	1.435E+03	2.151E+06	1.445E+02
2016	5.731E+03	4.589E+06	3.083E+02	1.531E+03	2.295E+06	1.542E+02
2017	6.016E+03	4.817E+06	3.237E+02	1.607E+03	2.409E+06	1.618E+02
2018	6.199E+03	4.964E+06	3.335E+02	1.656E+03	2.482E+06	1.668E+02
2019	6.426E+03	5.145E+06	3.457E+02	1.716E+03	2.573E+06	1.729E+02
2020	6.631E+03	5.310E+06	3.568E+02	1.771E+03	2.655E+06	1.784E+02
2021	6.818E+03	5.459E+06	3.668E+02	1.821E+03	2.730E+06	1.834E+02
2022	6.987E+03	5.595E+06	3.759E+02	1.866E+03	2.798E+06	1.880E+02
2023	7.142E+03	5.719E+06	3.842E+02	1.908E+03	2.859E+06	1.921E+02
2024	7.282E+03	5.831E+06	3.918E+02	1.945E+03	2.915E+06	1.959E+02
2025	7.409E+03	5.933E+06	3.986E+02	1.979E+03	2.966E+06	1.993E+02
2026	7.524E+03	6.025E+06	4.048E+02	2.010E+03	3.013E+06	2.024E+02
2027	7.629E+03	6.109E+06	4.105E+02	2.038E+03	3.055E+06	2.052E+02
2028	7.725E+03	6.185E+06	4.156E+02	2.063E+03	3.093E+06	2.078E+02
2029	7.811E+03	6.255E+06	4.203E+02	2.086E+03	3.127E+06	2.101E+02
2030	7.890E+03	6.318E+06	4.245E+02	2.107E+03	3.159E+06	2.122E+02
2031	7.961E+03	6.375E+06	4.283E+02	2.127E+03	3.188E+06	2.142E+02
2032	8.026E+03	6.427E+06	4.318E+02	2.144E+03	3.214E+06	2.159E+02
2033	8.085E+03	6.474E+06	4.350E+02	2.160E+03	3.237E+06	2.175E+02
2034	8.139E+03	6.517E+06	4.379E+02	2.174E+03	3.259E+06	2.189E+02
2035	8.188E+03	6.556E+06	4.405E+02	2.187E+03	3.278E+06	2.203E+02
2036	7.438E+03	5.956E+06	4.002E+02	1.987E+03	2.978E+06	2.001E+02
2037	6.757E+03	5.411E+06	3.636E+02	1.805E+03	2.705E+06	1.818E+02
2038	6.139E+03	4.916E+06	3.303E+02	1.640E+03	2.458E+06	1.651E+02
2039	5.577E+03	4.466E+06	3.000E+02	1.490E+03	2.233E+06	1.500E+02
2040	5.066E+03	4.057E+06	2.726E+02	1.353E+03	2.028E+06	1.363E+02
2041	4.603E+03	3.686E+06	2.476E+02	1.229E+03	1.843E+06	1.238E+02
2042	4.181E+03	3.348E+06	2.250E+02	1.117E+03	1.674E+06	1.125E+02
2043	3.799E+03	3.042E+06	2.044E+02	1.015E+03	1.521E+06	1.022E+02
2044	3.451E+03	2.763E+06	1.857E+02	9.218E+02	1.382E+06	9.283E+01
2045	3.135E+03	2.510E+06	1.687E+02	8.374E+02	1.255E+06	8.434E+01
2046	2.848E+03	2.281E+06	1.532E+02	7.607E+02	1.140E+06	7.662E+01
2047	2.587E+03	2.072E+06	1.392E+02	6.911E+02	1.036E+06	6.960E+01
2048	2.350E+03	1.882E+06	1.265E+02	6.278E+02	9.411E+05	6.323E+01
2049	2.135E+03	1.710E+06	1.149E+02	5.704E+02	8.549E+05	5.744E+01
2050	1.940E+03	1.553E+06	1.044E+02	5.182E+02	7.767E+05	5.219E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.762E+03	1.411E+06	9.482E+01	4.707E+02	7.056E+05	4.741E+01
2052	1.601E+03	1.282E+06	8.614E+01	4.276E+02	6.410E+05	4.307E+01
2053	1.454E+03	1.165E+06	7.825E+01	3.885E+02	5.823E+05	3.913E+01
2054	1.321E+03	1.058E+06	7.109E+01	3.529E+02	5.290E+05	3.555E+01
2055	1.200E+03	9.612E+05	6.458E+01	3.206E+02	4.806E+05	3.229E+01
2056	1.090E+03	8.732E+05	5.867E+01	2.913E+02	4.366E+05	2.934E+01
2057	9.907E+02	7.933E+05	5.330E+01	2.646E+02	3.966E+05	2.665E+01
2058	9.000E+02	7.207E+05	4.842E+01	2.404E+02	3.603E+05	2.421E+01
2059	8.176E+02	6.547E+05	4.399E+01	2.184E+02	3.274E+05	2.199E+01
2060	7.428E+02	5.948E+05	3.996E+01	1.984E+02	2.974E+05	1.998E+01
2061	6.748E+02	5.403E+05	3.630E+01	1.802E+02	2.702E+05	1.815E+01
2062	6.130E+02	4.909E+05	3.298E+01	1.637E+02	2.454E+05	1.649E+01
2063	5.569E+02	4.459E+05	2.996E+01	1.488E+02	2.230E+05	1.498E+01
2064	5.059E+02	4.051E+05	2.722E+01	1.351E+02	2.026E+05	1.361E+01
2065	4.596E+02	3.680E+05	2.473E+01	1.228E+02	1.840E+05	1.236E+01
2066	4.175E+02	3.343E+05	2.246E+01	1.115E+02	1.672E+05	1.123E+01
2067	3.793E+02	3.037E+05	2.041E+01	1.013E+02	1.519E+05	1.020E+01
2068	3.446E+02	2.759E+05	1.854E+01	9.205E+01	1.380E+05	9.270E+00
2069	3.131E+02	2.507E+05	1.684E+01	8.362E+01	1.253E+05	8.422E+00
2070	2.844E+02	2.277E+05	1.530E+01	7.597E+01	1.139E+05	7.651E+00
2071	2.584E+02	2.069E+05	1.390E+01	6.901E+01	1.034E+05	6.950E+00
2072	2.347E+02	1.880E+05	1.263E+01	6.270E+01	9.398E+04	6.314E+00
2073	2.132E+02	1.707E+05	1.147E+01	5.696E+01	8.537E+04	5.736E+00
2074	1.937E+02	1.551E+05	1.042E+01	5.174E+01	7.756E+04	5.211E+00
2075	1.760E+02	1.409E+05	9.468E+00	4.701E+01	7.046E+04	4.734E+00
2076	1.599E+02	1.280E+05	8.602E+00	4.270E+01	6.401E+04	4.301E+00
2077	1.452E+02	1.163E+05	7.814E+00	3.879E+01	5.815E+04	3.907E+00
2078	1.319E+02	1.057E+05	7.099E+00	3.524E+01	5.283E+04	3.549E+00
2079	1.199E+02	9.598E+04	6.449E+00	3.202E+01	4.799E+04	3.225E+00
2080	1.089E+02	8.720E+04	5.859E+00	2.909E+01	4.360E+04	2.929E+00
2081	9.893E+01	7.922E+04	5.323E+00	2.642E+01	3.961E+04	2.661E+00
2082	8.987E+01	7.197E+04	4.835E+00	2.401E+01	3.598E+04	2.418E+00
2083	8.165E+01	6.538E+04	4.393E+00	2.181E+01	3.269E+04	2.196E+00
2084	7.417E+01	5.939E+04	3.991E+00	1.981E+01	2.970E+04	1.995E+00
2085	6.738E+01	5.396E+04	3.625E+00	1.800E+01	2.698E+04	1.813E+00
2086	6.121E+01	4.902E+04	3.293E+00	1.635E+01	2.451E+04	1.647E+00
2087	5.561E+01	4.453E+04	2.992E+00	1.485E+01	2.227E+04	1.496E+00
2088	5.052E+01	4.045E+04	2.718E+00	1.349E+01	2.023E+04	1.359E+00
2089	4.590E+01	3.675E+04	2.469E+00	1.226E+01	1.838E+04	1.235E+00
2090	4.170E+01	3.339E+04	2.243E+00	1.114E+01	1.669E+04	1.122E+00
2091	3.788E+01	3.033E+04	2.038E+00	1.012E+01	1.517E+04	1.019E+00
2092	3.441E+01	2.755E+04	1.851E+00	9.192E+00	1.378E+04	9.257E-01
2093	3.126E+01	2.503E+04	1.682E+00	8.350E+00	1.252E+04	8.410E-01
2094	2.840E+01	2.274E+04	1.528E+00	7.586E+00	1.137E+04	7.640E-01
2095	2.580E+01	2.066E+04	1.388E+00	6.892E+00	1.033E+04	6.941E-01
2096	2.344E+01	1.877E+04	1.261E+00	6.261E+00	9.384E+03	6.305E-01
2097	2.129E+01	1.705E+04	1.146E+00	5.688E+00	8.525E+03	5.728E-01
2098	1.934E+01	1.549E+04	1.041E+00	5.167E+00	7.745E+03	5.204E-01
2099	1.757E+01	1.407E+04	9.455E-01	4.694E+00	7.036E+03	4.727E-01
2100	1.596E+01	1.278E+04	8.589E-01	4.264E+00	6.392E+03	4.295E-01
2101	1.450E+01	1.161E+04	7.803E-01	3.874E+00	5.807E+03	3.902E-01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	1.318E+01	1.055E+04	7.089E-01	3.519E+00	5.275E+03	3.544E-01
2103	1.197E+01	9.585E+03	6.440E-01	3.197E+00	4.792E+03	3.220E-01
2104	1.087E+01	8.707E+03	5.851E-01	2.905E+00	4.354E+03	2.925E-01
2105	9.879E+00	7.910E+03	5.315E-01	2.639E+00	3.955E+03	2.657E-01
2106	8.974E+00	7.186E+03	4.828E-01	2.397E+00	3.593E+03	2.414E-01
2107	8.153E+00	6.529E+03	4.387E-01	2.178E+00	3.264E+03	2.193E-01
2108	7.407E+00	5.931E+03	3.985E-01	1.978E+00	2.965E+03	1.992E-01
2109	6.729E+00	5.388E+03	3.620E-01	1.797E+00	2.694E+03	1.810E-01
2110	6.113E+00	4.895E+03	3.289E-01	1.633E+00	2.447E+03	1.644E-01
2111	5.553E+00	4.447E+03	2.988E-01	1.483E+00	2.223E+03	1.494E-01
2112	5.045E+00	4.040E+03	2.714E-01	1.348E+00	2.020E+03	1.357E-01
2113	4.583E+00	3.670E+03	2.466E-01	1.224E+00	1.835E+03	1.233E-01
2114	4.164E+00	3.334E+03	2.240E-01	1.112E+00	1.667E+03	1.120E-01
2115	3.782E+00	3.029E+03	2.035E-01	1.010E+00	1.514E+03	1.018E-01
2116	3.436E+00	2.752E+03	1.849E-01	9.179E-01	1.376E+03	9.244E-02
2117	3.122E+00	2.500E+03	1.680E-01	8.338E-01	1.250E+03	8.398E-02
2118	2.836E+00	2.271E+03	1.526E-01	7.575E-01	1.135E+03	7.629E-02
2119	2.576E+00	2.063E+03	1.386E-01	6.882E-01	1.032E+03	6.931E-02
2120	2.341E+00	1.874E+03	1.259E-01	6.252E-01	9.371E+02	6.296E-02
2121	2.126E+00	1.703E+03	1.144E-01	5.680E-01	8.513E+02	5.720E-02
2122	1.932E+00	1.547E+03	1.039E-01	5.160E-01	7.734E+02	5.196E-02
2123	1.755E+00	1.405E+03	9.442E-02	4.687E-01	7.026E+02	4.721E-02
2124	1.594E+00	1.277E+03	8.577E-02	4.258E-01	6.383E+02	4.289E-02
2125	1.448E+00	1.160E+03	7.792E-02	3.869E-01	5.799E+02	3.896E-02
2126	1.316E+00	1.054E+03	7.079E-02	3.514E-01	5.268E+02	3.539E-02
2127	1.195E+00	9.571E+02	6.431E-02	3.193E-01	4.786E+02	3.215E-02
2128	1.086E+00	8.695E+02	5.842E-02	2.900E-01	4.348E+02	2.921E-02
2129	9.865E-01	7.899E+02	5.307E-02	2.635E-01	3.950E+02	2.654E-02
2130	8.962E-01	7.176E+02	4.822E-02	2.394E-01	3.588E+02	2.411E-02
2131	8.141E-01	6.519E+02	4.380E-02	2.175E-01	3.260E+02	2.190E-02
2132	7.396E-01	5.923E+02	3.979E-02	1.976E-01	2.961E+02	1.990E-02
2133	6.719E-01	5.380E+02	3.615E-02	1.795E-01	2.690E+02	1.808E-02
2134	6.104E-01	4.888E+02	3.284E-02	1.630E-01	2.444E+02	1.642E-02
2135	5.545E-01	4.440E+02	2.984E-02	1.481E-01	2.220E+02	1.492E-02
2136	5.038E-01	4.034E+02	2.710E-02	1.346E-01	2.017E+02	1.355E-02
2137	4.577E-01	3.665E+02	2.462E-02	1.222E-01	1.832E+02	1.231E-02
2138	4.158E-01	3.329E+02	2.237E-02	1.111E-01	1.665E+02	1.118E-02
2139	3.777E-01	3.025E+02	2.032E-02	1.009E-01	1.512E+02	1.016E-02
2140	3.431E-01	2.748E+02	1.846E-02	9.166E-02	1.374E+02	9.231E-03
2141	3.117E-01	2.496E+02	1.677E-02	8.327E-02	1.248E+02	8.386E-03

Results (Continued)

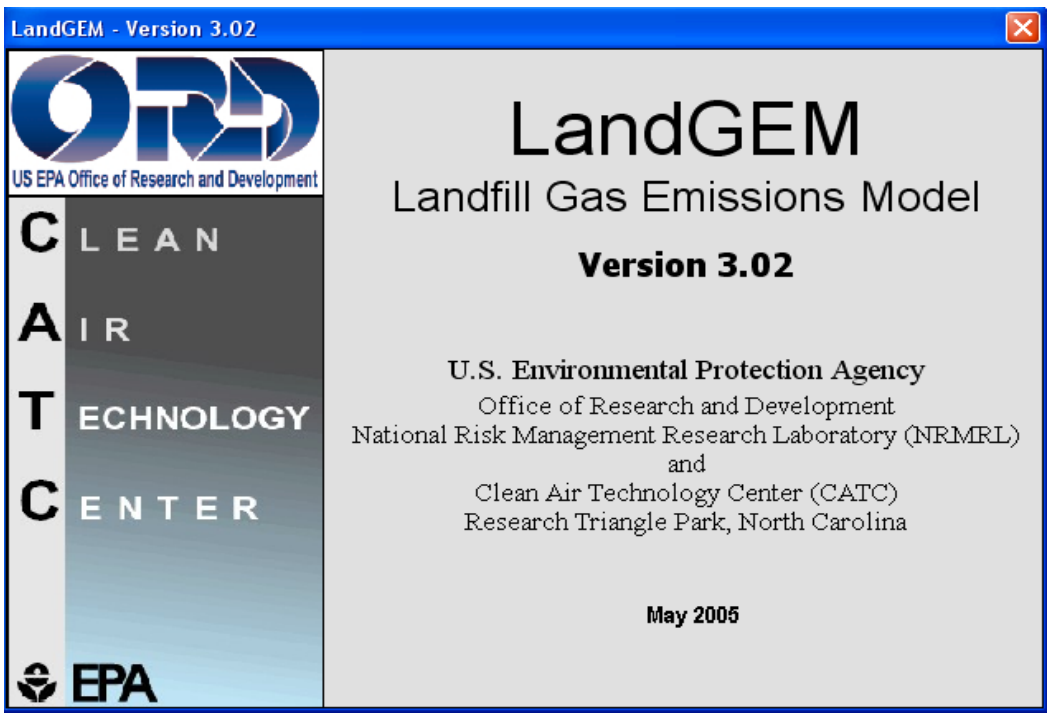
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	4.379E+02	2.392E+05	1.607E+01	6.860E+00	1.914E+03	1.286E-01
2003	1.064E+03	5.811E+05	3.904E+01	1.666E+01	4.649E+03	3.123E-01
2004	1.324E+03	7.231E+05	4.859E+01	2.074E+01	5.785E+03	3.887E-01
2005	1.548E+03	8.457E+05	5.682E+01	2.425E+01	6.766E+03	4.546E-01
2006	1.787E+03	9.761E+05	6.558E+01	2.799E+01	7.809E+03	5.247E-01
2007	2.136E+03	1.167E+06	7.839E+01	3.345E+01	9.333E+03	6.271E-01
2008	2.326E+03	1.271E+06	8.537E+01	3.643E+01	1.016E+04	6.829E-01
2009	2.523E+03	1.379E+06	9.262E+01	3.953E+01	1.103E+04	7.410E-01
2010	2.703E+03	1.477E+06	9.921E+01	4.234E+01	1.181E+04	7.937E-01
2011	2.866E+03	1.566E+06	1.052E+02	4.490E+01	1.253E+04	8.416E-01
2012	3.014E+03	1.647E+06	1.106E+02	4.722E+01	1.317E+04	8.851E-01
2013	3.419E+03	1.868E+06	1.255E+02	5.356E+01	1.494E+04	1.004E+00
2014	3.721E+03	2.033E+06	1.366E+02	5.830E+01	1.626E+04	1.093E+00
2015	3.937E+03	2.151E+06	1.445E+02	6.168E+01	1.721E+04	1.156E+00
2016	4.200E+03	2.295E+06	1.542E+02	6.580E+01	1.836E+04	1.233E+00
2017	4.409E+03	2.409E+06	1.618E+02	6.907E+01	1.927E+04	1.295E+00
2018	4.543E+03	2.482E+06	1.668E+02	7.117E+01	1.986E+04	1.334E+00
2019	4.709E+03	2.573E+06	1.729E+02	7.377E+01	2.058E+04	1.383E+00
2020	4.860E+03	2.655E+06	1.784E+02	7.613E+01	2.124E+04	1.427E+00
2021	4.997E+03	2.730E+06	1.834E+02	7.828E+01	2.184E+04	1.467E+00
2022	5.121E+03	2.798E+06	1.880E+02	8.022E+01	2.238E+04	1.504E+00
2023	5.234E+03	2.859E+06	1.921E+02	8.199E+01	2.287E+04	1.537E+00
2024	5.337E+03	2.915E+06	1.959E+02	8.360E+01	2.332E+04	1.567E+00
2025	5.430E+03	2.966E+06	1.993E+02	8.506E+01	2.373E+04	1.594E+00
2026	5.514E+03	3.013E+06	2.024E+02	8.639E+01	2.410E+04	1.619E+00
2027	5.591E+03	3.055E+06	2.052E+02	8.759E+01	2.444E+04	1.642E+00
2028	5.661E+03	3.093E+06	2.078E+02	8.869E+01	2.474E+04	1.662E+00
2029	5.725E+03	3.127E+06	2.101E+02	8.968E+01	2.502E+04	1.681E+00
2030	5.782E+03	3.159E+06	2.122E+02	9.058E+01	2.527E+04	1.698E+00
2031	5.835E+03	3.188E+06	2.142E+02	9.141E+01	2.550E+04	1.713E+00
2032	5.882E+03	3.214E+06	2.159E+02	9.215E+01	2.571E+04	1.727E+00
2033	5.926E+03	3.237E+06	2.175E+02	9.283E+01	2.590E+04	1.740E+00
2034	5.965E+03	3.259E+06	2.189E+02	9.344E+01	2.607E+04	1.752E+00
2035	6.001E+03	3.278E+06	2.203E+02	9.400E+01	2.623E+04	1.762E+00
2036	5.451E+03	2.978E+06	2.001E+02	8.540E+01	2.382E+04	1.601E+00
2037	4.952E+03	2.705E+06	1.818E+02	7.758E+01	2.164E+04	1.454E+00
2038	4.499E+03	2.458E+06	1.651E+02	7.048E+01	1.966E+04	1.321E+00
2039	4.087E+03	2.233E+06	1.500E+02	6.403E+01	1.786E+04	1.200E+00
2040	3.713E+03	2.028E+06	1.363E+02	5.817E+01	1.623E+04	1.090E+00
2041	3.373E+03	1.843E+06	1.238E+02	5.284E+01	1.474E+04	9.905E-01
2042	3.064E+03	1.674E+06	1.125E+02	4.801E+01	1.339E+04	8.999E-01
2043	2.784E+03	1.521E+06	1.022E+02	4.361E+01	1.217E+04	8.175E-01
2044	2.529E+03	1.382E+06	9.283E+01	3.962E+01	1.105E+04	7.427E-01
2045	2.298E+03	1.255E+06	8.434E+01	3.599E+01	1.004E+04	6.747E-01
2046	2.087E+03	1.140E+06	7.662E+01	3.270E+01	9.122E+03	6.129E-01
2047	1.896E+03	1.036E+06	6.960E+01	2.971E+01	8.287E+03	5.568E-01
2048	1.723E+03	9.411E+05	6.323E+01	2.699E+01	7.529E+03	5.059E-01
2049	1.565E+03	8.549E+05	5.744E+01	2.452E+01	6.840E+03	4.595E-01
2050	1.422E+03	7.767E+05	5.219E+01	2.227E+01	6.213E+03	4.175E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.292E+03	7.056E+05	4.741E+01	2.023E+01	5.645E+03	3.793E-01
2052	1.173E+03	6.410E+05	4.307E+01	1.838E+01	5.128E+03	3.446E-01
2053	1.066E+03	5.823E+05	3.913E+01	1.670E+01	4.659E+03	3.130E-01
2054	9.684E+02	5.290E+05	3.555E+01	1.517E+01	4.232E+03	2.844E-01
2055	8.797E+02	4.806E+05	3.229E+01	1.378E+01	3.845E+03	2.583E-01
2056	7.992E+02	4.366E+05	2.934E+01	1.252E+01	3.493E+03	2.347E-01
2057	7.261E+02	3.966E+05	2.665E+01	1.137E+01	3.173E+03	2.132E-01
2058	6.596E+02	3.603E+05	2.421E+01	1.033E+01	2.883E+03	1.937E-01
2059	5.992E+02	3.274E+05	2.199E+01	9.387E+00	2.619E+03	1.760E-01
2060	5.444E+02	2.974E+05	1.998E+01	8.528E+00	2.379E+03	1.599E-01
2061	4.945E+02	2.702E+05	1.815E+01	7.747E+00	2.161E+03	1.452E-01
2062	4.493E+02	2.454E+05	1.649E+01	7.038E+00	1.963E+03	1.319E-01
2063	4.081E+02	2.230E+05	1.498E+01	6.394E+00	1.784E+03	1.199E-01
2064	3.708E+02	2.026E+05	1.361E+01	5.809E+00	1.620E+03	1.089E-01
2065	3.368E+02	1.840E+05	1.236E+01	5.277E+00	1.472E+03	9.891E-02
2066	3.060E+02	1.672E+05	1.123E+01	4.794E+00	1.337E+03	8.986E-02
2067	2.780E+02	1.519E+05	1.020E+01	4.355E+00	1.215E+03	8.163E-02
2068	2.526E+02	1.380E+05	9.270E+00	3.956E+00	1.104E+03	7.416E-02
2069	2.294E+02	1.253E+05	8.422E+00	3.594E+00	1.003E+03	6.737E-02
2070	2.084E+02	1.139E+05	7.651E+00	3.265E+00	9.109E+02	6.121E-02
2071	1.894E+02	1.034E+05	6.950E+00	2.966E+00	8.276E+02	5.560E-02
2072	1.720E+02	9.398E+04	6.314E+00	2.695E+00	7.518E+02	5.051E-02
2073	1.563E+02	8.537E+04	5.736E+00	2.448E+00	6.830E+02	4.589E-02
2074	1.420E+02	7.756E+04	5.211E+00	2.224E+00	6.205E+02	4.169E-02
2075	1.290E+02	7.046E+04	4.734E+00	2.020E+00	5.637E+02	3.787E-02
2076	1.172E+02	6.401E+04	4.301E+00	1.836E+00	5.121E+02	3.441E-02
2077	1.064E+02	5.815E+04	3.907E+00	1.668E+00	4.652E+02	3.126E-02
2078	9.670E+01	5.283E+04	3.549E+00	1.515E+00	4.226E+02	2.840E-02
2079	8.785E+01	4.799E+04	3.225E+00	1.376E+00	3.839E+02	2.580E-02
2080	7.981E+01	4.360E+04	2.929E+00	1.250E+00	3.488E+02	2.344E-02
2081	7.250E+01	3.961E+04	2.661E+00	1.136E+00	3.169E+02	2.129E-02
2082	6.587E+01	3.598E+04	2.418E+00	1.032E+00	2.879E+02	1.934E-02
2083	5.984E+01	3.269E+04	2.196E+00	9.374E-01	2.615E+02	1.757E-02
2084	5.436E+01	2.970E+04	1.995E+00	8.516E-01	2.376E+02	1.596E-02
2085	4.938E+01	2.698E+04	1.813E+00	7.736E-01	2.158E+02	1.450E-02
2086	4.486E+01	2.451E+04	1.647E+00	7.028E-01	1.961E+02	1.317E-02
2087	4.076E+01	2.227E+04	1.496E+00	6.385E-01	1.781E+02	1.197E-02
2088	3.703E+01	2.023E+04	1.359E+00	5.800E-01	1.618E+02	1.087E-02
2089	3.364E+01	1.838E+04	1.235E+00	5.269E-01	1.470E+02	9.877E-03
2090	3.056E+01	1.669E+04	1.122E+00	4.787E-01	1.335E+02	8.973E-03
2091	2.776E+01	1.517E+04	1.019E+00	4.349E-01	1.213E+02	8.152E-03
2092	2.522E+01	1.378E+04	9.257E-01	3.951E-01	1.102E+02	7.406E-03
2093	2.291E+01	1.252E+04	8.410E-01	3.589E-01	1.001E+02	6.728E-03
2094	2.081E+01	1.137E+04	7.640E-01	3.261E-01	9.096E+01	6.112E-03
2095	1.891E+01	1.033E+04	6.941E-01	2.962E-01	8.264E+01	5.552E-03
2096	1.718E+01	9.384E+03	6.305E-01	2.691E-01	7.507E+01	5.044E-03
2097	1.561E+01	8.525E+03	5.728E-01	2.445E-01	6.820E+01	4.582E-03
2098	1.418E+01	7.745E+03	5.204E-01	2.221E-01	6.196E+01	4.163E-03
2099	1.288E+01	7.036E+03	4.727E-01	2.018E-01	5.629E+01	3.782E-03
2100	1.170E+01	6.392E+03	4.295E-01	1.833E-01	5.114E+01	3.436E-03
2101	1.063E+01	5.807E+03	3.902E-01	1.665E-01	4.645E+01	3.121E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	9.656E+00	5.275E+03	3.544E-01	1.513E-01	4.220E+01	2.836E-03
2103	8.772E+00	4.792E+03	3.220E-01	1.374E-01	3.834E+01	2.576E-03
2104	7.969E+00	4.354E+03	2.925E-01	1.248E-01	3.483E+01	2.340E-03
2105	7.240E+00	3.955E+03	2.657E-01	1.134E-01	3.164E+01	2.126E-03
2106	6.577E+00	3.593E+03	2.414E-01	1.030E-01	2.875E+01	1.931E-03
2107	5.975E+00	3.264E+03	2.193E-01	9.361E-02	2.611E+01	1.755E-03
2108	5.428E+00	2.965E+03	1.992E-01	8.504E-02	2.372E+01	1.594E-03
2109	4.931E+00	2.694E+03	1.810E-01	7.725E-02	2.155E+01	1.448E-03
2110	4.480E+00	2.447E+03	1.644E-01	7.018E-02	1.958E+01	1.316E-03
2111	4.070E+00	2.223E+03	1.494E-01	6.376E-02	1.779E+01	1.195E-03
2112	3.697E+00	2.020E+03	1.357E-01	5.792E-02	1.616E+01	1.086E-03
2113	3.359E+00	1.835E+03	1.233E-01	5.262E-02	1.468E+01	9.863E-04
2114	3.051E+00	1.667E+03	1.120E-01	4.780E-02	1.334E+01	8.961E-04
2115	2.772E+00	1.514E+03	1.018E-01	4.343E-02	1.212E+01	8.140E-04
2116	2.518E+00	1.376E+03	9.244E-02	3.945E-02	1.101E+01	7.395E-04
2117	2.288E+00	1.250E+03	8.398E-02	3.584E-02	9.999E+00	6.718E-04
2118	2.078E+00	1.135E+03	7.629E-02	3.256E-02	9.084E+00	6.103E-04
2119	1.888E+00	1.032E+03	6.931E-02	2.958E-02	8.252E+00	5.545E-04
2120	1.715E+00	9.371E+02	6.296E-02	2.687E-02	7.497E+00	5.037E-04
2121	1.558E+00	8.513E+02	5.720E-02	2.441E-02	6.811E+00	4.576E-04
2122	1.416E+00	7.734E+02	5.196E-02	2.218E-02	6.187E+00	4.157E-04
2123	1.286E+00	7.026E+02	4.721E-02	2.015E-02	5.621E+00	3.777E-04
2124	1.168E+00	6.383E+02	4.289E-02	1.830E-02	5.106E+00	3.431E-04
2125	1.061E+00	5.799E+02	3.896E-02	1.663E-02	4.639E+00	3.117E-04
2126	9.643E-01	5.268E+02	3.539E-02	1.511E-02	4.214E+00	2.832E-04
2127	8.760E-01	4.786E+02	3.215E-02	1.372E-02	3.829E+00	2.572E-04
2128	7.958E-01	4.348E+02	2.921E-02	1.247E-02	3.478E+00	2.337E-04
2129	7.230E-01	3.950E+02	2.654E-02	1.133E-02	3.160E+00	2.123E-04
2130	6.568E-01	3.588E+02	2.411E-02	1.029E-02	2.870E+00	1.929E-04
2131	5.967E-01	3.260E+02	2.190E-02	9.347E-03	2.608E+00	1.752E-04
2132	5.421E-01	2.961E+02	1.990E-02	8.492E-03	2.369E+00	1.592E-04
2133	4.924E-01	2.690E+02	1.808E-02	7.714E-03	2.152E+00	1.446E-04
2134	4.474E-01	2.444E+02	1.642E-02	7.008E-03	1.955E+00	1.314E-04
2135	4.064E-01	2.220E+02	1.492E-02	6.367E-03	1.776E+00	1.193E-04
2136	3.692E-01	2.017E+02	1.355E-02	5.784E-03	1.614E+00	1.084E-04
2137	3.354E-01	1.832E+02	1.231E-02	5.254E-03	1.466E+00	9.849E-05
2138	3.047E-01	1.665E+02	1.118E-02	4.774E-03	1.332E+00	8.948E-05
2139	2.768E-01	1.512E+02	1.016E-02	4.337E-03	1.210E+00	8.129E-05
2140	2.515E-01	1.374E+02	9.231E-03	3.940E-03	1.099E+00	7.385E-05
2141	2.285E-01	1.248E+02	8.386E-03	3.579E-03	9.985E-01	6.709E-05



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.060**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**110**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

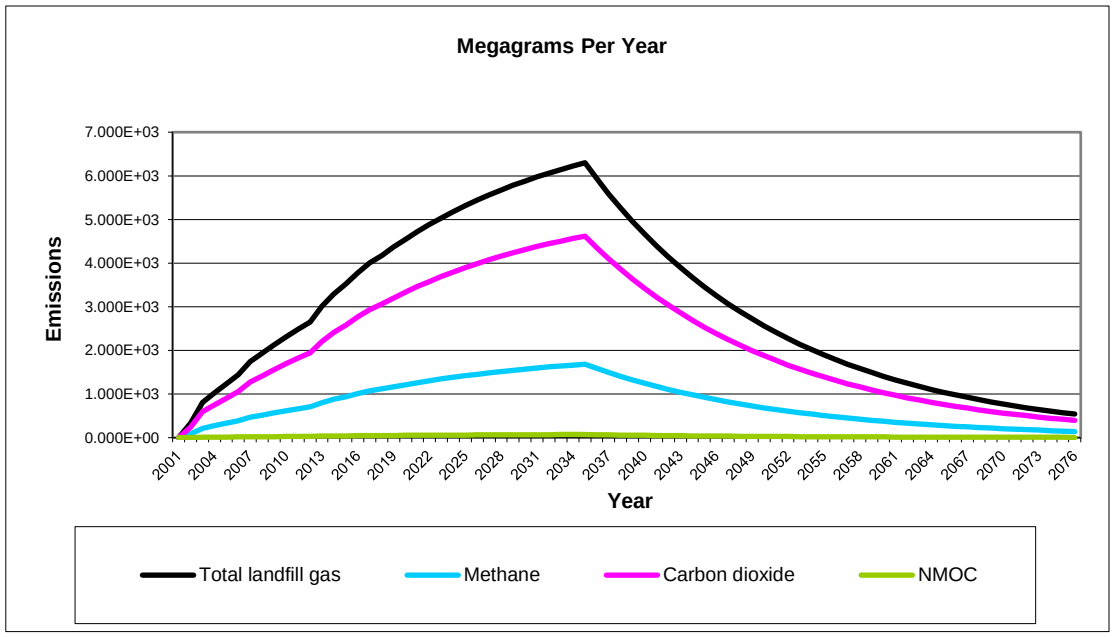
Pollutant Parameters

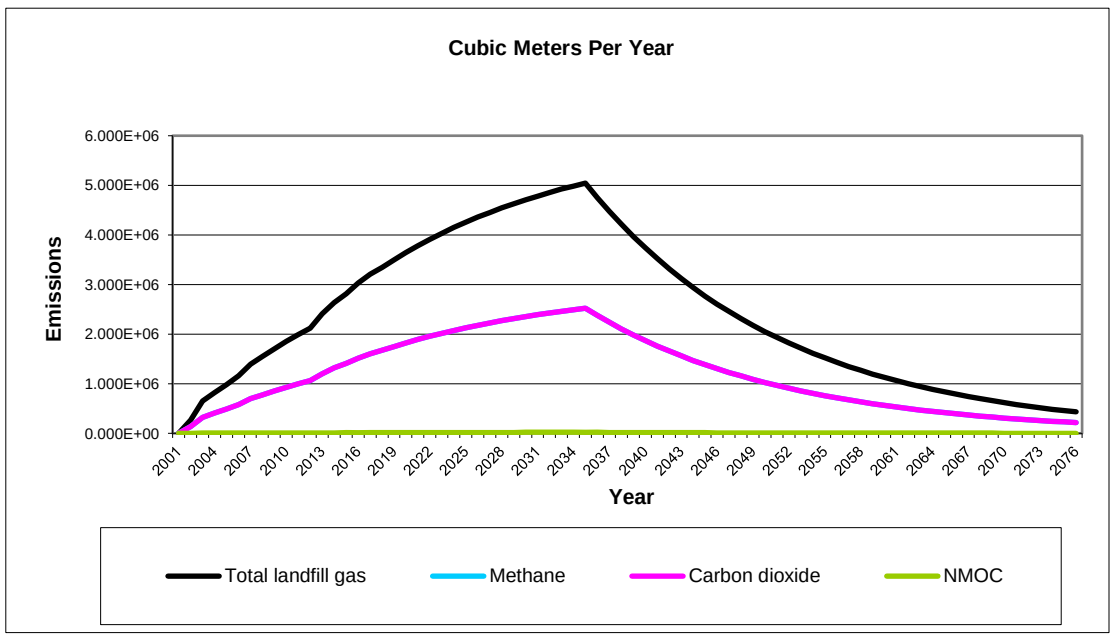
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

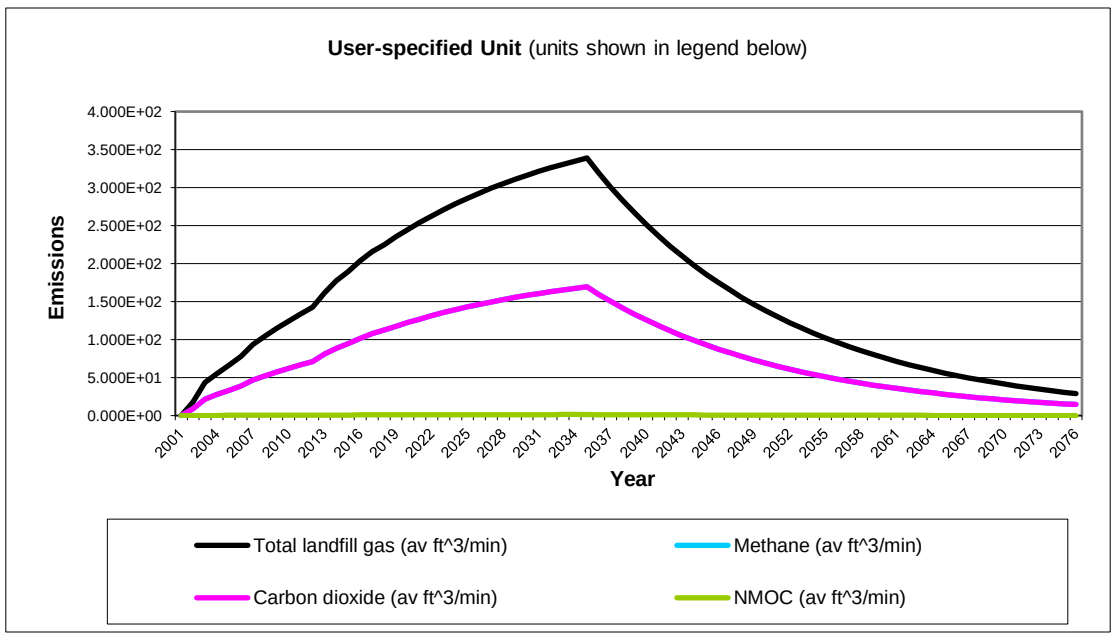
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
4.000E+02
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	3.286E+02	2.632E+05	1.768E+01	8.778E+01	1.316E+05	8.841E+00
2003	8.092E+02	6.480E+05	4.354E+01	2.162E+02	3.240E+05	2.177E+01
2004	1.030E+03	8.250E+05	5.543E+01	2.752E+02	4.125E+05	2.772E+01
2005	1.230E+03	9.847E+05	6.616E+01	3.285E+02	4.923E+05	3.308E+01
2006	1.444E+03	1.156E+06	7.767E+01	3.856E+02	5.780E+05	3.883E+01
2007	1.744E+03	1.397E+06	9.383E+01	4.659E+02	6.983E+05	4.692E+01
2008	1.932E+03	1.547E+06	1.039E+02	5.160E+02	7.735E+05	5.197E+01
2009	2.128E+03	1.704E+06	1.145E+02	5.683E+02	8.518E+05	5.723E+01
2010	2.312E+03	1.851E+06	1.244E+02	6.175E+02	9.256E+05	6.219E+01
2011	2.485E+03	1.990E+06	1.337E+02	6.638E+02	9.950E+05	6.686E+01
2012	2.649E+03	2.121E+06	1.425E+02	7.075E+02	1.060E+06	7.125E+01
2013	3.005E+03	2.406E+06	1.617E+02	8.027E+02	1.203E+06	8.084E+01
2014	3.292E+03	2.636E+06	1.771E+02	8.794E+02	1.318E+06	8.856E+01
2015	3.518E+03	2.817E+06	1.893E+02	9.397E+02	1.409E+06	9.464E+01
2016	3.781E+03	3.028E+06	2.034E+02	1.010E+03	1.514E+06	1.017E+02
2017	4.006E+03	3.208E+06	2.155E+02	1.070E+03	1.604E+06	1.078E+02
2018	4.177E+03	3.344E+06	2.247E+02	1.116E+03	1.672E+06	1.124E+02
2019	4.370E+03	3.499E+06	2.351E+02	1.167E+03	1.750E+06	1.176E+02
2020	4.552E+03	3.645E+06	2.449E+02	1.216E+03	1.823E+06	1.225E+02
2021	4.723E+03	3.782E+06	2.541E+02	1.262E+03	1.891E+06	1.271E+02
2022	4.885E+03	3.912E+06	2.628E+02	1.305E+03	1.956E+06	1.314E+02
2023	5.037E+03	4.033E+06	2.710E+02	1.345E+03	2.017E+06	1.355E+02
2024	5.180E+03	4.148E+06	2.787E+02	1.384E+03	2.074E+06	1.394E+02
2025	5.315E+03	4.256E+06	2.860E+02	1.420E+03	2.128E+06	1.430E+02
2026	5.442E+03	4.358E+06	2.928E+02	1.454E+03	2.179E+06	1.464E+02
2027	5.562E+03	4.454E+06	2.992E+02	1.486E+03	2.227E+06	1.496E+02
2028	5.675E+03	4.544E+06	3.053E+02	1.516E+03	2.272E+06	1.527E+02
2029	5.781E+03	4.629E+06	3.110E+02	1.544E+03	2.314E+06	1.555E+02
2030	5.881E+03	4.709E+06	3.164E+02	1.571E+03	2.354E+06	1.582E+02
2031	5.975E+03	4.784E+06	3.215E+02	1.596E+03	2.392E+06	1.607E+02
2032	6.063E+03	4.855E+06	3.262E+02	1.620E+03	2.428E+06	1.631E+02
2033	6.147E+03	4.922E+06	3.307E+02	1.642E+03	2.461E+06	1.654E+02
2034	6.225E+03	4.985E+06	3.349E+02	1.663E+03	2.493E+06	1.675E+02
2035	6.300E+03	5.044E+06	3.389E+02	1.683E+03	2.522E+06	1.695E+02
2036	5.933E+03	4.751E+06	3.192E+02	1.585E+03	2.375E+06	1.596E+02
2037	5.587E+03	4.474E+06	3.006E+02	1.492E+03	2.237E+06	1.503E+02
2038	5.262E+03	4.213E+06	2.831E+02	1.405E+03	2.107E+06	1.415E+02
2039	4.955E+03	3.968E+06	2.666E+02	1.324E+03	1.984E+06	1.333E+02
2040	4.667E+03	3.737E+06	2.511E+02	1.247E+03	1.868E+06	1.255E+02
2041	4.395E+03	3.519E+06	2.365E+02	1.174E+03	1.760E+06	1.182E+02
2042	4.139E+03	3.314E+06	2.227E+02	1.106E+03	1.657E+06	1.113E+02
2043	3.898E+03	3.121E+06	2.097E+02	1.041E+03	1.561E+06	1.049E+02
2044	3.671E+03	2.940E+06	1.975E+02	9.806E+02	1.470E+06	9.876E+01
2045	3.457E+03	2.768E+06	1.860E+02	9.235E+02	1.384E+06	9.300E+01
2046	3.256E+03	2.607E+06	1.752E+02	8.697E+02	1.304E+06	8.759E+01
2047	3.066E+03	2.455E+06	1.650E+02	8.190E+02	1.228E+06	8.249E+01
2048	2.888E+03	2.312E+06	1.554E+02	7.713E+02	1.156E+06	7.768E+01
2049	2.720E+03	2.178E+06	1.463E+02	7.264E+02	1.089E+06	7.316E+01
2050	2.561E+03	2.051E+06	1.378E+02	6.841E+02	1.025E+06	6.890E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.412E+03	1.931E+06	1.298E+02	6.443E+02	9.657E+05	6.489E+01
2052	2.272E+03	1.819E+06	1.222E+02	6.068E+02	9.095E+05	6.111E+01
2053	2.139E+03	1.713E+06	1.151E+02	5.714E+02	8.565E+05	5.755E+01
2054	2.015E+03	1.613E+06	1.084E+02	5.381E+02	8.066E+05	5.420E+01
2055	1.897E+03	1.519E+06	1.021E+02	5.068E+02	7.597E+05	5.104E+01
2056	1.787E+03	1.431E+06	9.614E+01	4.773E+02	7.154E+05	4.807E+01
2057	1.683E+03	1.348E+06	9.054E+01	4.495E+02	6.738E+05	4.527E+01
2058	1.585E+03	1.269E+06	8.527E+01	4.233E+02	6.345E+05	4.263E+01
2059	1.493E+03	1.195E+06	8.030E+01	3.987E+02	5.976E+05	4.015E+01
2060	1.406E+03	1.126E+06	7.563E+01	3.755E+02	5.628E+05	3.781E+01
2061	1.324E+03	1.060E+06	7.122E+01	3.536E+02	5.300E+05	3.561E+01
2062	1.247E+03	9.983E+05	6.707E+01	3.330E+02	4.991E+05	3.354E+01
2063	1.174E+03	9.401E+05	6.317E+01	3.136E+02	4.701E+05	3.158E+01
2064	1.106E+03	8.854E+05	5.949E+01	2.953E+02	4.427E+05	2.974E+01
2065	1.041E+03	8.338E+05	5.602E+01	2.781E+02	4.169E+05	2.801E+01
2066	9.807E+02	7.853E+05	5.276E+01	2.619E+02	3.926E+05	2.638E+01
2067	9.236E+02	7.395E+05	4.969E+01	2.467E+02	3.698E+05	2.484E+01
2068	8.698E+02	6.965E+05	4.680E+01	2.323E+02	3.482E+05	2.340E+01
2069	8.191E+02	6.559E+05	4.407E+01	2.188E+02	3.280E+05	2.204E+01
2070	7.714E+02	6.177E+05	4.150E+01	2.061E+02	3.089E+05	2.075E+01
2071	7.265E+02	5.817E+05	3.909E+01	1.941E+02	2.909E+05	1.954E+01
2072	6.842E+02	5.479E+05	3.681E+01	1.828E+02	2.739E+05	1.841E+01
2073	6.443E+02	5.160E+05	3.467E+01	1.721E+02	2.580E+05	1.733E+01
2074	6.068E+02	4.859E+05	3.265E+01	1.621E+02	2.430E+05	1.632E+01
2075	5.715E+02	4.576E+05	3.075E+01	1.526E+02	2.288E+05	1.537E+01
2076	5.382E+02	4.310E+05	2.896E+01	1.438E+02	2.155E+05	1.448E+01
2077	5.069E+02	4.059E+05	2.727E+01	1.354E+02	2.029E+05	1.364E+01
2078	4.773E+02	3.822E+05	2.568E+01	1.275E+02	1.911E+05	1.284E+01
2079	4.495E+02	3.600E+05	2.419E+01	1.201E+02	1.800E+05	1.209E+01
2080	4.234E+02	3.390E+05	2.278E+01	1.131E+02	1.695E+05	1.139E+01
2081	3.987E+02	3.193E+05	2.145E+01	1.065E+02	1.596E+05	1.073E+01
2082	3.755E+02	3.007E+05	2.020E+01	1.003E+02	1.503E+05	1.010E+01
2083	3.536E+02	2.832E+05	1.903E+01	9.446E+01	1.416E+05	9.513E+00
2084	3.330E+02	2.667E+05	1.792E+01	8.896E+01	1.333E+05	8.959E+00
2085	3.136E+02	2.511E+05	1.687E+01	8.378E+01	1.256E+05	8.437E+00
2086	2.954E+02	2.365E+05	1.589E+01	7.890E+01	1.183E+05	7.946E+00
2087	2.782E+02	2.227E+05	1.497E+01	7.430E+01	1.114E+05	7.483E+00
2088	2.620E+02	2.098E+05	1.409E+01	6.997E+01	1.049E+05	7.047E+00
2089	2.467E+02	1.976E+05	1.327E+01	6.590E+01	9.878E+04	6.637E+00
2090	2.323E+02	1.861E+05	1.250E+01	6.206E+01	9.303E+04	6.250E+00
2091	2.188E+02	1.752E+05	1.177E+01	5.845E+01	8.761E+04	5.886E+00
2092	2.061E+02	1.650E+05	1.109E+01	5.504E+01	8.251E+04	5.544E+00
2093	1.941E+02	1.554E+05	1.044E+01	5.184E+01	7.770E+04	5.221E+00
2094	1.828E+02	1.464E+05	9.833E+00	4.882E+01	7.318E+04	4.917E+00
2095	1.721E+02	1.378E+05	9.261E+00	4.598E+01	6.892E+04	4.630E+00
2096	1.621E+02	1.298E+05	8.722E+00	4.330E+01	6.490E+04	4.361E+00
2097	1.527E+02	1.222E+05	8.214E+00	4.078E+01	6.112E+04	4.107E+00
2098	1.438E+02	1.151E+05	7.735E+00	3.840E+01	5.756E+04	3.868E+00
2099	1.354E+02	1.084E+05	7.285E+00	3.617E+01	5.421E+04	3.642E+00
2100	1.275E+02	1.021E+05	6.861E+00	3.406E+01	5.105E+04	3.430E+00
2101	1.201E+02	9.616E+04	6.461E+00	3.208E+01	4.808E+04	3.231E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2102	1.131E+02	9.056E+04	6.085E+00	3.021E+01	4.528E+04	3.042E+00
2103	1.065E+02	8.529E+04	5.730E+00	2.845E+01	4.264E+04	2.865E+00
2104	1.003E+02	8.032E+04	5.397E+00	2.679E+01	4.016E+04	2.698E+00
2105	9.446E+01	7.564E+04	5.082E+00	2.523E+01	3.782E+04	2.541E+00
2106	8.896E+01	7.124E+04	4.786E+00	2.376E+01	3.562E+04	2.393E+00
2107	8.378E+01	6.709E+04	4.508E+00	2.238E+01	3.354E+04	2.254E+00
2108	7.890E+01	6.318E+04	4.245E+00	2.108E+01	3.159E+04	2.123E+00
2109	7.431E+01	5.950E+04	3.998E+00	1.985E+01	2.975E+04	1.999E+00
2110	6.998E+01	5.604E+04	3.765E+00	1.869E+01	2.802E+04	1.883E+00
2111	6.591E+01	5.277E+04	3.546E+00	1.760E+01	2.639E+04	1.773E+00
2112	6.207E+01	4.970E+04	3.339E+00	1.658E+01	2.485E+04	1.670E+00
2113	5.845E+01	4.681E+04	3.145E+00	1.561E+01	2.340E+04	1.572E+00
2114	5.505E+01	4.408E+04	2.962E+00	1.470E+01	2.204E+04	1.481E+00
2115	5.184E+01	4.151E+04	2.789E+00	1.385E+01	2.076E+04	1.395E+00
2116	4.882E+01	3.910E+04	2.627E+00	1.304E+01	1.955E+04	1.313E+00
2117	4.598E+01	3.682E+04	2.474E+00	1.228E+01	1.841E+04	1.237E+00
2118	4.330E+01	3.468E+04	2.330E+00	1.157E+01	1.734E+04	1.165E+00
2119	4.078E+01	3.266E+04	2.194E+00	1.089E+01	1.633E+04	1.097E+00
2120	3.841E+01	3.075E+04	2.066E+00	1.026E+01	1.538E+04	1.033E+00
2121	3.617E+01	2.896E+04	1.946E+00	9.661E+00	1.448E+04	9.730E-01
2122	3.406E+01	2.728E+04	1.833E+00	9.099E+00	1.364E+04	9.164E-01
2123	3.208E+01	2.569E+04	1.726E+00	8.569E+00	1.284E+04	8.630E-01
2124	3.021E+01	2.419E+04	1.625E+00	8.070E+00	1.210E+04	8.127E-01
2125	2.845E+01	2.278E+04	1.531E+00	7.600E+00	1.139E+04	7.654E-01
2126	2.680E+01	2.146E+04	1.442E+00	7.157E+00	1.073E+04	7.208E-01
2127	2.523E+01	2.021E+04	1.358E+00	6.741E+00	1.010E+04	6.789E-01
2128	2.377E+01	1.903E+04	1.279E+00	6.348E+00	9.515E+03	6.393E-01
2129	2.238E+01	1.792E+04	1.204E+00	5.978E+00	8.961E+03	6.021E-01
2130	2.108E+01	1.688E+04	1.134E+00	5.630E+00	8.439E+03	5.670E-01
2131	1.985E+01	1.590E+04	1.068E+00	5.302E+00	7.948E+03	5.340E-01
2132	1.869E+01	1.497E+04	1.006E+00	4.993E+00	7.485E+03	5.029E-01
2133	1.761E+01	1.410E+04	9.472E-01	4.703E+00	7.049E+03	4.736E-01
2134	1.658E+01	1.328E+04	8.921E-01	4.429E+00	6.638E+03	4.460E-01
2135	1.561E+01	1.250E+04	8.401E-01	4.171E+00	6.252E+03	4.201E-01
2136	1.471E+01	1.178E+04	7.912E-01	3.928E+00	5.888E+03	3.956E-01
2137	1.385E+01	1.109E+04	7.451E-01	3.699E+00	5.545E+03	3.726E-01
2138	1.304E+01	1.044E+04	7.017E-01	3.484E+00	5.222E+03	3.509E-01
2139	1.228E+01	9.836E+03	6.609E-01	3.281E+00	4.918E+03	3.304E-01
2140	1.157E+01	9.263E+03	6.224E-01	3.090E+00	4.631E+03	3.112E-01
2141	1.089E+01	8.724E+03	5.861E-01	2.910E+00	4.362E+03	2.931E-01

Results (Continued)

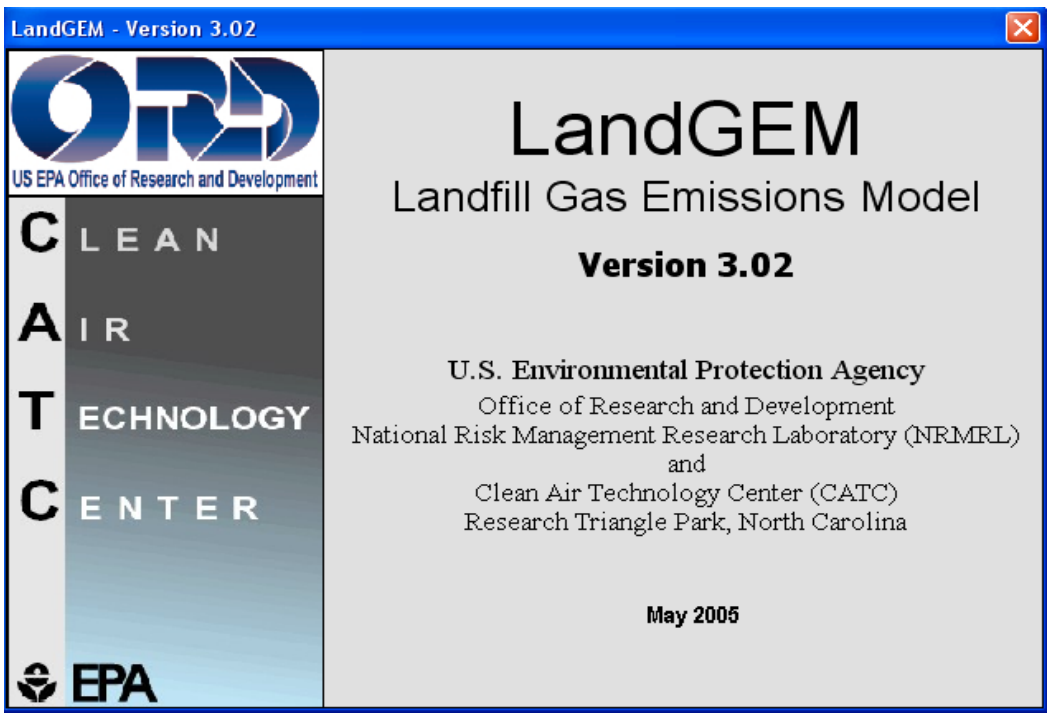
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	2.409E+02	1.316E+05	8.841E+00	3.773E+00	1.053E+03	7.073E-02
2003	5.931E+02	3.240E+05	2.177E+01	9.291E+00	2.592E+03	1.742E-01
2004	7.551E+02	4.125E+05	2.772E+01	1.183E+01	3.300E+03	2.217E-01
2005	9.012E+02	4.923E+05	3.308E+01	1.412E+01	3.939E+03	2.646E-01
2006	1.058E+03	5.780E+05	3.883E+01	1.657E+01	4.624E+03	3.107E-01
2007	1.278E+03	6.983E+05	4.692E+01	2.002E+01	5.586E+03	3.753E-01
2008	1.416E+03	7.735E+05	5.197E+01	2.218E+01	6.188E+03	4.158E-01
2009	1.559E+03	8.518E+05	5.723E+01	2.443E+01	6.814E+03	4.579E-01
2010	1.694E+03	9.256E+05	6.219E+01	2.654E+01	7.405E+03	4.975E-01
2011	1.821E+03	9.950E+05	6.686E+01	2.853E+01	7.960E+03	5.348E-01
2012	1.941E+03	1.060E+06	7.125E+01	3.041E+01	8.484E+03	5.700E-01
2013	2.202E+03	1.203E+06	8.084E+01	3.450E+01	9.625E+03	6.467E-01
2014	2.413E+03	1.318E+06	8.856E+01	3.780E+01	1.054E+04	7.085E-01
2015	2.578E+03	1.409E+06	9.464E+01	4.039E+01	1.127E+04	7.571E-01
2016	2.771E+03	1.514E+06	1.017E+02	4.341E+01	1.211E+04	8.137E-01
2017	2.936E+03	1.604E+06	1.078E+02	4.599E+01	1.283E+04	8.621E-01
2018	3.061E+03	1.672E+06	1.124E+02	4.795E+01	1.338E+04	8.988E-01
2019	3.203E+03	1.750E+06	1.176E+02	5.017E+01	1.400E+04	9.404E-01
2020	3.336E+03	1.823E+06	1.225E+02	5.226E+01	1.458E+04	9.796E-01
2021	3.462E+03	1.891E+06	1.271E+02	5.423E+01	1.513E+04	1.017E+00
2022	3.580E+03	1.956E+06	1.314E+02	5.609E+01	1.565E+04	1.051E+00
2023	3.692E+03	2.017E+06	1.355E+02	5.783E+01	1.613E+04	1.084E+00
2024	3.797E+03	2.074E+06	1.394E+02	5.948E+01	1.659E+04	1.115E+00
2025	3.895E+03	2.128E+06	1.430E+02	6.102E+01	1.702E+04	1.144E+00
2026	3.989E+03	2.179E+06	1.464E+02	6.248E+01	1.743E+04	1.171E+00
2027	4.076E+03	2.227E+06	1.496E+02	6.386E+01	1.781E+04	1.197E+00
2028	4.159E+03	2.272E+06	1.527E+02	6.515E+01	1.818E+04	1.221E+00
2029	4.237E+03	2.314E+06	1.555E+02	6.637E+01	1.852E+04	1.244E+00
2030	4.310E+03	2.354E+06	1.582E+02	6.752E+01	1.884E+04	1.266E+00
2031	4.379E+03	2.392E+06	1.607E+02	6.860E+01	1.914E+04	1.286E+00
2032	4.444E+03	2.428E+06	1.631E+02	6.961E+01	1.942E+04	1.305E+00
2033	4.505E+03	2.461E+06	1.654E+02	7.057E+01	1.969E+04	1.323E+00
2034	4.563E+03	2.493E+06	1.675E+02	7.148E+01	1.994E+04	1.340E+00
2035	4.617E+03	2.522E+06	1.695E+02	7.233E+01	2.018E+04	1.356E+00
2036	4.348E+03	2.375E+06	1.596E+02	6.811E+01	1.900E+04	1.277E+00
2037	4.095E+03	2.237E+06	1.503E+02	6.415E+01	1.790E+04	1.202E+00
2038	3.856E+03	2.107E+06	1.415E+02	6.041E+01	1.685E+04	1.132E+00
2039	3.632E+03	1.984E+06	1.333E+02	5.689E+01	1.587E+04	1.066E+00
2040	3.420E+03	1.868E+06	1.255E+02	5.358E+01	1.495E+04	1.004E+00
2041	3.221E+03	1.760E+06	1.182E+02	5.046E+01	1.408E+04	9.459E-01
2042	3.033E+03	1.657E+06	1.113E+02	4.752E+01	1.326E+04	8.908E-01
2043	2.857E+03	1.561E+06	1.049E+02	4.475E+01	1.249E+04	8.389E-01
2044	2.690E+03	1.470E+06	9.876E+01	4.215E+01	1.176E+04	7.900E-01
2045	2.534E+03	1.384E+06	9.300E+01	3.969E+01	1.107E+04	7.440E-01
2046	2.386E+03	1.304E+06	8.759E+01	3.738E+01	1.043E+04	7.007E-01
2047	2.247E+03	1.228E+06	8.249E+01	3.520E+01	9.821E+03	6.599E-01
2048	2.116E+03	1.156E+06	7.768E+01	3.315E+01	9.249E+03	6.215E-01
2049	1.993E+03	1.089E+06	7.316E+01	3.122E+01	8.711E+03	5.853E-01
2050	1.877E+03	1.025E+06	6.890E+01	2.941E+01	8.204E+03	5.512E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.768E+03	9.657E+05	6.489E+01	2.769E+01	7.726E+03	5.191E-01
2052	1.665E+03	9.095E+05	6.111E+01	2.608E+01	7.276E+03	4.889E-01
2053	1.568E+03	8.565E+05	5.755E+01	2.456E+01	6.852E+03	4.604E-01
2054	1.477E+03	8.066E+05	5.420E+01	2.313E+01	6.453E+03	4.336E-01
2055	1.391E+03	7.597E+05	5.104E+01	2.178E+01	6.077E+03	4.083E-01
2056	1.310E+03	7.154E+05	4.807E+01	2.052E+01	5.723E+03	3.846E-01
2057	1.233E+03	6.738E+05	4.527E+01	1.932E+01	5.390E+03	3.622E-01
2058	1.162E+03	6.345E+05	4.263E+01	1.820E+01	5.076E+03	3.411E-01
2059	1.094E+03	5.976E+05	4.015E+01	1.714E+01	4.781E+03	3.212E-01
2060	1.030E+03	5.628E+05	3.781E+01	1.614E+01	4.502E+03	3.025E-01
2061	9.702E+02	5.300E+05	3.561E+01	1.520E+01	4.240E+03	2.849E-01
2062	9.137E+02	4.991E+05	3.354E+01	1.431E+01	3.993E+03	2.683E-01
2063	8.605E+02	4.701E+05	3.158E+01	1.348E+01	3.761E+03	2.527E-01
2064	8.104E+02	4.427E+05	2.974E+01	1.269E+01	3.542E+03	2.380E-01
2065	7.632E+02	4.169E+05	2.801E+01	1.196E+01	3.335E+03	2.241E-01
2066	7.187E+02	3.926E+05	2.638E+01	1.126E+01	3.141E+03	2.110E-01
2067	6.769E+02	3.698E+05	2.484E+01	1.060E+01	2.958E+03	1.988E-01
2068	6.374E+02	3.482E+05	2.340E+01	9.986E+00	2.786E+03	1.872E-01
2069	6.003E+02	3.280E+05	2.204E+01	9.404E+00	2.624E+03	1.763E-01
2070	5.654E+02	3.089E+05	2.075E+01	8.857E+00	2.471E+03	1.660E-01
2071	5.324E+02	2.909E+05	1.954E+01	8.341E+00	2.327E+03	1.563E-01
2072	5.014E+02	2.739E+05	1.841E+01	7.855E+00	2.191E+03	1.472E-01
2073	4.722E+02	2.580E+05	1.733E+01	7.398E+00	2.064E+03	1.387E-01
2074	4.447E+02	2.430E+05	1.632E+01	6.967E+00	1.944E+03	1.306E-01
2075	4.188E+02	2.288E+05	1.537E+01	6.561E+00	1.830E+03	1.230E-01
2076	3.944E+02	2.155E+05	1.448E+01	6.179E+00	1.724E+03	1.158E-01
2077	3.715E+02	2.029E+05	1.364E+01	5.819E+00	1.623E+03	1.091E-01
2078	3.498E+02	1.911E+05	1.284E+01	5.480E+00	1.529E+03	1.027E-01
2079	3.295E+02	1.800E+05	1.209E+01	5.161E+00	1.440E+03	9.675E-02
2080	3.103E+02	1.695E+05	1.139E+01	4.861E+00	1.356E+03	9.111E-02
2081	2.922E+02	1.596E+05	1.073E+01	4.578E+00	1.277E+03	8.581E-02
2082	2.752E+02	1.503E+05	1.010E+01	4.311E+00	1.203E+03	8.081E-02
2083	2.592E+02	1.416E+05	9.513E+00	4.060E+00	1.133E+03	7.610E-02
2084	2.441E+02	1.333E+05	8.959E+00	3.824E+00	1.067E+03	7.167E-02
2085	2.299E+02	1.256E+05	8.437E+00	3.601E+00	1.005E+03	6.750E-02
2086	2.165E+02	1.183E+05	7.946E+00	3.391E+00	9.461E+02	6.357E-02
2087	2.039E+02	1.114E+05	7.483E+00	3.194E+00	8.910E+02	5.986E-02
2088	1.920E+02	1.049E+05	7.047E+00	3.008E+00	8.391E+02	5.638E-02
2089	1.808E+02	9.878E+04	6.637E+00	2.833E+00	7.902E+02	5.310E-02
2090	1.703E+02	9.303E+04	6.250E+00	2.668E+00	7.442E+02	5.000E-02
2091	1.604E+02	8.761E+04	5.886E+00	2.512E+00	7.009E+02	4.709E-02
2092	1.510E+02	8.251E+04	5.544E+00	2.366E+00	6.601E+02	4.435E-02
2093	1.422E+02	7.770E+04	5.221E+00	2.228E+00	6.216E+02	4.177E-02
2094	1.340E+02	7.318E+04	4.917E+00	2.098E+00	5.854E+02	3.933E-02
2095	1.261E+02	6.892E+04	4.630E+00	1.976E+00	5.513E+02	3.704E-02
2096	1.188E+02	6.490E+04	4.361E+00	1.861E+00	5.192E+02	3.489E-02
2097	1.119E+02	6.112E+04	4.107E+00	1.753E+00	4.890E+02	3.285E-02
2098	1.054E+02	5.756E+04	3.868E+00	1.651E+00	4.605E+02	3.094E-02
2099	9.923E+01	5.421E+04	3.642E+00	1.555E+00	4.337E+02	2.914E-02
2100	9.345E+01	5.105E+04	3.430E+00	1.464E+00	4.084E+02	2.744E-02
2101	8.801E+01	4.808E+04	3.231E+00	1.379E+00	3.846E+02	2.584E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	8.289E+01	4.528E+04	3.042E+00	1.298E+00	3.622E+02	2.434E-02
2103	7.806E+01	4.264E+04	2.865E+00	1.223E+00	3.411E+02	2.292E-02
2104	7.351E+01	4.016E+04	2.698E+00	1.152E+00	3.213E+02	2.159E-02
2105	6.923E+01	3.782E+04	2.541E+00	1.085E+00	3.026E+02	2.033E-02
2106	6.520E+01	3.562E+04	2.393E+00	1.021E+00	2.850E+02	1.915E-02
2107	6.140E+01	3.354E+04	2.254E+00	9.619E-01	2.684E+02	1.803E-02
2108	5.783E+01	3.159E+04	2.123E+00	9.059E-01	2.527E+02	1.698E-02
2109	5.446E+01	2.975E+04	1.999E+00	8.531E-01	2.380E+02	1.599E-02
2110	5.129E+01	2.802E+04	1.883E+00	8.035E-01	2.242E+02	1.506E-02
2111	4.830E+01	2.639E+04	1.773E+00	7.567E-01	2.111E+02	1.418E-02
2112	4.549E+01	2.485E+04	1.670E+00	7.126E-01	1.988E+02	1.336E-02
2113	4.284E+01	2.340E+04	1.572E+00	6.711E-01	1.872E+02	1.258E-02
2114	4.035E+01	2.204E+04	1.481E+00	6.320E-01	1.763E+02	1.185E-02
2115	3.800E+01	2.076E+04	1.395E+00	5.952E-01	1.661E+02	1.116E-02
2116	3.578E+01	1.955E+04	1.313E+00	5.606E-01	1.564E+02	1.051E-02
2117	3.370E+01	1.841E+04	1.237E+00	5.279E-01	1.473E+02	9.896E-03
2118	3.174E+01	1.734E+04	1.165E+00	4.972E-01	1.387E+02	9.319E-03
2119	2.989E+01	1.633E+04	1.097E+00	4.682E-01	1.306E+02	8.777E-03
2120	2.815E+01	1.538E+04	1.033E+00	4.409E-01	1.230E+02	8.265E-03
2121	2.651E+01	1.448E+04	9.730E-01	4.153E-01	1.159E+02	7.784E-03
2122	2.496E+01	1.364E+04	9.164E-01	3.911E-01	1.091E+02	7.331E-03
2123	2.351E+01	1.284E+04	8.630E-01	3.683E-01	1.028E+02	6.904E-03
2124	2.214E+01	1.210E+04	8.127E-01	3.469E-01	9.677E+01	6.502E-03
2125	2.085E+01	1.139E+04	7.654E-01	3.267E-01	9.113E+01	6.123E-03
2126	1.964E+01	1.073E+04	7.208E-01	3.076E-01	8.583E+01	5.767E-03
2127	1.849E+01	1.010E+04	6.789E-01	2.897E-01	8.083E+01	5.431E-03
2128	1.742E+01	9.515E+03	6.393E-01	2.729E-01	7.612E+01	5.115E-03
2129	1.640E+01	8.961E+03	6.021E-01	2.570E-01	7.169E+01	4.817E-03
2130	1.545E+01	8.439E+03	5.670E-01	2.420E-01	6.751E+01	4.536E-03
2131	1.455E+01	7.948E+03	5.340E-01	2.279E-01	6.358E+01	4.272E-03
2132	1.370E+01	7.485E+03	5.029E-01	2.146E-01	5.988E+01	4.023E-03
2133	1.290E+01	7.049E+03	4.736E-01	2.021E-01	5.639E+01	3.789E-03
2134	1.215E+01	6.638E+03	4.460E-01	1.904E-01	5.311E+01	3.568E-03
2135	1.144E+01	6.252E+03	4.201E-01	1.793E-01	5.001E+01	3.360E-03
2136	1.078E+01	5.888E+03	3.956E-01	1.688E-01	4.710E+01	3.165E-03
2137	1.015E+01	5.545E+03	3.726E-01	1.590E-01	4.436E+01	2.980E-03
2138	9.559E+00	5.222E+03	3.509E-01	1.497E-01	4.178E+01	2.807E-03
2139	9.002E+00	4.918E+03	3.304E-01	1.410E-01	3.934E+01	2.643E-03
2140	8.478E+00	4.631E+03	3.112E-01	1.328E-01	3.705E+01	2.490E-03
2141	7.984E+00	4.362E+03	2.931E-01	1.251E-01	3.489E+01	2.345E-03



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Thursday, November 28, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2001**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2001	20,479	22,527	0	0
2002	31,140	34,254	20,479	22,527
2003	16,714	18,385	51,619	56,781
2004	16,163	17,779	68,333	75,166
2005	17,787	19,566	84,496	92,946
2006	23,965	26,362	102,283	112,511
2007	18,035	19,839	126,248	138,873
2008	19,200	21,120	144,283	158,711
2009	19,200	21,120	163,483	179,831
2010	19,200	21,120	182,683	200,951
2011	19,200	21,120	201,883	222,071
2012	31,824	35,006	221,083	243,191
2013	28,791	31,670	252,907	278,198
2014	26,030	28,633	281,698	309,868
2015	29,152	32,067	307,728	338,501
2016	27,736	30,510	336,880	370,568
2017	25,167	27,684	364,616	401,078
2018	27,205	29,926	389,783	428,761
2019	27,205	29,926	416,988	458,687
2020	27,205	29,926	444,193	488,612
2021	27,205	29,926	471,398	518,538
2022	27,205	29,926	498,603	548,463
2023	27,205	29,926	525,808	578,389
2024	27,205	29,926	553,013	608,314
2025	27,205	29,926	580,218	638,240
2026	27,205	29,926	607,423	668,165
2027	27,205	29,926	634,628	698,091
2028	27,205	29,926	661,833	728,016
2029	27,205	29,926	689,038	757,942
2030	27,205	29,926	716,243	787,867
2031	27,205	29,926	743,448	817,793
2032	27,205	29,926	770,653	847,718
2033	27,205	29,926	797,858	877,644
2034	27,205	29,926	825,063	907,569
2035	0	0	852,268	937,495
2036	0	0	852,268	937,495
2037	0	0	852,268	937,495
2038	0	0	852,268	937,495
2039	0	0	852,268	937,495
2040	0	0	852,268	937,495

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2041	0	0	852,268	937,495
2042	0	0	852,268	937,495
2043	0	0	852,268	937,495
2044	0	0	852,268	937,495
2045	0	0	852,268	937,495
2046	0	0	852,268	937,495
2047	0	0	852,268	937,495
2048	0	0	852,268	937,495
2049	0	0	852,268	937,495
2050	0	0	852,268	937,495
2051	0	0	852,268	937,495
2052	0	0	852,268	937,495
2053	0	0	852,268	937,495
2054	0	0	852,268	937,495
2055	0	0	852,268	937,495
2056	0	0	852,268	937,495
2057	0	0	852,268	937,495
2058	0	0	852,268	937,495
2059	0	0	852,268	937,495
2060	0	0	852,268	937,495
2061	0	0	852,268	937,495
2062	0	0	852,268	937,495
2063	0	0	852,268	937,495
2064	0	0	852,268	937,495
2065	0	0	852,268	937,495
2066	0	0	852,268	937,495
2067	0	0	852,268	937,495
2068	0	0	852,268	937,495
2069	0	0	852,268	937,495
2070	0	0	852,268	937,495
2071	0	0	852,268	937,495
2072	0	0	852,268	937,495
2073	0	0	852,268	937,495
2074	0	0	852,268	937,495
2075	0	0	852,268	937,495
2076	0	0	852,268	937,495
2077	0	0	852,268	937,495
2078	0	0	852,268	937,495
2079	0	0	852,268	937,495
2080	0	0	852,268	937,495

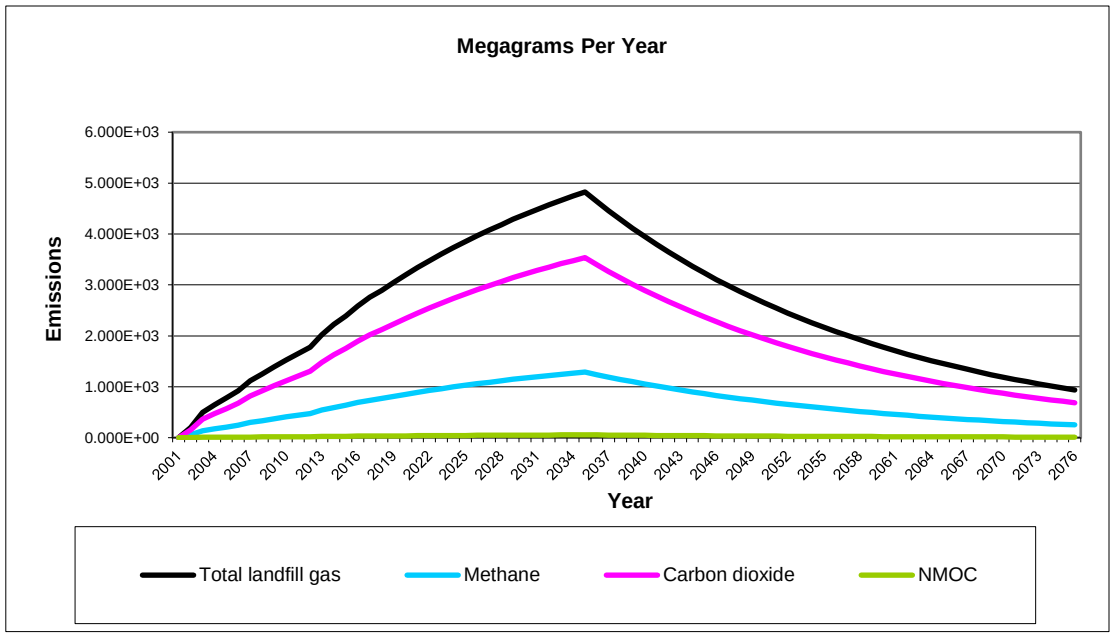
Pollutant Parameters

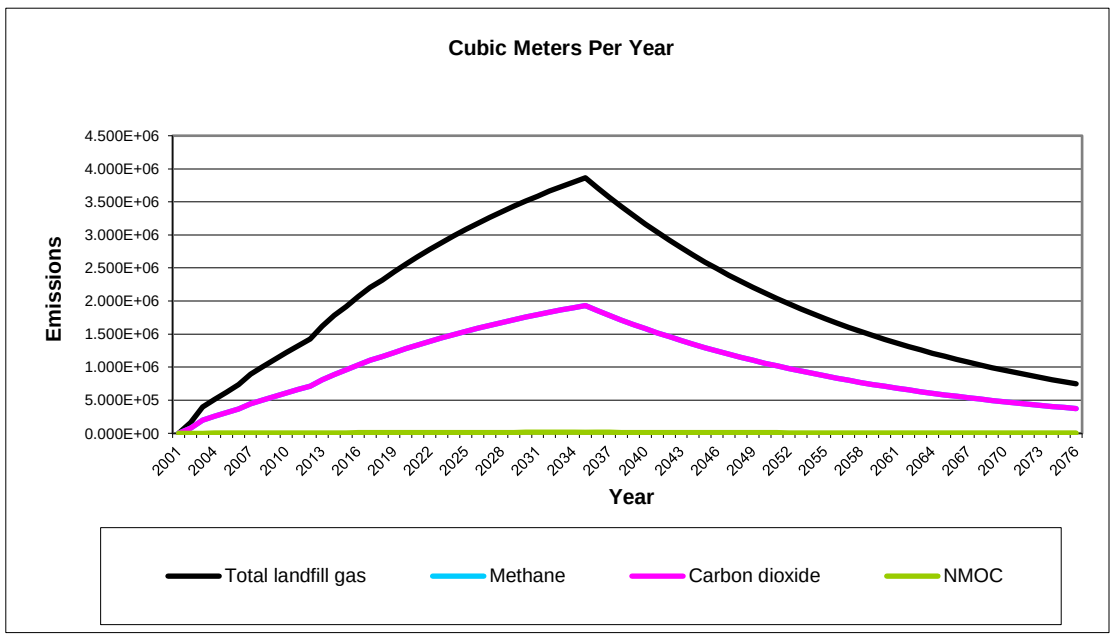
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

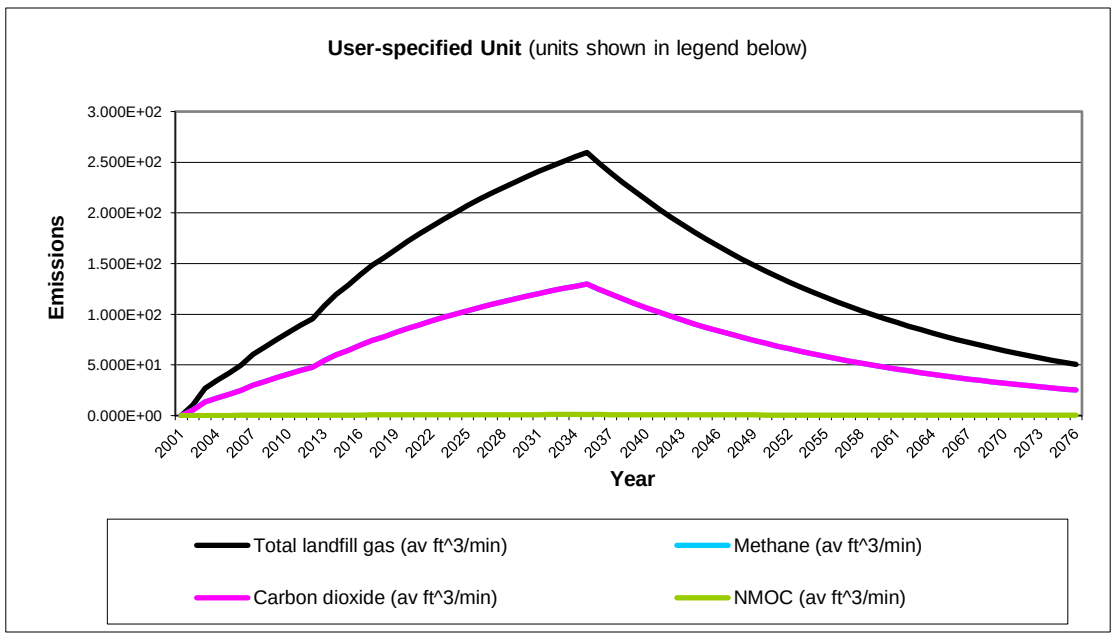
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
4.500E+06
4.000E+06
3.500E+06
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	2.010E+02	1.609E+05	1.081E+01	5.368E+01	8.046E+04	5.406E+00
2003	4.987E+02	3.993E+05	2.683E+01	1.332E+02	1.997E+05	1.341E+01
2004	6.431E+02	5.150E+05	3.460E+01	1.718E+02	2.575E+05	1.730E+01
2005	7.765E+02	6.218E+05	4.178E+01	2.074E+02	3.109E+05	2.089E+01
2006	9.206E+02	7.372E+05	4.953E+01	2.459E+02	3.686E+05	2.477E+01
2007	1.120E+03	8.966E+05	6.024E+01	2.991E+02	4.483E+05	3.012E+01
2008	1.253E+03	1.003E+06	6.740E+01	3.346E+02	5.016E+05	3.370E+01
2009	1.392E+03	1.115E+06	7.490E+01	3.718E+02	5.573E+05	3.745E+01
2010	1.526E+03	1.222E+06	8.210E+01	4.076E+02	6.109E+05	4.105E+01
2011	1.654E+03	1.325E+06	8.901E+01	4.419E+02	6.624E+05	4.451E+01
2012	1.778E+03	1.424E+06	9.566E+01	4.749E+02	7.119E+05	4.783E+01
2013	2.021E+03	1.618E+06	1.087E+02	5.397E+02	8.090E+05	5.436E+01
2014	2.224E+03	1.781E+06	1.196E+02	5.940E+02	8.904E+05	5.982E+01
2015	2.392E+03	1.915E+06	1.287E+02	6.390E+02	9.577E+05	6.435E+01
2016	2.584E+03	2.069E+06	1.390E+02	6.903E+02	1.035E+06	6.952E+01
2017	2.755E+03	2.206E+06	1.482E+02	7.359E+02	1.103E+06	7.412E+01
2018	2.894E+03	2.317E+06	1.557E+02	7.731E+02	1.159E+06	7.786E+01
2019	3.048E+03	2.440E+06	1.640E+02	8.141E+02	1.220E+06	8.198E+01
2020	3.195E+03	2.558E+06	1.719E+02	8.534E+02	1.279E+06	8.595E+01
2021	3.337E+03	2.672E+06	1.795E+02	8.913E+02	1.336E+06	8.976E+01
2022	3.473E+03	2.781E+06	1.869E+02	9.276E+02	1.390E+06	9.343E+01
2023	3.604E+03	2.886E+06	1.939E+02	9.626E+02	1.443E+06	9.694E+01
2024	3.729E+03	2.986E+06	2.006E+02	9.961E+02	1.493E+06	1.003E+02
2025	3.850E+03	3.083E+06	2.071E+02	1.028E+03	1.541E+06	1.036E+02
2026	3.966E+03	3.176E+06	2.134E+02	1.059E+03	1.588E+06	1.067E+02
2027	4.078E+03	3.265E+06	2.194E+02	1.089E+03	1.633E+06	1.097E+02
2028	4.185E+03	3.351E+06	2.251E+02	1.118E+03	1.675E+06	1.126E+02
2029	4.287E+03	3.433E+06	2.307E+02	1.145E+03	1.717E+06	1.153E+02
2030	4.386E+03	3.512E+06	2.360E+02	1.172E+03	1.756E+06	1.180E+02
2031	4.481E+03	3.588E+06	2.411E+02	1.197E+03	1.794E+06	1.206E+02
2032	4.573E+03	3.661E+06	2.460E+02	1.221E+03	1.831E+06	1.230E+02
2033	4.660E+03	3.732E+06	2.507E+02	1.245E+03	1.866E+06	1.254E+02
2034	4.744E+03	3.799E+06	2.553E+02	1.267E+03	1.900E+06	1.276E+02
2035	4.825E+03	3.864E+06	2.596E+02	1.289E+03	1.932E+06	1.298E+02
2036	4.636E+03	3.712E+06	2.494E+02	1.238E+03	1.856E+06	1.247E+02
2037	4.454E+03	3.567E+06	2.397E+02	1.190E+03	1.783E+06	1.198E+02
2038	4.280E+03	3.427E+06	2.303E+02	1.143E+03	1.714E+06	1.151E+02
2039	4.112E+03	3.293E+06	2.212E+02	1.098E+03	1.646E+06	1.106E+02
2040	3.951E+03	3.164E+06	2.126E+02	1.055E+03	1.582E+06	1.063E+02
2041	3.796E+03	3.039E+06	2.042E+02	1.014E+03	1.520E+06	1.021E+02
2042	3.647E+03	2.920E+06	1.962E+02	9.741E+02	1.460E+06	9.811E+01
2043	3.504E+03	2.806E+06	1.885E+02	9.359E+02	1.403E+06	9.426E+01
2044	3.367E+03	2.696E+06	1.811E+02	8.992E+02	1.348E+06	9.056E+01
2045	3.235E+03	2.590E+06	1.740E+02	8.640E+02	1.295E+06	8.701E+01
2046	3.108E+03	2.489E+06	1.672E+02	8.301E+02	1.244E+06	8.360E+01
2047	2.986E+03	2.391E+06	1.606E+02	7.976E+02	1.195E+06	8.032E+01
2048	2.869E+03	2.297E+06	1.543E+02	7.663E+02	1.149E+06	7.717E+01
2049	2.756E+03	2.207E+06	1.483E+02	7.362E+02	1.104E+06	7.415E+01
2050	2.648E+03	2.121E+06	1.425E+02	7.074E+02	1.060E+06	7.124E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	2.544E+03	2.037E+06	1.369E+02	6.796E+02	1.019E+06	6.845E+01
2052	2.445E+03	1.958E+06	1.315E+02	6.530E+02	9.788E+05	6.576E+01
2053	2.349E+03	1.881E+06	1.264E+02	6.274E+02	9.404E+05	6.318E+01
2054	2.257E+03	1.807E+06	1.214E+02	6.028E+02	9.035E+05	6.071E+01
2055	2.168E+03	1.736E+06	1.167E+02	5.791E+02	8.681E+05	5.833E+01
2056	2.083E+03	1.668E+06	1.121E+02	5.564E+02	8.341E+05	5.604E+01
2057	2.001E+03	1.603E+06	1.077E+02	5.346E+02	8.014E+05	5.384E+01
2058	1.923E+03	1.540E+06	1.035E+02	5.137E+02	7.699E+05	5.173E+01
2059	1.848E+03	1.479E+06	9.941E+01	4.935E+02	7.397E+05	4.970E+01
2060	1.775E+03	1.421E+06	9.551E+01	4.742E+02	7.107E+05	4.775E+01
2061	1.706E+03	1.366E+06	9.176E+01	4.556E+02	6.829E+05	4.588E+01
2062	1.639E+03	1.312E+06	8.817E+01	4.377E+02	6.561E+05	4.408E+01
2063	1.574E+03	1.261E+06	8.471E+01	4.205E+02	6.304E+05	4.235E+01
2064	1.513E+03	1.211E+06	8.139E+01	4.041E+02	6.056E+05	4.069E+01
2065	1.453E+03	1.164E+06	7.820E+01	3.882E+02	5.819E+05	3.910E+01
2066	1.396E+03	1.118E+06	7.513E+01	3.730E+02	5.591E+05	3.756E+01
2067	1.342E+03	1.074E+06	7.218E+01	3.584E+02	5.372E+05	3.609E+01
2068	1.289E+03	1.032E+06	6.935E+01	3.443E+02	5.161E+05	3.468E+01
2069	1.238E+03	9.917E+05	6.663E+01	3.308E+02	4.959E+05	3.332E+01
2070	1.190E+03	9.528E+05	6.402E+01	3.178E+02	4.764E+05	3.201E+01
2071	1.143E+03	9.155E+05	6.151E+01	3.054E+02	4.577E+05	3.076E+01
2072	1.098E+03	8.796E+05	5.910E+01	2.934E+02	4.398E+05	2.955E+01
2073	1.055E+03	8.451E+05	5.678E+01	2.819E+02	4.225E+05	2.839E+01
2074	1.014E+03	8.120E+05	5.456E+01	2.708E+02	4.060E+05	2.728E+01
2075	9.742E+02	7.801E+05	5.242E+01	2.602E+02	3.901E+05	2.621E+01
2076	9.360E+02	7.495E+05	5.036E+01	2.500E+02	3.748E+05	2.518E+01
2077	8.993E+02	7.201E+05	4.839E+01	2.402E+02	3.601E+05	2.419E+01
2078	8.641E+02	6.919E+05	4.649E+01	2.308E+02	3.460E+05	2.324E+01
2079	8.302E+02	6.648E+05	4.467E+01	2.218E+02	3.324E+05	2.233E+01
2080	7.976E+02	6.387E+05	4.291E+01	2.131E+02	3.194E+05	2.146E+01
2081	7.664E+02	6.137E+05	4.123E+01	2.047E+02	3.068E+05	2.062E+01
2082	7.363E+02	5.896E+05	3.962E+01	1.967E+02	2.948E+05	1.981E+01
2083	7.074E+02	5.665E+05	3.806E+01	1.890E+02	2.832E+05	1.903E+01
2084	6.797E+02	5.443E+05	3.657E+01	1.816E+02	2.721E+05	1.828E+01
2085	6.530E+02	5.229E+05	3.514E+01	1.744E+02	2.615E+05	1.757E+01
2086	6.274E+02	5.024E+05	3.376E+01	1.676E+02	2.512E+05	1.688E+01
2087	6.028E+02	4.827E+05	3.243E+01	1.610E+02	2.414E+05	1.622E+01
2088	5.792E+02	4.638E+05	3.116E+01	1.547E+02	2.319E+05	1.558E+01
2089	5.565E+02	4.456E+05	2.994E+01	1.486E+02	2.228E+05	1.497E+01
2090	5.347E+02	4.281E+05	2.877E+01	1.428E+02	2.141E+05	1.438E+01
2091	5.137E+02	4.114E+05	2.764E+01	1.372E+02	2.057E+05	1.382E+01
2092	4.936E+02	3.952E+05	2.655E+01	1.318E+02	1.976E+05	1.328E+01
2093	4.742E+02	3.797E+05	2.551E+01	1.267E+02	1.899E+05	1.276E+01
2094	4.556E+02	3.648E+05	2.451E+01	1.217E+02	1.824E+05	1.226E+01
2095	4.377E+02	3.505E+05	2.355E+01	1.169E+02	1.753E+05	1.178E+01
2096	4.206E+02	3.368E+05	2.263E+01	1.123E+02	1.684E+05	1.131E+01
2097	4.041E+02	3.236E+05	2.174E+01	1.079E+02	1.618E+05	1.087E+01
2098	3.882E+02	3.109E+05	2.089E+01	1.037E+02	1.554E+05	1.044E+01
2099	3.730E+02	2.987E+05	2.007E+01	9.964E+01	1.494E+05	1.003E+01
2100	3.584E+02	2.870E+05	1.928E+01	9.573E+01	1.435E+05	9.641E+00
2101	3.443E+02	2.757E+05	1.853E+01	9.198E+01	1.379E+05	9.263E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	3.308E+02	2.649E+05	1.780E+01	8.837E+01	1.325E+05	8.900E+00
2103	3.179E+02	2.545E+05	1.710E+01	8.491E+01	1.273E+05	8.551E+00
2104	3.054E+02	2.446E+05	1.643E+01	8.158E+01	1.223E+05	8.216E+00
2105	2.934E+02	2.350E+05	1.579E+01	7.838E+01	1.175E+05	7.894E+00
2106	2.819E+02	2.258E+05	1.517E+01	7.531E+01	1.129E+05	7.584E+00
2107	2.709E+02	2.169E+05	1.457E+01	7.235E+01	1.085E+05	7.287E+00
2108	2.603E+02	2.084E+05	1.400E+01	6.952E+01	1.042E+05	7.001E+00
2109	2.500E+02	2.002E+05	1.345E+01	6.679E+01	1.001E+05	6.727E+00
2110	2.402E+02	1.924E+05	1.293E+01	6.417E+01	9.619E+04	6.463E+00
2111	2.308E+02	1.848E+05	1.242E+01	6.166E+01	9.242E+04	6.209E+00
2112	2.218E+02	1.776E+05	1.193E+01	5.924E+01	8.879E+04	5.966E+00
2113	2.131E+02	1.706E+05	1.146E+01	5.691E+01	8.531E+04	5.732E+00
2114	2.047E+02	1.639E+05	1.101E+01	5.468E+01	8.197E+04	5.507E+00
2115	1.967E+02	1.575E+05	1.058E+01	5.254E+01	7.875E+04	5.291E+00
2116	1.890E+02	1.513E+05	1.017E+01	5.048E+01	7.566E+04	5.084E+00
2117	1.816E+02	1.454E+05	9.769E+00	4.850E+01	7.270E+04	4.884E+00
2118	1.745E+02	1.397E+05	9.386E+00	4.660E+01	6.985E+04	4.693E+00
2119	1.676E+02	1.342E+05	9.018E+00	4.477E+01	6.711E+04	4.509E+00
2120	1.610E+02	1.290E+05	8.664E+00	4.302E+01	6.448E+04	4.332E+00
2121	1.547E+02	1.239E+05	8.325E+00	4.133E+01	6.195E+04	4.162E+00
2122	1.487E+02	1.190E+05	7.998E+00	3.971E+01	5.952E+04	3.999E+00
2123	1.428E+02	1.144E+05	7.685E+00	3.815E+01	5.719E+04	3.842E+00
2124	1.372E+02	1.099E+05	7.383E+00	3.666E+01	5.494E+04	3.692E+00
2125	1.318E+02	1.056E+05	7.094E+00	3.522E+01	5.279E+04	3.547E+00
2126	1.267E+02	1.014E+05	6.816E+00	3.384E+01	5.072E+04	3.408E+00
2127	1.217E+02	9.746E+04	6.548E+00	3.251E+01	4.873E+04	3.274E+00
2128	1.169E+02	9.364E+04	6.292E+00	3.124E+01	4.682E+04	3.146E+00
2129	1.124E+02	8.997E+04	6.045E+00	3.001E+01	4.498E+04	3.022E+00
2130	1.079E+02	8.644E+04	5.808E+00	2.883E+01	4.322E+04	2.904E+00
2131	1.037E+02	8.305E+04	5.580E+00	2.770E+01	4.153E+04	2.790E+00
2132	9.965E+01	7.979E+04	5.361E+00	2.662E+01	3.990E+04	2.681E+00
2133	9.574E+01	7.666E+04	5.151E+00	2.557E+01	3.833E+04	2.576E+00
2134	9.199E+01	7.366E+04	4.949E+00	2.457E+01	3.683E+04	2.475E+00
2135	8.838E+01	7.077E+04	4.755E+00	2.361E+01	3.539E+04	2.378E+00
2136	8.491E+01	6.800E+04	4.569E+00	2.268E+01	3.400E+04	2.284E+00
2137	8.159E+01	6.533E+04	4.389E+00	2.179E+01	3.266E+04	2.195E+00
2138	7.839E+01	6.277E+04	4.217E+00	2.094E+01	3.138E+04	2.109E+00
2139	7.531E+01	6.031E+04	4.052E+00	2.012E+01	3.015E+04	2.026E+00
2140	7.236E+01	5.794E+04	3.893E+00	1.933E+01	2.897E+04	1.947E+00
2141	6.952E+01	5.567E+04	3.740E+00	1.857E+01	2.784E+04	1.870E+00

Results (Continued)

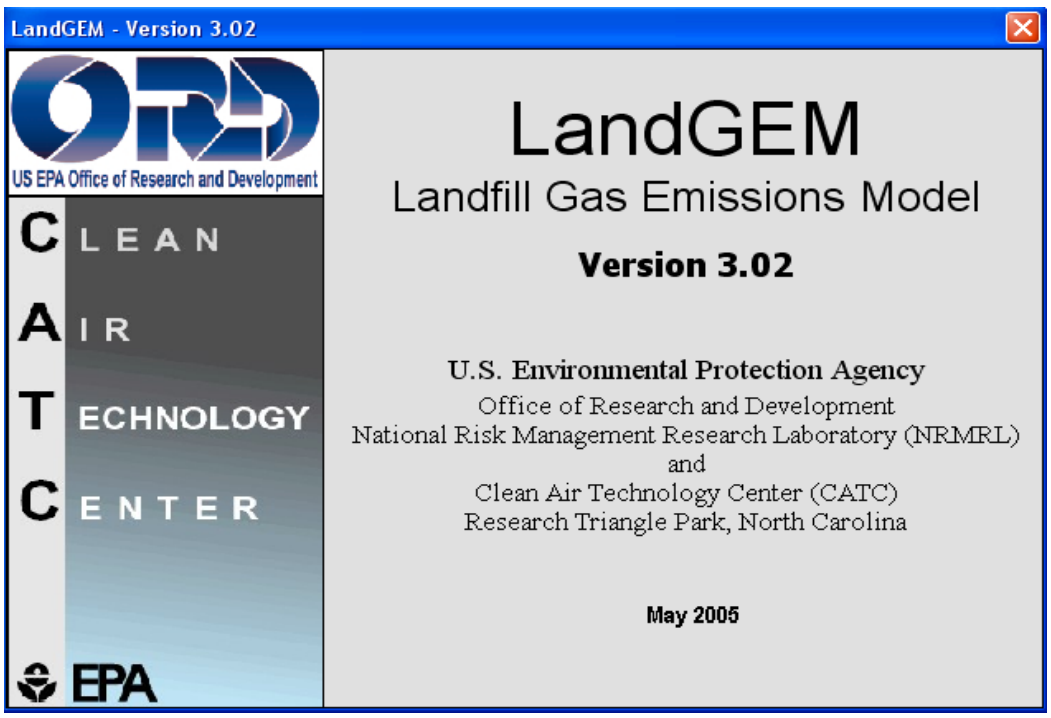
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2001	0	0	0	0	0	0
2002	1.473E+02	8.046E+04	5.406E+00	2.307E+00	6.437E+02	4.325E-02
2003	3.655E+02	1.997E+05	1.341E+01	5.725E+00	1.597E+03	1.073E-01
2004	4.713E+02	2.575E+05	1.730E+01	7.384E+00	2.060E+03	1.384E-01
2005	5.691E+02	3.109E+05	2.089E+01	8.915E+00	2.487E+03	1.671E-01
2006	6.747E+02	3.686E+05	2.477E+01	1.057E+01	2.949E+03	1.981E-01
2007	8.206E+02	4.483E+05	3.012E+01	1.286E+01	3.586E+03	2.410E-01
2008	9.181E+02	5.016E+05	3.370E+01	1.438E+01	4.013E+03	2.696E-01
2009	1.020E+03	5.573E+05	3.745E+01	1.598E+01	4.459E+03	2.996E-01
2010	1.118E+03	6.109E+05	4.105E+01	1.752E+01	4.887E+03	3.284E-01
2011	1.213E+03	6.624E+05	4.451E+01	1.899E+01	5.299E+03	3.561E-01
2012	1.303E+03	7.119E+05	4.783E+01	2.041E+01	5.695E+03	3.826E-01
2013	1.481E+03	8.090E+05	5.436E+01	2.320E+01	6.472E+03	4.348E-01
2014	1.630E+03	8.904E+05	5.982E+01	2.553E+01	7.123E+03	4.786E-01
2015	1.753E+03	9.577E+05	6.435E+01	2.746E+01	7.662E+03	5.148E-01
2016	1.894E+03	1.035E+06	6.952E+01	2.967E+01	8.278E+03	5.562E-01
2017	2.019E+03	1.103E+06	7.412E+01	3.163E+01	8.825E+03	5.929E-01
2018	2.121E+03	1.159E+06	7.786E+01	3.323E+01	9.270E+03	6.228E-01
2019	2.234E+03	1.220E+06	8.198E+01	3.499E+01	9.762E+03	6.559E-01
2020	2.342E+03	1.279E+06	8.595E+01	3.668E+01	1.023E+04	6.876E-01
2021	2.445E+03	1.336E+06	8.976E+01	3.831E+01	1.069E+04	7.181E-01
2022	2.545E+03	1.390E+06	9.343E+01	3.987E+01	1.112E+04	7.474E-01
2023	2.641E+03	1.443E+06	9.694E+01	4.137E+01	1.154E+04	7.755E-01
2024	2.733E+03	1.493E+06	1.003E+02	4.282E+01	1.195E+04	8.026E-01
2025	2.822E+03	1.541E+06	1.036E+02	4.420E+01	1.233E+04	8.286E-01
2026	2.907E+03	1.588E+06	1.067E+02	4.553E+01	1.270E+04	8.535E-01
2027	2.988E+03	1.633E+06	1.097E+02	4.681E+01	1.306E+04	8.775E-01
2028	3.067E+03	1.675E+06	1.126E+02	4.804E+01	1.340E+04	9.006E-01
2029	3.142E+03	1.717E+06	1.153E+02	4.923E+01	1.373E+04	9.227E-01
2030	3.215E+03	1.756E+06	1.180E+02	5.036E+01	1.405E+04	9.440E-01
2031	3.284E+03	1.794E+06	1.206E+02	5.145E+01	1.435E+04	9.644E-01
2032	3.351E+03	1.831E+06	1.230E+02	5.250E+01	1.465E+04	9.841E-01
2033	3.415E+03	1.866E+06	1.254E+02	5.350E+01	1.493E+04	1.003E+00
2034	3.477E+03	1.900E+06	1.276E+02	5.447E+01	1.520E+04	1.021E+00
2035	3.536E+03	1.932E+06	1.298E+02	5.540E+01	1.546E+04	1.038E+00
2036	3.398E+03	1.856E+06	1.247E+02	5.323E+01	1.485E+04	9.978E-01
2037	3.265E+03	1.783E+06	1.198E+02	5.114E+01	1.427E+04	9.586E-01
2038	3.137E+03	1.714E+06	1.151E+02	4.914E+01	1.371E+04	9.210E-01
2039	3.014E+03	1.646E+06	1.106E+02	4.721E+01	1.317E+04	8.849E-01
2040	2.895E+03	1.582E+06	1.063E+02	4.536E+01	1.265E+04	8.502E-01
2041	2.782E+03	1.520E+06	1.021E+02	4.358E+01	1.216E+04	8.169E-01
2042	2.673E+03	1.460E+06	9.811E+01	4.187E+01	1.168E+04	7.849E-01
2043	2.568E+03	1.403E+06	9.426E+01	4.023E+01	1.122E+04	7.541E-01
2044	2.467E+03	1.348E+06	9.056E+01	3.865E+01	1.078E+04	7.245E-01
2045	2.371E+03	1.295E+06	8.701E+01	3.714E+01	1.036E+04	6.961E-01
2046	2.278E+03	1.244E+06	8.360E+01	3.568E+01	9.954E+03	6.688E-01
2047	2.188E+03	1.195E+06	8.032E+01	3.428E+01	9.564E+03	6.426E-01
2048	2.103E+03	1.149E+06	7.717E+01	3.294E+01	9.189E+03	6.174E-01
2049	2.020E+03	1.104E+06	7.415E+01	3.165E+01	8.828E+03	5.932E-01
2050	1.941E+03	1.060E+06	7.124E+01	3.040E+01	8.482E+03	5.699E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	1.865E+03	1.019E+06	6.845E+01	2.921E+01	8.150E+03	5.476E-01
2052	1.792E+03	9.788E+05	6.576E+01	2.807E+01	7.830E+03	5.261E-01
2053	1.721E+03	9.404E+05	6.318E+01	2.697E+01	7.523E+03	5.055E-01
2054	1.654E+03	9.035E+05	6.071E+01	2.591E+01	7.228E+03	4.857E-01
2055	1.589E+03	8.681E+05	5.833E+01	2.489E+01	6.945E+03	4.666E-01
2056	1.527E+03	8.341E+05	5.604E+01	2.392E+01	6.672E+03	4.483E-01
2057	1.467E+03	8.014E+05	5.384E+01	2.298E+01	6.411E+03	4.307E-01
2058	1.409E+03	7.699E+05	5.173E+01	2.208E+01	6.159E+03	4.139E-01
2059	1.354E+03	7.397E+05	4.970E+01	2.121E+01	5.918E+03	3.976E-01
2060	1.301E+03	7.107E+05	4.775E+01	2.038E+01	5.686E+03	3.820E-01
2061	1.250E+03	6.829E+05	4.588E+01	1.958E+01	5.463E+03	3.671E-01
2062	1.201E+03	6.561E+05	4.408E+01	1.881E+01	5.249E+03	3.527E-01
2063	1.154E+03	6.304E+05	4.235E+01	1.808E+01	5.043E+03	3.388E-01
2064	1.109E+03	6.056E+05	4.069E+01	1.737E+01	4.845E+03	3.255E-01
2065	1.065E+03	5.819E+05	3.910E+01	1.669E+01	4.655E+03	3.128E-01
2066	1.023E+03	5.591E+05	3.756E+01	1.603E+01	4.473E+03	3.005E-01
2067	9.833E+02	5.372E+05	3.609E+01	1.540E+01	4.297E+03	2.887E-01
2068	9.447E+02	5.161E+05	3.468E+01	1.480E+01	4.129E+03	2.774E-01
2069	9.077E+02	4.959E+05	3.332E+01	1.422E+01	3.967E+03	2.665E-01
2070	8.721E+02	4.764E+05	3.201E+01	1.366E+01	3.811E+03	2.561E-01
2071	8.379E+02	4.577E+05	3.076E+01	1.313E+01	3.662E+03	2.460E-01
2072	8.050E+02	4.398E+05	2.955E+01	1.261E+01	3.518E+03	2.364E-01
2073	7.735E+02	4.225E+05	2.839E+01	1.212E+01	3.380E+03	2.271E-01
2074	7.431E+02	4.060E+05	2.728E+01	1.164E+01	3.248E+03	2.182E-01
2075	7.140E+02	3.901E+05	2.621E+01	1.119E+01	3.120E+03	2.097E-01
2076	6.860E+02	3.748E+05	2.518E+01	1.075E+01	2.998E+03	2.014E-01
2077	6.591E+02	3.601E+05	2.419E+01	1.033E+01	2.881E+03	1.935E-01
2078	6.333E+02	3.460E+05	2.324E+01	9.920E+00	2.768E+03	1.860E-01
2079	6.084E+02	3.324E+05	2.233E+01	9.531E+00	2.659E+03	1.787E-01
2080	5.846E+02	3.194E+05	2.146E+01	9.158E+00	2.555E+03	1.717E-01
2081	5.617E+02	3.068E+05	2.062E+01	8.799E+00	2.455E+03	1.649E-01
2082	5.396E+02	2.948E+05	1.981E+01	8.454E+00	2.358E+03	1.585E-01
2083	5.185E+02	2.832E+05	1.903E+01	8.122E+00	2.266E+03	1.522E-01
2084	4.981E+02	2.721E+05	1.828E+01	7.804E+00	2.177E+03	1.463E-01
2085	4.786E+02	2.615E+05	1.757E+01	7.498E+00	2.092E+03	1.405E-01
2086	4.598E+02	2.512E+05	1.688E+01	7.204E+00	2.010E+03	1.350E-01
2087	4.418E+02	2.414E+05	1.622E+01	6.921E+00	1.931E+03	1.297E-01
2088	4.245E+02	2.319E+05	1.558E+01	6.650E+00	1.855E+03	1.246E-01
2089	4.078E+02	2.228E+05	1.497E+01	6.389E+00	1.782E+03	1.198E-01
2090	3.919E+02	2.141E+05	1.438E+01	6.139E+00	1.713E+03	1.151E-01
2091	3.765E+02	2.057E+05	1.382E+01	5.898E+00	1.645E+03	1.106E-01
2092	3.617E+02	1.976E+05	1.328E+01	5.667E+00	1.581E+03	1.062E-01
2093	3.475E+02	1.899E+05	1.276E+01	5.444E+00	1.519E+03	1.021E-01
2094	3.339E+02	1.824E+05	1.226E+01	5.231E+00	1.459E+03	9.805E-02
2095	3.208E+02	1.753E+05	1.178E+01	5.026E+00	1.402E+03	9.421E-02
2096	3.082E+02	1.684E+05	1.131E+01	4.829E+00	1.347E+03	9.051E-02
2097	2.962E+02	1.618E+05	1.087E+01	4.639E+00	1.294E+03	8.697E-02
2098	2.845E+02	1.554E+05	1.044E+01	4.458E+00	1.244E+03	8.356E-02
2099	2.734E+02	1.494E+05	1.003E+01	4.283E+00	1.195E+03	8.028E-02
2100	2.627E+02	1.435E+05	9.641E+00	4.115E+00	1.148E+03	7.713E-02
2101	2.524E+02	1.379E+05	9.263E+00	3.953E+00	1.103E+03	7.411E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2102	2.425E+02	1.325E+05	8.900E+00	3.798E+00	1.060E+03	7.120E-02
2103	2.330E+02	1.273E+05	8.551E+00	3.650E+00	1.018E+03	6.841E-02
2104	2.238E+02	1.223E+05	8.216E+00	3.506E+00	9.782E+02	6.573E-02
2105	2.151E+02	1.175E+05	7.894E+00	3.369E+00	9.399E+02	6.315E-02
2106	2.066E+02	1.129E+05	7.584E+00	3.237E+00	9.030E+02	6.067E-02
2107	1.985E+02	1.085E+05	7.287E+00	3.110E+00	8.676E+02	5.829E-02
2108	1.907E+02	1.042E+05	7.001E+00	2.988E+00	8.336E+02	5.601E-02
2109	1.833E+02	1.001E+05	6.727E+00	2.871E+00	8.009E+02	5.381E-02
2110	1.761E+02	9.619E+04	6.463E+00	2.758E+00	7.695E+02	5.170E-02
2111	1.692E+02	9.242E+04	6.209E+00	2.650E+00	7.393E+02	4.968E-02
2112	1.625E+02	8.879E+04	5.966E+00	2.546E+00	7.103E+02	4.773E-02
2113	1.562E+02	8.531E+04	5.732E+00	2.446E+00	6.825E+02	4.586E-02
2114	1.500E+02	8.197E+04	5.507E+00	2.350E+00	6.557E+02	4.406E-02
2115	1.442E+02	7.875E+04	5.291E+00	2.258E+00	6.300E+02	4.233E-02
2116	1.385E+02	7.566E+04	5.084E+00	2.170E+00	6.053E+02	4.067E-02
2117	1.331E+02	7.270E+04	4.884E+00	2.085E+00	5.816E+02	3.908E-02
2118	1.279E+02	6.985E+04	4.693E+00	2.003E+00	5.588E+02	3.754E-02
2119	1.228E+02	6.711E+04	4.509E+00	1.924E+00	5.369E+02	3.607E-02
2120	1.180E+02	6.448E+04	4.332E+00	1.849E+00	5.158E+02	3.466E-02
2121	1.134E+02	6.195E+04	4.162E+00	1.776E+00	4.956E+02	3.330E-02
2122	1.089E+02	5.952E+04	3.999E+00	1.707E+00	4.762E+02	3.199E-02
2123	1.047E+02	5.719E+04	3.842E+00	1.640E+00	4.575E+02	3.074E-02
2124	1.006E+02	5.494E+04	3.692E+00	1.576E+00	4.395E+02	2.953E-02
2125	9.663E+01	5.279E+04	3.547E+00	1.514E+00	4.223E+02	2.837E-02
2126	9.284E+01	5.072E+04	3.408E+00	1.454E+00	4.058E+02	2.726E-02
2127	8.920E+01	4.873E+04	3.274E+00	1.397E+00	3.898E+02	2.619E-02
2128	8.570E+01	4.682E+04	3.146E+00	1.343E+00	3.746E+02	2.517E-02
2129	8.234E+01	4.498E+04	3.022E+00	1.290E+00	3.599E+02	2.418E-02
2130	7.911E+01	4.322E+04	2.904E+00	1.239E+00	3.458E+02	2.323E-02
2131	7.601E+01	4.153E+04	2.790E+00	1.191E+00	3.322E+02	2.232E-02
2132	7.303E+01	3.990E+04	2.681E+00	1.144E+00	3.192E+02	2.145E-02
2133	7.017E+01	3.833E+04	2.576E+00	1.099E+00	3.067E+02	2.060E-02
2134	6.742E+01	3.683E+04	2.475E+00	1.056E+00	2.946E+02	1.980E-02
2135	6.477E+01	3.539E+04	2.378E+00	1.015E+00	2.831E+02	1.902E-02
2136	6.223E+01	3.400E+04	2.284E+00	9.749E-01	2.720E+02	1.827E-02
2137	5.979E+01	3.266E+04	2.195E+00	9.367E-01	2.613E+02	1.756E-02
2138	5.745E+01	3.138E+04	2.109E+00	9.000E-01	2.511E+02	1.687E-02
2139	5.520E+01	3.015E+04	2.026E+00	8.647E-01	2.412E+02	1.621E-02
2140	5.303E+01	2.897E+04	1.947E+00	8.308E-01	2.318E+02	1.557E-02
2141	5.095E+01	2.784E+04	1.870E+00	7.982E-01	2.227E+02	1.496E-02



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2001**	
Actual Closure Year (without limit)	***2001***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.096**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**127**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	0	0	468,810	515,691
2003	0	0	468,810	515,691
2004	0	0	468,810	515,691
2005	0	0	468,810	515,691
2006	0	0	468,810	515,691
2007	0	0	468,810	515,691
2008	0	0	468,810	515,691
2009	0	0	468,810	515,691
2010	0	0	468,810	515,691
2011	0	0	468,810	515,691
2012	0	0	468,810	515,691
2013	0	0	468,810	515,691
2014	0	0	468,810	515,691
2015	0	0	468,810	515,691
2016	0	0	468,810	515,691
2017	0	0	468,810	515,691
2018	0	0	468,810	515,691
2019	0	0	468,810	515,691

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	0	0	468,810	515,691
2021	0	0	468,810	515,691
2022	0	0	468,810	515,691
2023	0	0	468,810	515,691
2024	0	0	468,810	515,691
2025	0	0	468,810	515,691
2026	0	0	468,810	515,691
2027	0	0	468,810	515,691
2028	0	0	468,810	515,691
2029	0	0	468,810	515,691
2030	0	0	468,810	515,691
2031	0	0	468,810	515,691
2032	0	0	468,810	515,691
2033	0	0	468,810	515,691
2034	0	0	468,810	515,691
2035	0	0	468,810	515,691
2036	0	0	468,810	515,691
2037	0	0	468,810	515,691
2038	0	0	468,810	515,691
2039	0	0	468,810	515,691
2040	0	0	468,810	515,691
2041	0	0	468,810	515,691
2042	0	0	468,810	515,691
2043	0	0	468,810	515,691
2044	0	0	468,810	515,691
2045	0	0	468,810	515,691
2046	0	0	468,810	515,691
2047	0	0	468,810	515,691
2048	0	0	468,810	515,691
2049	0	0	468,810	515,691
2050	0	0	468,810	515,691
2051	0	0	468,810	515,691
2052	0	0	468,810	515,691
2053	0	0	468,810	515,691
2054	0	0	468,810	515,691
2055	0	0	468,810	515,691
2056	0	0	468,810	515,691
2057	0	0	468,810	515,691
2058	0	0	468,810	515,691
2059	0	0	468,810	515,691

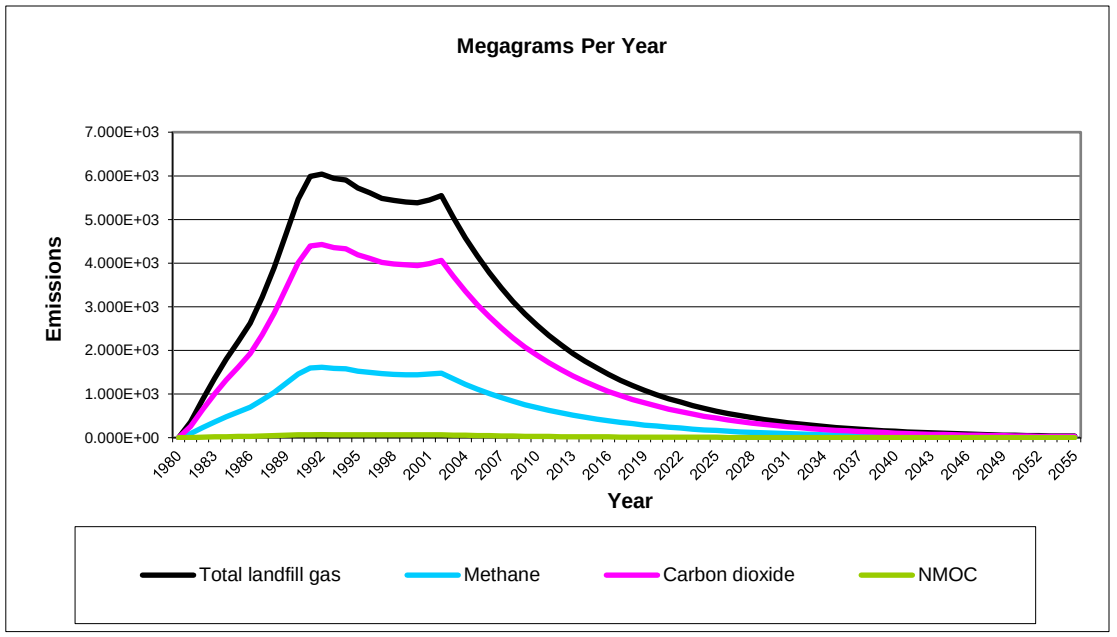
Pollutant Parameters

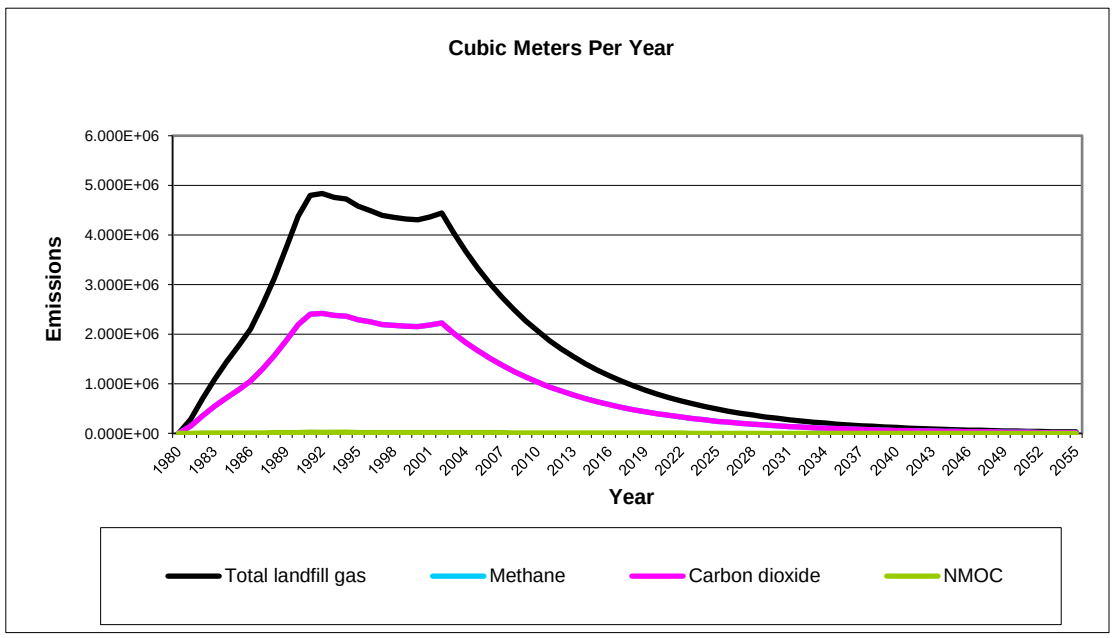
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

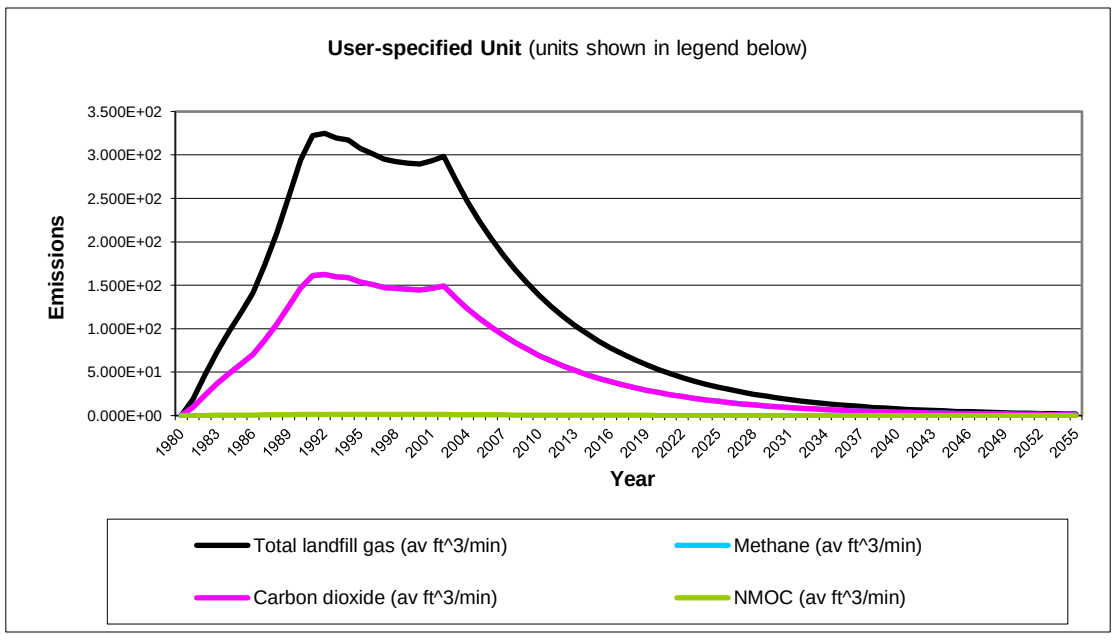
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	3.547E+02	2.841E+05	1.909E+01	9.475E+01	1.420E+05	9.543E+00
1982	8.766E+02	7.019E+05	4.716E+01	2.341E+02	3.510E+05	2.358E+01
1983	1.361E+03	1.090E+06	7.323E+01	3.636E+02	5.450E+05	3.662E+01
1984	1.798E+03	1.440E+06	9.675E+01	4.803E+02	7.199E+05	4.837E+01
1985	2.201E+03	1.762E+06	1.184E+02	5.879E+02	8.812E+05	5.921E+01
1986	2.627E+03	2.104E+06	1.413E+02	7.017E+02	1.052E+06	7.067E+01
1987	3.219E+03	2.578E+06	1.732E+02	8.598E+02	1.289E+06	8.659E+01
1988	3.896E+03	3.120E+06	2.096E+02	1.041E+03	1.560E+06	1.048E+02
1989	4.675E+03	3.743E+06	2.515E+02	1.249E+03	1.872E+06	1.258E+02
1990	5.467E+03	4.377E+06	2.941E+02	1.460E+03	2.189E+06	1.471E+02
1991	5.990E+03	4.796E+06	3.223E+02	1.600E+03	2.398E+06	1.611E+02
1992	6.039E+03	4.836E+06	3.249E+02	1.613E+03	2.418E+06	1.625E+02
1993	5.943E+03	4.759E+06	3.198E+02	1.588E+03	2.380E+06	1.599E+02
1994	5.900E+03	4.724E+06	3.174E+02	1.576E+03	2.362E+06	1.587E+02
1995	5.716E+03	4.578E+06	3.076E+02	1.527E+03	2.289E+06	1.538E+02
1996	5.608E+03	4.490E+06	3.017E+02	1.498E+03	2.245E+06	1.509E+02
1997	5.483E+03	4.391E+06	2.950E+02	1.465E+03	2.195E+06	1.475E+02
1998	5.434E+03	4.352E+06	2.924E+02	1.452E+03	2.176E+06	1.462E+02
1999	5.401E+03	4.325E+06	2.906E+02	1.443E+03	2.162E+06	1.453E+02
2000	5.380E+03	4.308E+06	2.894E+02	1.437E+03	2.154E+06	1.447E+02
2001	5.449E+03	4.363E+06	2.932E+02	1.455E+03	2.182E+06	1.466E+02
2002	5.547E+03	4.442E+06	2.985E+02	1.482E+03	2.221E+06	1.492E+02
2003	5.040E+03	4.035E+06	2.711E+02	1.346E+03	2.018E+06	1.356E+02
2004	4.578E+03	3.666E+06	2.463E+02	1.223E+03	1.833E+06	1.232E+02
2005	4.159E+03	3.331E+06	2.238E+02	1.111E+03	1.665E+06	1.119E+02
2006	3.779E+03	3.026E+06	2.033E+02	1.009E+03	1.513E+06	1.016E+02
2007	3.433E+03	2.749E+06	1.847E+02	9.169E+02	1.374E+06	9.234E+01
2008	3.118E+03	2.497E+06	1.678E+02	8.330E+02	1.249E+06	8.389E+01
2009	2.833E+03	2.269E+06	1.524E+02	7.567E+02	1.134E+06	7.621E+01
2010	2.574E+03	2.061E+06	1.385E+02	6.875E+02	1.030E+06	6.923E+01
2011	2.338E+03	1.872E+06	1.258E+02	6.245E+02	9.361E+05	6.290E+01
2012	2.124E+03	1.701E+06	1.143E+02	5.674E+02	8.504E+05	5.714E+01
2013	1.930E+03	1.545E+06	1.038E+02	5.154E+02	7.726E+05	5.191E+01
2014	1.753E+03	1.404E+06	9.432E+01	4.682E+02	7.019E+05	4.716E+01
2015	1.593E+03	1.275E+06	8.568E+01	4.254E+02	6.376E+05	4.284E+01
2016	1.447E+03	1.159E+06	7.784E+01	3.864E+02	5.793E+05	3.892E+01
2017	1.314E+03	1.052E+06	7.071E+01	3.511E+02	5.262E+05	3.536E+01
2018	1.194E+03	9.561E+05	6.424E+01	3.189E+02	4.781E+05	3.212E+01
2019	1.085E+03	8.686E+05	5.836E+01	2.897E+02	4.343E+05	2.918E+01
2020	9.854E+02	7.891E+05	5.302E+01	2.632E+02	3.945E+05	2.651E+01
2021	8.952E+02	7.169E+05	4.817E+01	2.391E+02	3.584E+05	2.408E+01
2022	8.133E+02	6.512E+05	4.376E+01	2.172E+02	3.256E+05	2.188E+01
2023	7.388E+02	5.916E+05	3.975E+01	1.974E+02	2.958E+05	1.988E+01
2024	6.712E+02	5.375E+05	3.611E+01	1.793E+02	2.687E+05	1.806E+01
2025	6.098E+02	4.883E+05	3.281E+01	1.629E+02	2.441E+05	1.640E+01
2026	5.540E+02	4.436E+05	2.980E+01	1.480E+02	2.218E+05	1.490E+01
2027	5.032E+02	4.030E+05	2.708E+01	1.344E+02	2.015E+05	1.354E+01
2028	4.572E+02	3.661E+05	2.460E+01	1.221E+02	1.830E+05	1.230E+01
2029	4.153E+02	3.326E+05	2.235E+01	1.109E+02	1.663E+05	1.117E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	3.773E+02	3.021E+05	2.030E+01	1.008E+02	1.511E+05	1.015E+01
2031	3.428E+02	2.745E+05	1.844E+01	9.156E+01	1.372E+05	9.221E+00
2032	3.114E+02	2.494E+05	1.675E+01	8.318E+01	1.247E+05	8.377E+00
2033	2.829E+02	2.265E+05	1.522E+01	7.556E+01	1.133E+05	7.610E+00
2034	2.570E+02	2.058E+05	1.383E+01	6.865E+01	1.029E+05	6.914E+00
2035	2.335E+02	1.870E+05	1.256E+01	6.236E+01	9.348E+04	6.281E+00
2036	2.121E+02	1.698E+05	1.141E+01	5.666E+01	8.492E+04	5.706E+00
2037	1.927E+02	1.543E+05	1.037E+01	5.147E+01	7.715E+04	5.184E+00
2038	1.751E+02	1.402E+05	9.418E+00	4.676E+01	7.009E+04	4.709E+00
2039	1.590E+02	1.273E+05	8.556E+00	4.248E+01	6.367E+04	4.278E+00
2040	1.445E+02	1.157E+05	7.773E+00	3.859E+01	5.784E+04	3.886E+00
2041	1.312E+02	1.051E+05	7.061E+00	3.506E+01	5.255E+04	3.531E+00
2042	1.192E+02	9.548E+04	6.415E+00	3.185E+01	4.774E+04	3.208E+00
2043	1.083E+02	8.674E+04	5.828E+00	2.893E+01	4.337E+04	2.914E+00
2044	9.840E+01	7.880E+04	5.294E+00	2.628E+01	3.940E+04	2.647E+00
2045	8.940E+01	7.158E+04	4.810E+00	2.388E+01	3.579E+04	2.405E+00
2046	8.121E+01	6.503E+04	4.370E+00	2.169E+01	3.252E+04	2.185E+00
2047	7.378E+01	5.908E+04	3.970E+00	1.971E+01	2.954E+04	1.985E+00
2048	6.703E+01	5.367E+04	3.606E+00	1.790E+01	2.684E+04	1.803E+00
2049	6.089E+01	4.876E+04	3.276E+00	1.626E+01	2.438E+04	1.638E+00
2050	5.532E+01	4.430E+04	2.976E+00	1.478E+01	2.215E+04	1.488E+00
2051	5.025E+01	4.024E+04	2.704E+00	1.342E+01	2.012E+04	1.352E+00
2052	4.565E+01	3.656E+04	2.456E+00	1.219E+01	1.828E+04	1.228E+00
2053	4.147E+01	3.321E+04	2.231E+00	1.108E+01	1.661E+04	1.116E+00
2054	3.768E+01	3.017E+04	2.027E+00	1.006E+01	1.509E+04	1.014E+00
2055	3.423E+01	2.741E+04	1.842E+00	9.143E+00	1.370E+04	9.208E-01
2056	3.110E+01	2.490E+04	1.673E+00	8.306E+00	1.245E+04	8.365E-01
2057	2.825E+01	2.262E+04	1.520E+00	7.546E+00	1.131E+04	7.600E-01
2058	2.566E+01	2.055E+04	1.381E+00	6.855E+00	1.028E+04	6.904E-01
2059	2.331E+01	1.867E+04	1.254E+00	6.228E+00	9.335E+03	6.272E-01
2060	2.118E+01	1.696E+04	1.140E+00	5.658E+00	8.480E+03	5.698E-01
2061	1.924E+01	1.541E+04	1.035E+00	5.140E+00	7.704E+03	5.176E-01
2062	1.748E+01	1.400E+04	9.405E-01	4.669E+00	6.999E+03	4.702E-01
2063	1.588E+01	1.272E+04	8.544E-01	4.242E+00	6.358E+03	4.272E-01
2064	1.443E+01	1.155E+04	7.762E-01	3.854E+00	5.776E+03	3.881E-01
2065	1.311E+01	1.049E+04	7.051E-01	3.501E+00	5.247E+03	3.526E-01
2066	1.191E+01	9.534E+03	6.406E-01	3.180E+00	4.767E+03	3.203E-01
2067	1.082E+01	8.661E+03	5.820E-01	2.889E+00	4.331E+03	2.910E-01
2068	9.827E+00	7.869E+03	5.287E-01	2.625E+00	3.934E+03	2.643E-01
2069	8.927E+00	7.148E+03	4.803E-01	2.385E+00	3.574E+03	2.401E-01
2070	8.110E+00	6.494E+03	4.363E-01	2.166E+00	3.247E+03	2.182E-01
2071	7.368E+00	5.900E+03	3.964E-01	1.968E+00	2.950E+03	1.982E-01
2072	6.693E+00	5.360E+03	3.601E-01	1.788E+00	2.680E+03	1.801E-01
2073	6.080E+00	4.869E+03	3.271E-01	1.624E+00	2.434E+03	1.636E-01
2074	5.524E+00	4.423E+03	2.972E-01	1.475E+00	2.212E+03	1.486E-01
2075	5.018E+00	4.018E+03	2.700E-01	1.340E+00	2.009E+03	1.350E-01
2076	4.559E+00	3.651E+03	2.453E-01	1.218E+00	1.825E+03	1.226E-01
2077	4.142E+00	3.316E+03	2.228E-01	1.106E+00	1.658E+03	1.114E-01
2078	3.763E+00	3.013E+03	2.024E-01	1.005E+00	1.506E+03	1.012E-01
2079	3.418E+00	2.737E+03	1.839E-01	9.130E-01	1.369E+03	9.195E-02
2080	3.105E+00	2.487E+03	1.671E-01	8.294E-01	1.243E+03	8.353E-02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	2.821E+00	2.259E+03	1.518E-01	7.535E-01	1.129E+03	7.589E-02
2082	2.563E+00	2.052E+03	1.379E-01	6.845E-01	1.026E+03	6.894E-02
2083	2.328E+00	1.864E+03	1.253E-01	6.219E-01	9.321E+02	6.263E-02
2084	2.115E+00	1.694E+03	1.138E-01	5.650E-01	8.468E+02	5.690E-02
2085	1.921E+00	1.539E+03	1.034E-01	5.132E-01	7.693E+02	5.169E-02
2086	1.746E+00	1.398E+03	9.392E-02	4.663E-01	6.989E+02	4.696E-02
2087	1.586E+00	1.270E+03	8.532E-02	4.236E-01	6.349E+02	4.266E-02
2088	1.441E+00	1.154E+03	7.751E-02	3.848E-01	5.768E+02	3.875E-02
2089	1.309E+00	1.048E+03	7.041E-02	3.496E-01	5.240E+02	3.521E-02
2090	1.189E+00	9.521E+02	6.397E-02	3.176E-01	4.760E+02	3.198E-02
2091	1.080E+00	8.649E+02	5.811E-02	2.885E-01	4.325E+02	2.906E-02
2092	9.813E-01	7.857E+02	5.279E-02	2.621E-01	3.929E+02	2.640E-02
2093	8.914E-01	7.138E+02	4.796E-02	2.381E-01	3.569E+02	2.398E-02
2094	8.098E-01	6.485E+02	4.357E-02	2.163E-01	3.242E+02	2.179E-02
2095	7.357E-01	5.891E+02	3.958E-02	1.965E-01	2.946E+02	1.979E-02
2096	6.684E-01	5.352E+02	3.596E-02	1.785E-01	2.676E+02	1.798E-02
2097	6.072E-01	4.862E+02	3.267E-02	1.622E-01	2.431E+02	1.633E-02
2098	5.516E-01	4.417E+02	2.968E-02	1.473E-01	2.209E+02	1.484E-02
2099	5.011E-01	4.013E+02	2.696E-02	1.339E-01	2.006E+02	1.348E-02
2100	4.552E-01	3.645E+02	2.449E-02	1.216E-01	1.823E+02	1.225E-02
2101	4.136E-01	3.312E+02	2.225E-02	1.105E-01	1.656E+02	1.113E-02
2102	3.757E-01	3.009E+02	2.021E-02	1.004E-01	1.504E+02	1.011E-02
2103	3.413E-01	2.733E+02	1.836E-02	9.117E-02	1.367E+02	9.182E-03
2104	3.101E-01	2.483E+02	1.668E-02	8.283E-02	1.241E+02	8.342E-03
2105	2.817E-01	2.256E+02	1.516E-02	7.524E-02	1.128E+02	7.578E-03
2106	2.559E-01	2.049E+02	1.377E-02	6.836E-02	1.025E+02	6.884E-03
2107	2.325E-01	1.862E+02	1.251E-02	6.210E-02	9.308E+01	6.254E-03
2108	2.112E-01	1.691E+02	1.136E-02	5.642E-02	8.456E+01	5.682E-03
2109	1.919E-01	1.536E+02	1.032E-02	5.125E-02	7.682E+01	5.162E-03
2110	1.743E-01	1.396E+02	9.378E-03	4.656E-02	6.979E+01	4.689E-03
2111	1.584E-01	1.268E+02	8.520E-03	4.230E-02	6.340E+01	4.260E-03
2112	1.439E-01	1.152E+02	7.740E-03	3.843E-02	5.760E+01	3.870E-03
2113	1.307E-01	1.047E+02	7.032E-03	3.491E-02	5.233E+01	3.516E-03
2114	1.187E-01	9.507E+01	6.388E-03	3.171E-02	4.754E+01	3.194E-03
2115	1.079E-01	8.637E+01	5.803E-03	2.881E-02	4.318E+01	2.902E-03
2116	9.799E-02	7.846E+01	5.272E-03	2.617E-02	3.923E+01	2.636E-03
2117	8.902E-02	7.128E+01	4.789E-03	2.378E-02	3.564E+01	2.395E-03
2118	8.087E-02	6.476E+01	4.351E-03	2.160E-02	3.238E+01	2.175E-03
2119	7.347E-02	5.883E+01	3.953E-03	1.962E-02	2.941E+01	1.976E-03
2120	6.674E-02	5.344E+01	3.591E-03	1.783E-02	2.672E+01	1.795E-03

Results (Continued)

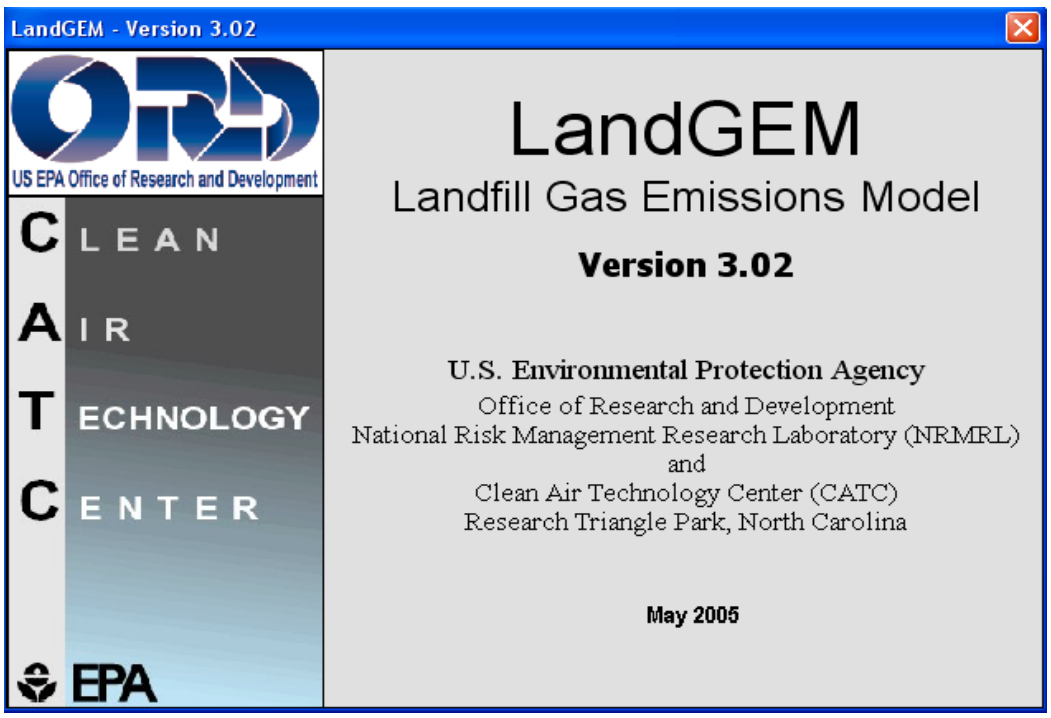
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	2.600E+02	1.420E+05	9.543E+00	4.073E+00	1.136E+03	7.634E-02
1982	6.424E+02	3.510E+05	2.358E+01	1.006E+01	2.808E+03	1.886E-01
1983	9.976E+02	5.450E+05	3.662E+01	1.563E+01	4.360E+03	2.929E-01
1984	1.318E+03	7.199E+05	4.837E+01	2.065E+01	5.760E+03	3.870E-01
1985	1.613E+03	8.812E+05	5.921E+01	2.527E+01	7.050E+03	4.737E-01
1986	1.925E+03	1.052E+06	7.067E+01	3.016E+01	8.415E+03	5.654E-01
1987	2.359E+03	1.289E+06	8.659E+01	3.696E+01	1.031E+04	6.928E-01
1988	2.856E+03	1.560E+06	1.048E+02	4.473E+01	1.248E+04	8.385E-01
1989	3.426E+03	1.872E+06	1.258E+02	5.367E+01	1.497E+04	1.006E+00
1990	4.006E+03	2.189E+06	1.471E+02	6.276E+01	1.751E+04	1.176E+00
1991	4.390E+03	2.398E+06	1.611E+02	6.877E+01	1.918E+04	1.289E+00
1992	4.426E+03	2.418E+06	1.625E+02	6.934E+01	1.934E+04	1.300E+00
1993	4.356E+03	2.380E+06	1.599E+02	6.824E+01	1.904E+04	1.279E+00
1994	4.324E+03	2.362E+06	1.587E+02	6.774E+01	1.890E+04	1.270E+00
1995	4.190E+03	2.289E+06	1.538E+02	6.563E+01	1.831E+04	1.230E+00
1996	4.110E+03	2.245E+06	1.509E+02	6.438E+01	1.796E+04	1.207E+00
1997	4.019E+03	2.195E+06	1.475E+02	6.295E+01	1.756E+04	1.180E+00
1998	3.983E+03	2.176E+06	1.462E+02	6.239E+01	1.741E+04	1.170E+00
1999	3.958E+03	2.162E+06	1.453E+02	6.201E+01	1.730E+04	1.162E+00
2000	3.943E+03	2.154E+06	1.447E+02	6.177E+01	1.723E+04	1.158E+00
2001	3.993E+03	2.182E+06	1.466E+02	6.256E+01	1.745E+04	1.173E+00
2002	4.066E+03	2.221E+06	1.492E+02	6.369E+01	1.777E+04	1.194E+00
2003	3.693E+03	2.018E+06	1.356E+02	5.786E+01	1.614E+04	1.085E+00
2004	3.355E+03	1.833E+06	1.232E+02	5.256E+01	1.466E+04	9.853E-01
2005	3.048E+03	1.665E+06	1.119E+02	4.775E+01	1.332E+04	8.951E-01
2006	2.769E+03	1.513E+06	1.016E+02	4.338E+01	1.210E+04	8.132E-01
2007	2.516E+03	1.374E+06	9.234E+01	3.941E+01	1.099E+04	7.387E-01
2008	2.285E+03	1.249E+06	8.389E+01	3.580E+01	9.988E+03	6.711E-01
2009	2.076E+03	1.134E+06	7.621E+01	3.253E+01	9.074E+03	6.097E-01
2010	1.886E+03	1.030E+06	6.923E+01	2.955E+01	8.243E+03	5.539E-01
2011	1.714E+03	9.361E+05	6.290E+01	2.684E+01	7.489E+03	5.032E-01
2012	1.557E+03	8.504E+05	5.714E+01	2.439E+01	6.803E+03	4.571E-01
2013	1.414E+03	7.726E+05	5.191E+01	2.215E+01	6.181E+03	4.153E-01
2014	1.285E+03	7.019E+05	4.716E+01	2.013E+01	5.615E+03	3.773E-01
2015	1.167E+03	6.376E+05	4.284E+01	1.828E+01	5.101E+03	3.427E-01
2016	1.060E+03	5.793E+05	3.892E+01	1.661E+01	4.634E+03	3.114E-01
2017	9.633E+02	5.262E+05	3.536E+01	1.509E+01	4.210E+03	2.829E-01
2018	8.751E+02	4.781E+05	3.212E+01	1.371E+01	3.824E+03	2.570E-01
2019	7.950E+02	4.343E+05	2.918E+01	1.245E+01	3.474E+03	2.334E-01
2020	7.222E+02	3.945E+05	2.651E+01	1.131E+01	3.156E+03	2.121E-01
2021	6.561E+02	3.584E+05	2.408E+01	1.028E+01	2.867E+03	1.927E-01
2022	5.960E+02	3.256E+05	2.188E+01	9.337E+00	2.605E+03	1.750E-01
2023	5.415E+02	2.958E+05	1.988E+01	8.483E+00	2.367E+03	1.590E-01
2024	4.919E+02	2.687E+05	1.806E+01	7.706E+00	2.150E+03	1.445E-01
2025	4.469E+02	2.441E+05	1.640E+01	7.001E+00	1.953E+03	1.312E-01
2026	4.060E+02	2.218E+05	1.490E+01	6.360E+00	1.774E+03	1.192E-01
2027	3.688E+02	2.015E+05	1.354E+01	5.778E+00	1.612E+03	1.083E-01
2028	3.351E+02	1.830E+05	1.230E+01	5.249E+00	1.464E+03	9.839E-02
2029	3.044E+02	1.663E+05	1.117E+01	4.768E+00	1.330E+03	8.938E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	2.765E+02	1.511E+05	1.015E+01	4.332E+00	1.209E+03	8.120E-02
2031	2.512E+02	1.372E+05	9.221E+00	3.935E+00	1.098E+03	7.377E-02
2032	2.282E+02	1.247E+05	8.377E+00	3.575E+00	9.974E+02	6.702E-02
2033	2.073E+02	1.133E+05	7.610E+00	3.248E+00	9.061E+02	6.088E-02
2034	1.884E+02	1.029E+05	6.914E+00	2.951E+00	8.232E+02	5.531E-02
2035	1.711E+02	9.348E+04	6.281E+00	2.681E+00	7.478E+02	5.025E-02
2036	1.554E+02	8.492E+04	5.706E+00	2.435E+00	6.794E+02	4.565E-02
2037	1.412E+02	7.715E+04	5.184E+00	2.212E+00	6.172E+02	4.147E-02
2038	1.283E+02	7.009E+04	4.709E+00	2.010E+00	5.607E+02	3.767E-02
2039	1.166E+02	6.367E+04	4.278E+00	1.826E+00	5.094E+02	3.422E-02
2040	1.059E+02	5.784E+04	3.886E+00	1.659E+00	4.627E+02	3.109E-02
2041	9.619E+01	5.255E+04	3.531E+00	1.507E+00	4.204E+02	2.825E-02
2042	8.738E+01	4.774E+04	3.208E+00	1.369E+00	3.819E+02	2.566E-02
2043	7.939E+01	4.337E+04	2.914E+00	1.244E+00	3.469E+02	2.331E-02
2044	7.212E+01	3.940E+04	2.647E+00	1.130E+00	3.152E+02	2.118E-02
2045	6.552E+01	3.579E+04	2.405E+00	1.026E+00	2.863E+02	1.924E-02
2046	5.952E+01	3.252E+04	2.185E+00	9.324E-01	2.601E+02	1.748E-02
2047	5.407E+01	2.954E+04	1.985E+00	8.471E-01	2.363E+02	1.588E-02
2048	4.912E+01	2.684E+04	1.803E+00	7.695E-01	2.147E+02	1.442E-02
2049	4.463E+01	2.438E+04	1.638E+00	6.991E-01	1.950E+02	1.310E-02
2050	4.054E+01	2.215E+04	1.488E+00	6.351E-01	1.772E+02	1.190E-02
2051	3.683E+01	2.012E+04	1.352E+00	5.770E-01	1.610E+02	1.082E-02
2052	3.346E+01	1.828E+04	1.228E+00	5.242E-01	1.462E+02	9.825E-03
2053	3.040E+01	1.661E+04	1.116E+00	4.762E-01	1.328E+02	8.926E-03
2054	2.761E+01	1.509E+04	1.014E+00	4.326E-01	1.207E+02	8.109E-03
2055	2.509E+01	1.370E+04	9.208E-01	3.930E-01	1.096E+02	7.367E-03
2056	2.279E+01	1.245E+04	8.365E-01	3.570E-01	9.960E+01	6.692E-03
2057	2.070E+01	1.131E+04	7.600E-01	3.243E-01	9.048E+01	6.080E-03
2058	1.881E+01	1.028E+04	6.904E-01	2.946E-01	8.220E+01	5.523E-03
2059	1.709E+01	9.335E+03	6.272E-01	2.677E-01	7.468E+01	5.018E-03
2060	1.552E+01	8.480E+03	5.698E-01	2.432E-01	6.784E+01	4.558E-03
2061	1.410E+01	7.704E+03	5.176E-01	2.209E-01	6.163E+01	4.141E-03
2062	1.281E+01	6.999E+03	4.702E-01	2.007E-01	5.599E+01	3.762E-03
2063	1.164E+01	6.358E+03	4.272E-01	1.823E-01	5.087E+01	3.418E-03
2064	1.057E+01	5.776E+03	3.881E-01	1.656E-01	4.621E+01	3.105E-03
2065	9.605E+00	5.247E+03	3.526E-01	1.505E-01	4.198E+01	2.821E-03
2066	8.726E+00	4.767E+03	3.203E-01	1.367E-01	3.814E+01	2.562E-03
2067	7.927E+00	4.331E+03	2.910E-01	1.242E-01	3.465E+01	2.328E-03
2068	7.202E+00	3.934E+03	2.643E-01	1.128E-01	3.147E+01	2.115E-03
2069	6.543E+00	3.574E+03	2.401E-01	1.025E-01	2.859E+01	1.921E-03
2070	5.944E+00	3.247E+03	2.182E-01	9.311E-02	2.598E+01	1.745E-03
2071	5.400E+00	2.950E+03	1.982E-01	8.459E-02	2.360E+01	1.586E-03
2072	4.905E+00	2.680E+03	1.801E-01	7.684E-02	2.144E+01	1.440E-03
2073	4.456E+00	2.434E+03	1.636E-01	6.981E-02	1.948E+01	1.309E-03
2074	4.048E+00	2.212E+03	1.486E-01	6.342E-02	1.769E+01	1.189E-03
2075	3.678E+00	2.009E+03	1.350E-01	5.762E-02	1.607E+01	1.080E-03
2076	3.341E+00	1.825E+03	1.226E-01	5.234E-02	1.460E+01	9.811E-04
2077	3.035E+00	1.658E+03	1.114E-01	4.755E-02	1.327E+01	8.913E-04
2078	2.757E+00	1.506E+03	1.012E-01	4.320E-02	1.205E+01	8.097E-04
2079	2.505E+00	1.369E+03	9.195E-02	3.924E-02	1.095E+01	7.356E-04
2080	2.276E+00	1.243E+03	8.353E-02	3.565E-02	9.946E+00	6.683E-04

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	2.067E+00	1.129E+03	7.589E-02	3.239E-02	9.036E+00	6.071E-04
2082	1.878E+00	1.026E+03	6.894E-02	2.942E-02	8.209E+00	5.515E-04
2083	1.706E+00	9.321E+02	6.263E-02	2.673E-02	7.457E+00	5.010E-04
2084	1.550E+00	8.468E+02	5.690E-02	2.428E-02	6.775E+00	4.552E-04
2085	1.408E+00	7.693E+02	5.169E-02	2.206E-02	6.154E+00	4.135E-04
2086	1.279E+00	6.989E+02	4.696E-02	2.004E-02	5.591E+00	3.757E-04
2087	1.162E+00	6.349E+02	4.266E-02	1.821E-02	5.079E+00	3.413E-04
2088	1.056E+00	5.768E+02	3.875E-02	1.654E-02	4.614E+00	3.100E-04
2089	9.592E-01	5.240E+02	3.521E-02	1.503E-02	4.192E+00	2.817E-04
2090	8.714E-01	4.760E+02	3.198E-02	1.365E-02	3.808E+00	2.559E-04
2091	7.916E-01	4.325E+02	2.906E-02	1.240E-02	3.460E+00	2.325E-04
2092	7.192E-01	3.929E+02	2.640E-02	1.127E-02	3.143E+00	2.112E-04
2093	6.533E-01	3.569E+02	2.398E-02	1.023E-02	2.855E+00	1.918E-04
2094	5.935E-01	3.242E+02	2.179E-02	9.298E-03	2.594E+00	1.743E-04
2095	5.392E-01	2.946E+02	1.979E-02	8.447E-03	2.356E+00	1.583E-04
2096	4.898E-01	2.676E+02	1.798E-02	7.674E-03	2.141E+00	1.438E-04
2097	4.450E-01	2.431E+02	1.633E-02	6.971E-03	1.945E+00	1.307E-04
2098	4.043E-01	2.209E+02	1.484E-02	6.333E-03	1.767E+00	1.187E-04
2099	3.673E-01	2.006E+02	1.348E-02	5.753E-03	1.605E+00	1.078E-04
2100	3.336E-01	1.823E+02	1.225E-02	5.227E-03	1.458E+00	9.797E-05
2101	3.031E-01	1.656E+02	1.113E-02	4.748E-03	1.325E+00	8.901E-05
2102	2.754E-01	1.504E+02	1.011E-02	4.314E-03	1.203E+00	8.086E-05
2103	2.502E-01	1.367E+02	9.182E-03	3.919E-03	1.093E+00	7.346E-05
2104	2.273E-01	1.241E+02	8.342E-03	3.560E-03	9.932E-01	6.673E-05
2105	2.065E-01	1.128E+02	7.578E-03	3.234E-03	9.023E-01	6.062E-05
2106	1.876E-01	1.025E+02	6.884E-03	2.938E-03	8.197E-01	5.508E-05
2107	1.704E-01	9.308E+01	6.254E-03	2.669E-03	7.447E-01	5.003E-05
2108	1.548E-01	8.456E+01	5.682E-03	2.425E-03	6.765E-01	4.545E-05
2109	1.406E-01	7.682E+01	5.162E-03	2.203E-03	6.146E-01	4.129E-05
2110	1.278E-01	6.979E+01	4.689E-03	2.001E-03	5.583E-01	3.751E-05
2111	1.161E-01	6.340E+01	4.260E-03	1.818E-03	5.072E-01	3.408E-05
2112	1.054E-01	5.760E+01	3.870E-03	1.652E-03	4.608E-01	3.096E-05
2113	9.578E-02	5.233E+01	3.516E-03	1.500E-03	4.186E-01	2.813E-05
2114	8.701E-02	4.754E+01	3.194E-03	1.363E-03	3.803E-01	2.555E-05
2115	7.905E-02	4.318E+01	2.902E-03	1.238E-03	3.455E-01	2.321E-05
2116	7.181E-02	3.923E+01	2.636E-03	1.125E-03	3.139E-01	2.109E-05
2117	6.524E-02	3.564E+01	2.395E-03	1.022E-03	2.851E-01	1.916E-05
2118	5.927E-02	3.238E+01	2.175E-03	9.285E-04	2.590E-01	1.740E-05
2119	5.384E-02	2.941E+01	1.976E-03	8.435E-04	2.353E-01	1.581E-05
2120	4.891E-02	2.672E+01	1.795E-03	7.663E-04	2.138E-01	1.436E-05



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2001**	
Actual Closure Year (without limit)	***2001***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.060**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**110**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	0	0	468,810	515,691
2003	0	0	468,810	515,691
2004	0	0	468,810	515,691
2005	0	0	468,810	515,691
2006	0	0	468,810	515,691
2007	0	0	468,810	515,691
2008	0	0	468,810	515,691
2009	0	0	468,810	515,691
2010	0	0	468,810	515,691
2011	0	0	468,810	515,691
2012	0	0	468,810	515,691
2013	0	0	468,810	515,691
2014	0	0	468,810	515,691
2015	0	0	468,810	515,691
2016	0	0	468,810	515,691
2017	0	0	468,810	515,691
2018	0	0	468,810	515,691
2019	0	0	468,810	515,691

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	0	0	468,810	515,691
2021	0	0	468,810	515,691
2022	0	0	468,810	515,691
2023	0	0	468,810	515,691
2024	0	0	468,810	515,691
2025	0	0	468,810	515,691
2026	0	0	468,810	515,691
2027	0	0	468,810	515,691
2028	0	0	468,810	515,691
2029	0	0	468,810	515,691
2030	0	0	468,810	515,691
2031	0	0	468,810	515,691
2032	0	0	468,810	515,691
2033	0	0	468,810	515,691
2034	0	0	468,810	515,691
2035	0	0	468,810	515,691
2036	0	0	468,810	515,691
2037	0	0	468,810	515,691
2038	0	0	468,810	515,691
2039	0	0	468,810	515,691
2040	0	0	468,810	515,691
2041	0	0	468,810	515,691
2042	0	0	468,810	515,691
2043	0	0	468,810	515,691
2044	0	0	468,810	515,691
2045	0	0	468,810	515,691
2046	0	0	468,810	515,691
2047	0	0	468,810	515,691
2048	0	0	468,810	515,691
2049	0	0	468,810	515,691
2050	0	0	468,810	515,691
2051	0	0	468,810	515,691
2052	0	0	468,810	515,691
2053	0	0	468,810	515,691
2054	0	0	468,810	515,691
2055	0	0	468,810	515,691
2056	0	0	468,810	515,691
2057	0	0	468,810	515,691
2058	0	0	468,810	515,691
2059	0	0	468,810	515,691

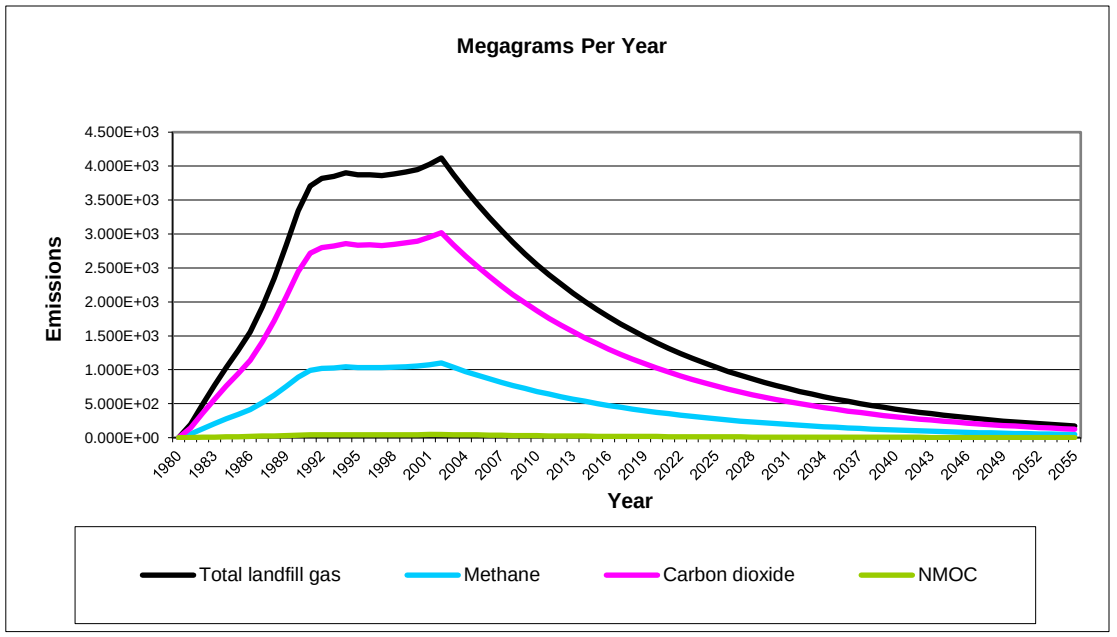
Pollutant Parameters

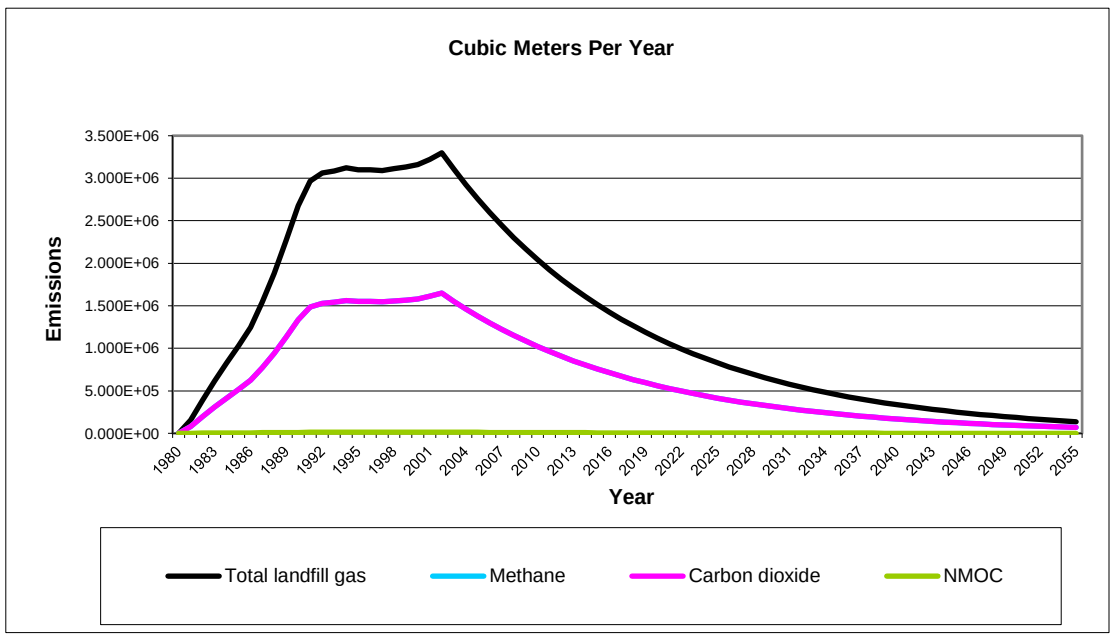
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

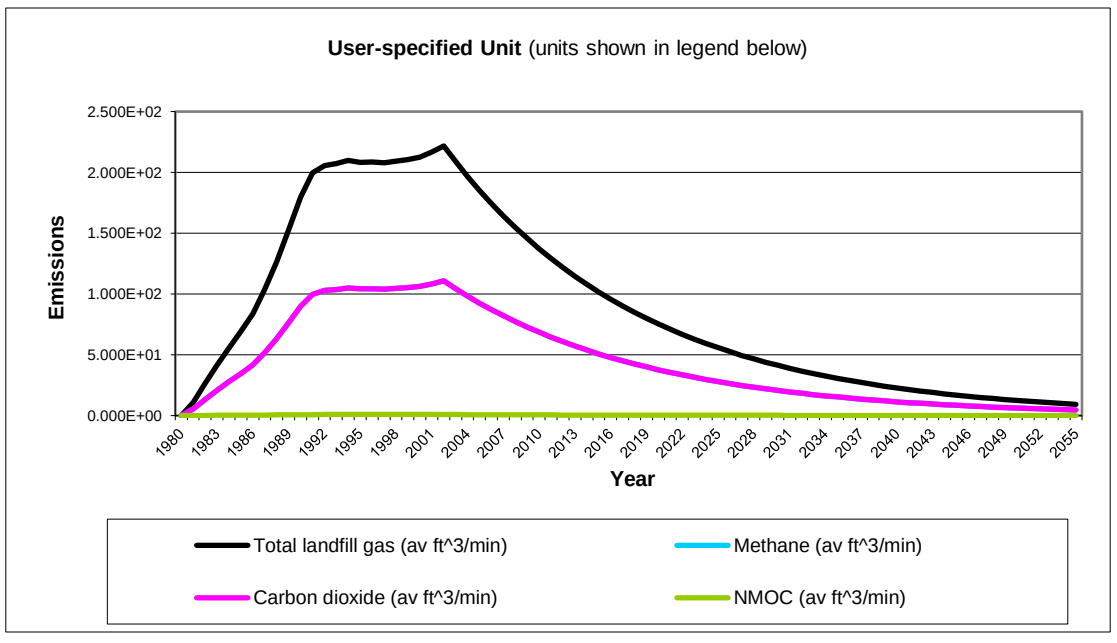
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
4.500E+03
4.000E+03
3.500E+03
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
3.500E+06
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.951E+02	1.562E+05	1.050E+01	5.212E+01	7.812E+04	5.249E+00
1982	4.887E+02	3.913E+05	2.629E+01	1.305E+02	1.956E+05	1.315E+01
1983	7.709E+02	6.173E+05	4.147E+01	2.059E+02	3.086E+05	2.074E+01
1984	1.035E+03	8.287E+05	5.568E+01	2.764E+02	4.144E+05	2.784E+01
1985	1.287E+03	1.030E+06	6.923E+01	3.437E+02	5.152E+05	3.462E+01
1986	1.557E+03	1.247E+06	8.377E+01	4.159E+02	6.234E+05	4.189E+01
1987	1.924E+03	1.541E+06	1.035E+02	5.140E+02	7.704E+05	5.176E+01
1988	2.347E+03	1.879E+06	1.263E+02	6.269E+02	9.396E+05	6.313E+01
1989	2.835E+03	2.270E+06	1.525E+02	7.571E+02	1.135E+06	7.625E+01
1990	3.340E+03	2.675E+06	1.797E+02	8.922E+02	1.337E+06	8.986E+01
1991	3.709E+03	2.970E+06	1.995E+02	9.906E+02	1.485E+06	9.977E+01
1992	3.822E+03	3.060E+06	2.056E+02	1.021E+03	1.530E+06	1.028E+02
1993	3.850E+03	3.083E+06	2.072E+02	1.028E+03	1.542E+06	1.036E+02
1994	3.902E+03	3.124E+06	2.099E+02	1.042E+03	1.562E+06	1.050E+02
1995	3.870E+03	3.099E+06	2.082E+02	1.034E+03	1.550E+06	1.041E+02
1996	3.873E+03	3.101E+06	2.084E+02	1.035E+03	1.551E+06	1.042E+02
1997	3.861E+03	3.092E+06	2.078E+02	1.031E+03	1.546E+06	1.039E+02
1998	3.886E+03	3.112E+06	2.091E+02	1.038E+03	1.556E+06	1.045E+02
1999	3.915E+03	3.135E+06	2.106E+02	1.046E+03	1.567E+06	1.053E+02
2000	3.947E+03	3.161E+06	2.124E+02	1.054E+03	1.580E+06	1.062E+02
2001	4.026E+03	3.224E+06	2.166E+02	1.075E+03	1.612E+06	1.083E+02
2002	4.120E+03	3.299E+06	2.217E+02	1.101E+03	1.650E+06	1.108E+02
2003	3.880E+03	3.107E+06	2.088E+02	1.036E+03	1.554E+06	1.044E+02
2004	3.654E+03	2.926E+06	1.966E+02	9.761E+02	1.463E+06	9.830E+01
2005	3.441E+03	2.756E+06	1.852E+02	9.192E+02	1.378E+06	9.258E+01
2006	3.241E+03	2.595E+06	1.744E+02	8.657E+02	1.298E+06	8.719E+01
2007	3.052E+03	2.444E+06	1.642E+02	8.153E+02	1.222E+06	8.211E+01
2008	2.874E+03	2.302E+06	1.547E+02	7.678E+02	1.151E+06	7.733E+01
2009	2.707E+03	2.168E+06	1.456E+02	7.231E+02	1.084E+06	7.282E+01
2010	2.549E+03	2.041E+06	1.372E+02	6.810E+02	1.021E+06	6.858E+01
2011	2.401E+03	1.923E+06	1.292E+02	6.413E+02	9.613E+05	6.459E+01
2012	2.261E+03	1.811E+06	1.217E+02	6.040E+02	9.053E+05	6.083E+01
2013	2.129E+03	1.705E+06	1.146E+02	5.688E+02	8.526E+05	5.729E+01
2014	2.005E+03	1.606E+06	1.079E+02	5.357E+02	8.029E+05	5.395E+01
2015	1.889E+03	1.512E+06	1.016E+02	5.045E+02	7.562E+05	5.081E+01
2016	1.779E+03	1.424E+06	9.570E+01	4.751E+02	7.121E+05	4.785E+01
2017	1.675E+03	1.341E+06	9.012E+01	4.474E+02	6.707E+05	4.506E+01
2018	1.578E+03	1.263E+06	8.488E+01	4.214E+02	6.316E+05	4.244E+01
2019	1.486E+03	1.190E+06	7.993E+01	3.968E+02	5.948E+05	3.997E+01
2020	1.399E+03	1.120E+06	7.528E+01	3.737E+02	5.602E+05	3.764E+01
2021	1.318E+03	1.055E+06	7.089E+01	3.520E+02	5.276E+05	3.545E+01
2022	1.241E+03	9.937E+05	6.677E+01	3.315E+02	4.968E+05	3.338E+01
2023	1.169E+03	9.358E+05	6.288E+01	3.122E+02	4.679E+05	3.144E+01
2024	1.101E+03	8.813E+05	5.922E+01	2.940E+02	4.407E+05	2.961E+01
2025	1.037E+03	8.300E+05	5.577E+01	2.769E+02	4.150E+05	2.788E+01
2026	9.762E+02	7.817E+05	5.252E+01	2.607E+02	3.908E+05	2.626E+01
2027	9.193E+02	7.361E+05	4.946E+01	2.456E+02	3.681E+05	2.473E+01
2028	8.658E+02	6.933E+05	4.658E+01	2.313E+02	3.466E+05	2.329E+01
2029	8.154E+02	6.529E+05	4.387E+01	2.178E+02	3.265E+05	2.193E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	7.679E+02	6.149E+05	4.131E+01	2.051E+02	3.074E+05	2.066E+01
2031	7.232E+02	5.791E+05	3.891E+01	1.932E+02	2.895E+05	1.945E+01
2032	6.810E+02	5.453E+05	3.664E+01	1.819E+02	2.727E+05	1.832E+01
2033	6.414E+02	5.136E+05	3.451E+01	1.713E+02	2.568E+05	1.725E+01
2034	6.040E+02	4.837E+05	3.250E+01	1.613E+02	2.418E+05	1.625E+01
2035	5.689E+02	4.555E+05	3.061E+01	1.519E+02	2.278E+05	1.530E+01
2036	5.357E+02	4.290E+05	2.882E+01	1.431E+02	2.145E+05	1.441E+01
2037	5.045E+02	4.040E+05	2.715E+01	1.348E+02	2.020E+05	1.357E+01
2038	4.751E+02	3.805E+05	2.556E+01	1.269E+02	1.902E+05	1.278E+01
2039	4.475E+02	3.583E+05	2.408E+01	1.195E+02	1.792E+05	1.204E+01
2040	4.214E+02	3.375E+05	2.267E+01	1.126E+02	1.687E+05	1.134E+01
2041	3.969E+02	3.178E+05	2.135E+01	1.060E+02	1.589E+05	1.068E+01
2042	3.738E+02	2.993E+05	2.011E+01	9.984E+01	1.496E+05	1.005E+01
2043	3.520E+02	2.819E+05	1.894E+01	9.402E+01	1.409E+05	9.469E+00
2044	3.315E+02	2.655E+05	1.784E+01	8.855E+01	1.327E+05	8.918E+00
2045	3.122E+02	2.500E+05	1.680E+01	8.339E+01	1.250E+05	8.398E+00
2046	2.940E+02	2.354E+05	1.582E+01	7.853E+01	1.177E+05	7.909E+00
2047	2.769E+02	2.217E+05	1.490E+01	7.396E+01	1.109E+05	7.449E+00
2048	2.608E+02	2.088E+05	1.403E+01	6.965E+01	1.044E+05	7.015E+00
2049	2.456E+02	1.967E+05	1.321E+01	6.560E+01	9.833E+04	6.606E+00
2050	2.313E+02	1.852E+05	1.244E+01	6.178E+01	9.260E+04	6.222E+00
2051	2.178E+02	1.744E+05	1.172E+01	5.818E+01	8.721E+04	5.859E+00
2052	2.051E+02	1.643E+05	1.104E+01	5.479E+01	8.213E+04	5.518E+00
2053	1.932E+02	1.547E+05	1.039E+01	5.160E+01	7.735E+04	5.197E+00
2054	1.819E+02	1.457E+05	9.788E+00	4.860E+01	7.284E+04	4.894E+00
2055	1.713E+02	1.372E+05	9.218E+00	4.577E+01	6.860E+04	4.609E+00
2056	1.614E+02	1.292E+05	8.682E+00	4.310E+01	6.460E+04	4.341E+00
2057	1.520E+02	1.217E+05	8.176E+00	4.059E+01	6.084E+04	4.088E+00
2058	1.431E+02	1.146E+05	7.700E+00	3.823E+01	5.730E+04	3.850E+00
2059	1.348E+02	1.079E+05	7.251E+00	3.600E+01	5.396E+04	3.626E+00
2060	1.269E+02	1.016E+05	6.829E+00	3.390E+01	5.082E+04	3.415E+00
2061	1.195E+02	9.572E+04	6.431E+00	3.193E+01	4.786E+04	3.216E+00
2062	1.126E+02	9.015E+04	6.057E+00	3.007E+01	4.507E+04	3.028E+00
2063	1.060E+02	8.490E+04	5.704E+00	2.832E+01	4.245E+04	2.852E+00
2064	9.985E+01	7.995E+04	5.372E+00	2.667E+01	3.998E+04	2.686E+00
2065	9.403E+01	7.530E+04	5.059E+00	2.512E+01	3.765E+04	2.530E+00
2066	8.856E+01	7.091E+04	4.765E+00	2.365E+01	3.546E+04	2.382E+00
2067	8.340E+01	6.678E+04	4.487E+00	2.228E+01	3.339E+04	2.244E+00
2068	7.854E+01	6.289E+04	4.226E+00	2.098E+01	3.145E+04	2.113E+00
2069	7.397E+01	5.923E+04	3.980E+00	1.976E+01	2.961E+04	1.990E+00
2070	6.966E+01	5.578E+04	3.748E+00	1.861E+01	2.789E+04	1.874E+00
2071	6.560E+01	5.253E+04	3.530E+00	1.752E+01	2.627E+04	1.765E+00
2072	6.178E+01	4.947E+04	3.324E+00	1.650E+01	2.474E+04	1.662E+00
2073	5.819E+01	4.659E+04	3.131E+00	1.554E+01	2.330E+04	1.565E+00
2074	5.480E+01	4.388E+04	2.948E+00	1.464E+01	2.194E+04	1.474E+00
2075	5.161E+01	4.132E+04	2.777E+00	1.378E+01	2.066E+04	1.388E+00
2076	4.860E+01	3.892E+04	2.615E+00	1.298E+01	1.946E+04	1.307E+00
2077	4.577E+01	3.665E+04	2.463E+00	1.223E+01	1.833E+04	1.231E+00
2078	4.310E+01	3.452E+04	2.319E+00	1.151E+01	1.726E+04	1.160E+00
2079	4.059E+01	3.251E+04	2.184E+00	1.084E+01	1.625E+04	1.092E+00
2080	3.823E+01	3.061E+04	2.057E+00	1.021E+01	1.531E+04	1.028E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	3.600E+01	2.883E+04	1.937E+00	9.617E+00	1.442E+04	9.686E-01
2082	3.391E+01	2.715E+04	1.824E+00	9.057E+00	1.358E+04	9.121E-01
2083	3.193E+01	2.557E+04	1.718E+00	8.530E+00	1.279E+04	8.590E-01
2084	3.007E+01	2.408E+04	1.618E+00	8.033E+00	1.204E+04	8.090E-01
2085	2.832E+01	2.268E+04	1.524E+00	7.565E+00	1.134E+04	7.619E-01
2086	2.667E+01	2.136E+04	1.435E+00	7.124E+00	1.068E+04	7.175E-01
2087	2.512E+01	2.011E+04	1.351E+00	6.710E+00	1.006E+04	6.757E-01
2088	2.366E+01	1.894E+04	1.273E+00	6.319E+00	9.471E+03	6.364E-01
2089	2.228E+01	1.784E+04	1.199E+00	5.951E+00	8.920E+03	5.993E-01
2090	2.098E+01	1.680E+04	1.129E+00	5.604E+00	8.400E+03	5.644E-01
2091	1.976E+01	1.582E+04	1.063E+00	5.278E+00	7.911E+03	5.316E-01
2092	1.861E+01	1.490E+04	1.001E+00	4.971E+00	7.450E+03	5.006E-01
2093	1.753E+01	1.403E+04	9.429E-01	4.681E+00	7.017E+03	4.714E-01
2094	1.650E+01	1.322E+04	8.880E-01	4.409E+00	6.608E+03	4.440E-01
2095	1.554E+01	1.245E+04	8.363E-01	4.152E+00	6.223E+03	4.181E-01
2096	1.464E+01	1.172E+04	7.876E-01	3.910E+00	5.861E+03	3.938E-01
2097	1.379E+01	1.104E+04	7.417E-01	3.682E+00	5.519E+03	3.709E-01
2098	1.298E+01	1.040E+04	6.985E-01	3.468E+00	5.198E+03	3.493E-01
2099	1.223E+01	9.791E+03	6.578E-01	3.266E+00	4.895E+03	3.289E-01
2100	1.151E+01	9.220E+03	6.195E-01	3.076E+00	4.610E+03	3.098E-01
2101	1.084E+01	8.684E+03	5.834E-01	2.897E+00	4.342E+03	2.917E-01
2102	1.021E+01	8.178E+03	5.495E-01	2.728E+00	4.089E+03	2.747E-01
2103	9.618E+00	7.702E+03	5.175E-01	2.569E+00	3.851E+03	2.587E-01
2104	9.058E+00	7.253E+03	4.873E-01	2.419E+00	3.627E+03	2.437E-01
2105	8.530E+00	6.831E+03	4.590E-01	2.279E+00	3.415E+03	2.295E-01
2106	8.034E+00	6.433E+03	4.322E-01	2.146E+00	3.216E+03	2.161E-01
2107	7.566E+00	6.058E+03	4.071E-01	2.021E+00	3.029E+03	2.035E-01
2108	7.125E+00	5.705E+03	3.834E-01	1.903E+00	2.853E+03	1.917E-01
2109	6.710E+00	5.373E+03	3.610E-01	1.792E+00	2.687E+03	1.805E-01
2110	6.319E+00	5.060E+03	3.400E-01	1.688E+00	2.530E+03	1.700E-01
2111	5.951E+00	4.766E+03	3.202E-01	1.590E+00	2.383E+03	1.601E-01
2112	5.605E+00	4.488E+03	3.016E-01	1.497E+00	2.244E+03	1.508E-01
2113	5.278E+00	4.227E+03	2.840E-01	1.410E+00	2.113E+03	1.420E-01
2114	4.971E+00	3.981E+03	2.675E-01	1.328E+00	1.990E+03	1.337E-01
2115	4.682E+00	3.749E+03	2.519E-01	1.250E+00	1.874E+03	1.259E-01
2116	4.409E+00	3.530E+03	2.372E-01	1.178E+00	1.765E+03	1.186E-01
2117	4.152E+00	3.325E+03	2.234E-01	1.109E+00	1.662E+03	1.117E-01
2118	3.910E+00	3.131E+03	2.104E-01	1.044E+00	1.566E+03	1.052E-01
2119	3.683E+00	2.949E+03	1.981E-01	9.837E-01	1.474E+03	9.907E-02
2120	3.468E+00	2.777E+03	1.866E-01	9.264E-01	1.389E+03	9.330E-02

Results (Continued)

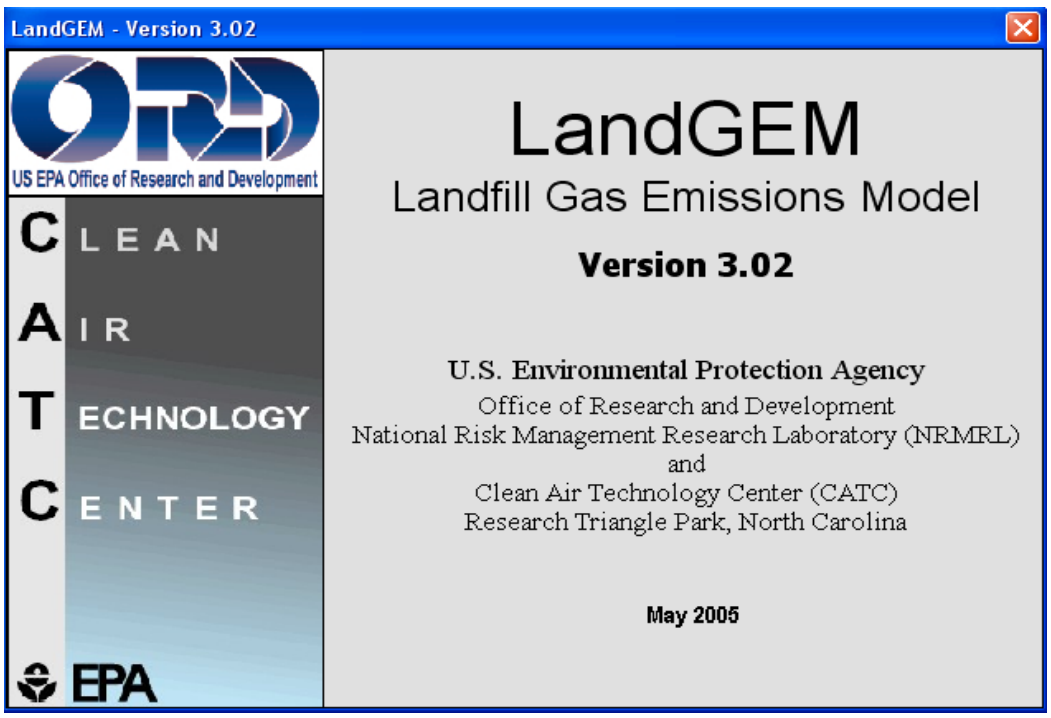
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.430E+02	7.812E+04	5.249E+00	2.240E+00	6.250E+02	4.199E-02
1982	3.581E+02	1.956E+05	1.315E+01	5.610E+00	1.565E+03	1.052E-01
1983	5.650E+02	3.086E+05	2.074E+01	8.850E+00	2.469E+03	1.659E-01
1984	7.585E+02	4.144E+05	2.784E+01	1.188E+01	3.315E+03	2.227E-01
1985	9.430E+02	5.152E+05	3.462E+01	1.477E+01	4.121E+03	2.769E-01
1986	1.141E+03	6.234E+05	4.189E+01	1.788E+01	4.987E+03	3.351E-01
1987	1.410E+03	7.704E+05	5.176E+01	2.209E+01	6.163E+03	4.141E-01
1988	1.720E+03	9.396E+05	6.313E+01	2.694E+01	7.517E+03	5.051E-01
1989	2.077E+03	1.135E+06	7.625E+01	3.254E+01	9.079E+03	6.100E-01
1990	2.448E+03	1.337E+06	8.986E+01	3.835E+01	1.070E+04	7.189E-01
1991	2.718E+03	1.485E+06	9.977E+01	4.258E+01	1.188E+04	7.982E-01
1992	2.801E+03	1.530E+06	1.028E+02	4.388E+01	1.224E+04	8.224E-01
1993	2.822E+03	1.542E+06	1.036E+02	4.421E+01	1.233E+04	8.286E-01
1994	2.859E+03	1.562E+06	1.050E+02	4.479E+01	1.250E+04	8.397E-01
1995	2.837E+03	1.550E+06	1.041E+02	4.444E+01	1.240E+04	8.330E-01
1996	2.838E+03	1.551E+06	1.042E+02	4.447E+01	1.241E+04	8.335E-01
1997	2.830E+03	1.546E+06	1.039E+02	4.433E+01	1.237E+04	8.310E-01
1998	2.848E+03	1.556E+06	1.045E+02	4.461E+01	1.245E+04	8.363E-01
1999	2.869E+03	1.567E+06	1.053E+02	4.494E+01	1.254E+04	8.424E-01
2000	2.893E+03	1.580E+06	1.062E+02	4.532E+01	1.264E+04	8.494E-01
2001	2.951E+03	1.612E+06	1.083E+02	4.622E+01	1.290E+04	8.664E-01
2002	3.020E+03	1.650E+06	1.108E+02	4.730E+01	1.320E+04	8.867E-01
2003	2.844E+03	1.554E+06	1.044E+02	4.455E+01	1.243E+04	8.350E-01
2004	2.678E+03	1.463E+06	9.830E+01	4.195E+01	1.170E+04	7.864E-01
2005	2.522E+03	1.378E+06	9.258E+01	3.951E+01	1.102E+04	7.406E-01
2006	2.375E+03	1.298E+06	8.719E+01	3.721E+01	1.038E+04	6.975E-01
2007	2.237E+03	1.222E+06	8.211E+01	3.504E+01	9.776E+03	6.569E-01
2008	2.107E+03	1.151E+06	7.733E+01	3.300E+01	9.207E+03	6.186E-01
2009	1.984E+03	1.084E+06	7.282E+01	3.108E+01	8.671E+03	5.826E-01
2010	1.868E+03	1.021E+06	6.858E+01	2.927E+01	8.166E+03	5.487E-01
2011	1.760E+03	9.613E+05	6.459E+01	2.757E+01	7.690E+03	5.167E-01
2012	1.657E+03	9.053E+05	6.083E+01	2.596E+01	7.243E+03	4.866E-01
2013	1.561E+03	8.526E+05	5.729E+01	2.445E+01	6.821E+03	4.583E-01
2014	1.470E+03	8.029E+05	5.395E+01	2.302E+01	6.424E+03	4.316E-01
2015	1.384E+03	7.562E+05	5.081E+01	2.168E+01	6.049E+03	4.065E-01
2016	1.304E+03	7.121E+05	4.785E+01	2.042E+01	5.697E+03	3.828E-01
2017	1.228E+03	6.707E+05	4.506E+01	1.923E+01	5.365E+03	3.605E-01
2018	1.156E+03	6.316E+05	4.244E+01	1.811E+01	5.053E+03	3.395E-01
2019	1.089E+03	5.948E+05	3.997E+01	1.706E+01	4.759E+03	3.197E-01
2020	1.025E+03	5.602E+05	3.764E+01	1.606E+01	4.482E+03	3.011E-01
2021	9.657E+02	5.276E+05	3.545E+01	1.513E+01	4.221E+03	2.836E-01
2022	9.095E+02	4.968E+05	3.338E+01	1.425E+01	3.975E+03	2.671E-01
2023	8.565E+02	4.679E+05	3.144E+01	1.342E+01	3.743E+03	2.515E-01
2024	8.066E+02	4.407E+05	2.961E+01	1.264E+01	3.525E+03	2.369E-01
2025	7.597E+02	4.150E+05	2.788E+01	1.190E+01	3.320E+03	2.231E-01
2026	7.154E+02	3.908E+05	2.626E+01	1.121E+01	3.127E+03	2.101E-01
2027	6.738E+02	3.681E+05	2.473E+01	1.055E+01	2.945E+03	1.978E-01
2028	6.345E+02	3.466E+05	2.329E+01	9.940E+00	2.773E+03	1.863E-01
2029	5.976E+02	3.265E+05	2.193E+01	9.361E+00	2.612E+03	1.755E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	5.628E+02	3.074E+05	2.066E+01	8.816E+00	2.460E+03	1.653E-01
2031	5.300E+02	2.895E+05	1.945E+01	8.303E+00	2.316E+03	1.556E-01
2032	4.991E+02	2.727E+05	1.832E+01	7.819E+00	2.181E+03	1.466E-01
2033	4.701E+02	2.568E+05	1.725E+01	7.364E+00	2.054E+03	1.380E-01
2034	4.427E+02	2.418E+05	1.625E+01	6.935E+00	1.935E+03	1.300E-01
2035	4.169E+02	2.278E+05	1.530E+01	6.531E+00	1.822E+03	1.224E-01
2036	3.926E+02	2.145E+05	1.441E+01	6.151E+00	1.716E+03	1.153E-01
2037	3.698E+02	2.020E+05	1.357E+01	5.793E+00	1.616E+03	1.086E-01
2038	3.482E+02	1.902E+05	1.278E+01	5.455E+00	1.522E+03	1.023E-01
2039	3.280E+02	1.792E+05	1.204E+01	5.138E+00	1.433E+03	9.630E-02
2040	3.089E+02	1.687E+05	1.134E+01	4.838E+00	1.350E+03	9.069E-02
2041	2.909E+02	1.589E+05	1.068E+01	4.557E+00	1.271E+03	8.541E-02
2042	2.739E+02	1.496E+05	1.005E+01	4.291E+00	1.197E+03	8.044E-02
2043	2.580E+02	1.409E+05	9.469E+00	4.041E+00	1.127E+03	7.575E-02
2044	2.430E+02	1.327E+05	8.918E+00	3.806E+00	1.062E+03	7.134E-02
2045	2.288E+02	1.250E+05	8.398E+00	3.584E+00	1.000E+03	6.719E-02
2046	2.155E+02	1.177E+05	7.909E+00	3.376E+00	9.417E+02	6.327E-02
2047	2.029E+02	1.109E+05	7.449E+00	3.179E+00	8.869E+02	5.959E-02
2048	1.911E+02	1.044E+05	7.015E+00	2.994E+00	8.352E+02	5.612E-02
2049	1.800E+02	9.833E+04	6.606E+00	2.820E+00	7.866E+02	5.285E-02
2050	1.695E+02	9.260E+04	6.222E+00	2.655E+00	7.408E+02	4.977E-02
2051	1.596E+02	8.721E+04	5.859E+00	2.501E+00	6.977E+02	4.688E-02
2052	1.503E+02	8.213E+04	5.518E+00	2.355E+00	6.570E+02	4.415E-02
2053	1.416E+02	7.735E+04	5.197E+00	2.218E+00	6.188E+02	4.157E-02
2054	1.333E+02	7.284E+04	4.894E+00	2.089E+00	5.827E+02	3.915E-02
2055	1.256E+02	6.860E+04	4.609E+00	1.967E+00	5.488E+02	3.687E-02
2056	1.183E+02	6.460E+04	4.341E+00	1.853E+00	5.168E+02	3.473E-02
2057	1.114E+02	6.084E+04	4.088E+00	1.745E+00	4.867E+02	3.270E-02
2058	1.049E+02	5.730E+04	3.850E+00	1.643E+00	4.584E+02	3.080E-02
2059	9.878E+01	5.396E+04	3.626E+00	1.547E+00	4.317E+02	2.901E-02
2060	9.303E+01	5.082E+04	3.415E+00	1.457E+00	4.066E+02	2.732E-02
2061	8.761E+01	4.786E+04	3.216E+00	1.372E+00	3.829E+02	2.573E-02
2062	8.251E+01	4.507E+04	3.028E+00	1.292E+00	3.606E+02	2.423E-02
2063	7.770E+01	4.245E+04	2.852E+00	1.217E+00	3.396E+02	2.282E-02
2064	7.318E+01	3.998E+04	2.686E+00	1.146E+00	3.198E+02	2.149E-02
2065	6.891E+01	3.765E+04	2.530E+00	1.080E+00	3.012E+02	2.024E-02
2066	6.490E+01	3.546E+04	2.382E+00	1.017E+00	2.836E+02	1.906E-02
2067	6.112E+01	3.339E+04	2.244E+00	9.575E-01	2.671E+02	1.795E-02
2068	5.756E+01	3.145E+04	2.113E+00	9.017E-01	2.516E+02	1.690E-02
2069	5.421E+01	2.961E+04	1.990E+00	8.492E-01	2.369E+02	1.592E-02
2070	5.105E+01	2.789E+04	1.874E+00	7.998E-01	2.231E+02	1.499E-02
2071	4.808E+01	2.627E+04	1.765E+00	7.532E-01	2.101E+02	1.412E-02
2072	4.528E+01	2.474E+04	1.662E+00	7.093E-01	1.979E+02	1.330E-02
2073	4.264E+01	2.330E+04	1.565E+00	6.680E-01	1.864E+02	1.252E-02
2074	4.016E+01	2.194E+04	1.474E+00	6.291E-01	1.755E+02	1.179E-02
2075	3.782E+01	2.066E+04	1.388E+00	5.925E-01	1.653E+02	1.111E-02
2076	3.562E+01	1.946E+04	1.307E+00	5.580E-01	1.557E+02	1.046E-02
2077	3.354E+01	1.833E+04	1.231E+00	5.255E-01	1.466E+02	9.850E-03
2078	3.159E+01	1.726E+04	1.160E+00	4.949E-01	1.381E+02	9.277E-03
2079	2.975E+01	1.625E+04	1.092E+00	4.661E-01	1.300E+02	8.736E-03
2080	2.802E+01	1.531E+04	1.028E+00	4.389E-01	1.225E+02	8.228E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	2.639E+01	1.442E+04	9.686E-01	4.134E-01	1.153E+02	7.748E-03
2082	2.485E+01	1.358E+04	9.121E-01	3.893E-01	1.086E+02	7.297E-03
2083	2.340E+01	1.279E+04	8.590E-01	3.666E-01	1.023E+02	6.872E-03
2084	2.204E+01	1.204E+04	8.090E-01	3.453E-01	9.632E+01	6.472E-03
2085	2.076E+01	1.134E+04	7.619E-01	3.252E-01	9.071E+01	6.095E-03
2086	1.955E+01	1.068E+04	7.175E-01	3.062E-01	8.543E+01	5.740E-03
2087	1.841E+01	1.006E+04	6.757E-01	2.884E-01	8.046E+01	5.406E-03
2088	1.734E+01	9.471E+03	6.364E-01	2.716E-01	7.577E+01	5.091E-03
2089	1.633E+01	8.920E+03	5.993E-01	2.558E-01	7.136E+01	4.795E-03
2090	1.538E+01	8.400E+03	5.644E-01	2.409E-01	6.720E+01	4.515E-03
2091	1.448E+01	7.911E+03	5.316E-01	2.269E-01	6.329E+01	4.252E-03
2092	1.364E+01	7.450E+03	5.006E-01	2.136E-01	5.960E+01	4.005E-03
2093	1.284E+01	7.017E+03	4.714E-01	2.012E-01	5.613E+01	3.772E-03
2094	1.210E+01	6.608E+03	4.440E-01	1.895E-01	5.286E+01	3.552E-03
2095	1.139E+01	6.223E+03	4.181E-01	1.785E-01	4.979E+01	3.345E-03
2096	1.073E+01	5.861E+03	3.938E-01	1.681E-01	4.689E+01	3.150E-03
2097	1.010E+01	5.519E+03	3.709E-01	1.583E-01	4.416E+01	2.967E-03
2098	9.515E+00	5.198E+03	3.493E-01	1.491E-01	4.158E+01	2.794E-03
2099	8.961E+00	4.895E+03	3.289E-01	1.404E-01	3.916E+01	2.631E-03
2100	8.439E+00	4.610E+03	3.098E-01	1.322E-01	3.688E+01	2.478E-03
2101	7.948E+00	4.342E+03	2.917E-01	1.245E-01	3.473E+01	2.334E-03
2102	7.485E+00	4.089E+03	2.747E-01	1.173E-01	3.271E+01	2.198E-03
2103	7.049E+00	3.851E+03	2.587E-01	1.104E-01	3.081E+01	2.070E-03
2104	6.638E+00	3.627E+03	2.437E-01	1.040E-01	2.901E+01	1.949E-03
2105	6.252E+00	3.415E+03	2.295E-01	9.794E-02	2.732E+01	1.836E-03
2106	5.888E+00	3.216E+03	2.161E-01	9.223E-02	2.573E+01	1.729E-03
2107	5.545E+00	3.029E+03	2.035E-01	8.686E-02	2.423E+01	1.628E-03
2108	5.222E+00	2.853E+03	1.917E-01	8.180E-02	2.282E+01	1.533E-03
2109	4.918E+00	2.687E+03	1.805E-01	7.704E-02	2.149E+01	1.444E-03
2110	4.631E+00	2.530E+03	1.700E-01	7.255E-02	2.024E+01	1.360E-03
2111	4.362E+00	2.383E+03	1.601E-01	6.833E-02	1.906E+01	1.281E-03
2112	4.108E+00	2.244E+03	1.508E-01	6.435E-02	1.795E+01	1.206E-03
2113	3.869E+00	2.113E+03	1.420E-01	6.060E-02	1.691E+01	1.136E-03
2114	3.643E+00	1.990E+03	1.337E-01	5.707E-02	1.592E+01	1.070E-03
2115	3.431E+00	1.874E+03	1.259E-01	5.375E-02	1.500E+01	1.008E-03
2116	3.231E+00	1.765E+03	1.186E-01	5.062E-02	1.412E+01	9.488E-04
2117	3.043E+00	1.662E+03	1.117E-01	4.767E-02	1.330E+01	8.936E-04
2118	2.866E+00	1.566E+03	1.052E-01	4.490E-02	1.252E+01	8.415E-04
2119	2.699E+00	1.474E+03	9.907E-02	4.228E-02	1.180E+01	7.925E-04
2120	2.542E+00	1.389E+03	9.330E-02	3.982E-02	1.111E+01	7.464E-04



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2001**	
Actual Closure Year (without limit)	***2001***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	0	0	468,810	515,691
2003	0	0	468,810	515,691
2004	0	0	468,810	515,691
2005	0	0	468,810	515,691
2006	0	0	468,810	515,691
2007	0	0	468,810	515,691
2008	0	0	468,810	515,691
2009	0	0	468,810	515,691
2010	0	0	468,810	515,691
2011	0	0	468,810	515,691
2012	0	0	468,810	515,691
2013	0	0	468,810	515,691
2014	0	0	468,810	515,691
2015	0	0	468,810	515,691
2016	0	0	468,810	515,691
2017	0	0	468,810	515,691
2018	0	0	468,810	515,691
2019	0	0	468,810	515,691

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	0	0	468,810	515,691
2021	0	0	468,810	515,691
2022	0	0	468,810	515,691
2023	0	0	468,810	515,691
2024	0	0	468,810	515,691
2025	0	0	468,810	515,691
2026	0	0	468,810	515,691
2027	0	0	468,810	515,691
2028	0	0	468,810	515,691
2029	0	0	468,810	515,691
2030	0	0	468,810	515,691
2031	0	0	468,810	515,691
2032	0	0	468,810	515,691
2033	0	0	468,810	515,691
2034	0	0	468,810	515,691
2035	0	0	468,810	515,691
2036	0	0	468,810	515,691
2037	0	0	468,810	515,691
2038	0	0	468,810	515,691
2039	0	0	468,810	515,691
2040	0	0	468,810	515,691
2041	0	0	468,810	515,691
2042	0	0	468,810	515,691
2043	0	0	468,810	515,691
2044	0	0	468,810	515,691
2045	0	0	468,810	515,691
2046	0	0	468,810	515,691
2047	0	0	468,810	515,691
2048	0	0	468,810	515,691
2049	0	0	468,810	515,691
2050	0	0	468,810	515,691
2051	0	0	468,810	515,691
2052	0	0	468,810	515,691
2053	0	0	468,810	515,691
2054	0	0	468,810	515,691
2055	0	0	468,810	515,691
2056	0	0	468,810	515,691
2057	0	0	468,810	515,691
2058	0	0	468,810	515,691
2059	0	0	468,810	515,691

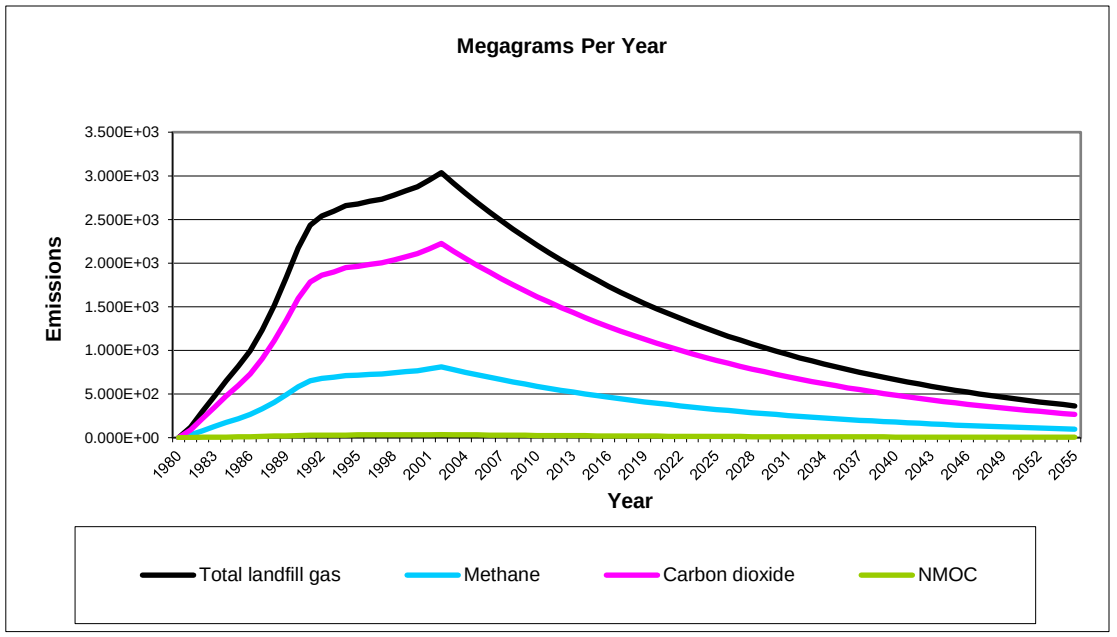
Pollutant Parameters

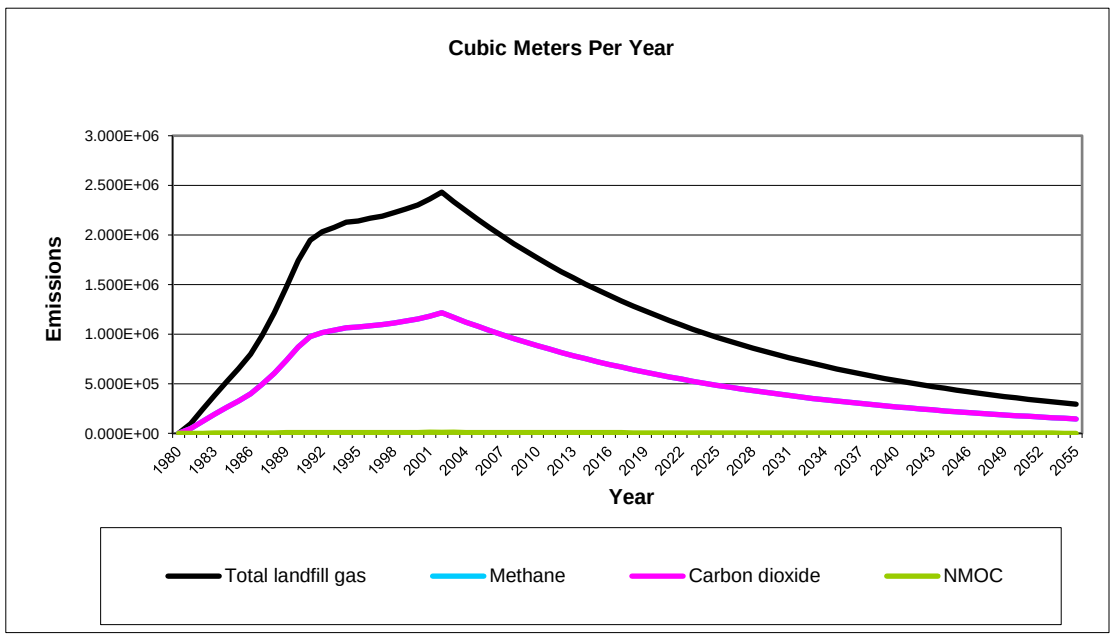
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

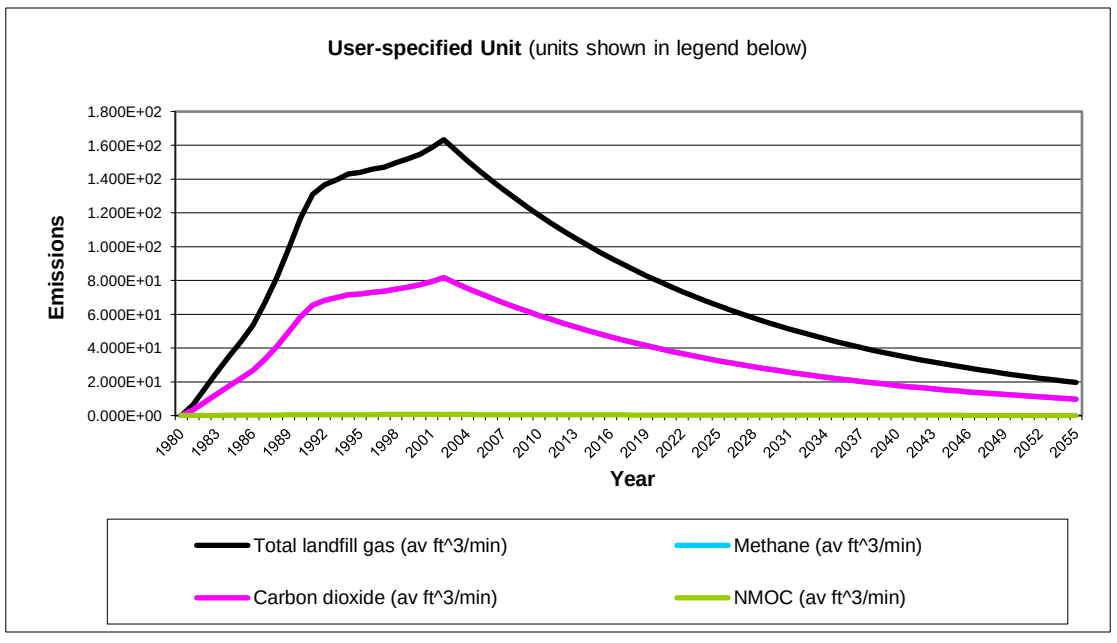
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
3.500E+03
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
1.800E+02
1.600E+02
1.400E+02
1.200E+02
1.000E+02
8.000E+01
6.000E+01
4.000E+01
2.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.193E+02	9.554E+04	6.420E+00	3.187E+01	4.777E+04	3.210E+00
1982	3.011E+02	2.411E+05	1.620E+01	8.042E+01	1.205E+05	8.099E+00
1983	4.792E+02	3.838E+05	2.578E+01	1.280E+02	1.919E+05	1.289E+01
1984	6.494E+02	5.200E+05	3.494E+01	1.735E+02	2.600E+05	1.747E+01
1985	8.148E+02	6.524E+05	4.384E+01	2.176E+02	3.262E+05	2.192E+01
1986	9.939E+02	7.959E+05	5.347E+01	2.655E+02	3.979E+05	2.674E+01
1987	1.235E+03	9.888E+05	6.644E+01	3.298E+02	4.944E+05	3.322E+01
1988	1.513E+03	1.212E+06	8.143E+01	4.042E+02	6.059E+05	4.071E+01
1989	1.836E+03	1.470E+06	9.878E+01	4.904E+02	7.350E+05	4.939E+01
1990	2.174E+03	1.741E+06	1.170E+02	5.807E+02	8.705E+05	5.849E+01
1991	2.433E+03	1.948E+06	1.309E+02	6.499E+02	9.742E+05	6.545E+01
1992	2.539E+03	2.033E+06	1.366E+02	6.781E+02	1.016E+06	6.830E+01
1993	2.593E+03	2.076E+06	1.395E+02	6.926E+02	1.038E+06	6.975E+01
1994	2.660E+03	2.130E+06	1.431E+02	7.104E+02	1.065E+06	7.155E+01
1995	2.675E+03	2.142E+06	1.439E+02	7.146E+02	1.071E+06	7.197E+01
1996	2.710E+03	2.170E+06	1.458E+02	7.238E+02	1.085E+06	7.290E+01
1997	2.734E+03	2.190E+06	1.471E+02	7.304E+02	1.095E+06	7.356E+01
1998	2.780E+03	2.226E+06	1.495E+02	7.424E+02	1.113E+06	7.477E+01
1999	2.827E+03	2.263E+06	1.521E+02	7.550E+02	1.132E+06	7.604E+01
2000	2.875E+03	2.302E+06	1.547E+02	7.679E+02	1.151E+06	7.734E+01
2001	2.951E+03	2.363E+06	1.588E+02	7.882E+02	1.182E+06	7.939E+01
2002	3.036E+03	2.431E+06	1.634E+02	8.110E+02	1.216E+06	8.168E+01
2003	2.917E+03	2.336E+06	1.570E+02	7.792E+02	1.168E+06	7.848E+01
2004	2.803E+03	2.244E+06	1.508E+02	7.487E+02	1.122E+06	7.540E+01
2005	2.693E+03	2.156E+06	1.449E+02	7.193E+02	1.078E+06	7.244E+01
2006	2.587E+03	2.072E+06	1.392E+02	6.911E+02	1.036E+06	6.960E+01
2007	2.486E+03	1.991E+06	1.337E+02	6.640E+02	9.953E+05	6.687E+01
2008	2.388E+03	1.913E+06	1.285E+02	6.380E+02	9.563E+05	6.425E+01
2009	2.295E+03	1.838E+06	1.235E+02	6.130E+02	9.188E+05	6.173E+01
2010	2.205E+03	1.765E+06	1.186E+02	5.889E+02	8.827E+05	5.931E+01
2011	2.118E+03	1.696E+06	1.140E+02	5.658E+02	8.481E+05	5.699E+01
2012	2.035E+03	1.630E+06	1.095E+02	5.436E+02	8.149E+05	5.475E+01
2013	1.955E+03	1.566E+06	1.052E+02	5.223E+02	7.829E+05	5.260E+01
2014	1.879E+03	1.504E+06	1.011E+02	5.018E+02	7.522E+05	5.054E+01
2015	1.805E+03	1.445E+06	9.712E+01	4.822E+02	7.227E+05	4.856E+01
2016	1.734E+03	1.389E+06	9.331E+01	4.633E+02	6.944E+05	4.666E+01
2017	1.666E+03	1.334E+06	8.965E+01	4.451E+02	6.672E+05	4.483E+01
2018	1.601E+03	1.282E+06	8.614E+01	4.276E+02	6.410E+05	4.307E+01
2019	1.538E+03	1.232E+06	8.276E+01	4.109E+02	6.159E+05	4.138E+01
2020	1.478E+03	1.183E+06	7.952E+01	3.948E+02	5.917E+05	3.976E+01
2021	1.420E+03	1.137E+06	7.640E+01	3.793E+02	5.685E+05	3.820E+01
2022	1.364E+03	1.092E+06	7.340E+01	3.644E+02	5.462E+05	3.670E+01
2023	1.311E+03	1.050E+06	7.052E+01	3.501E+02	5.248E+05	3.526E+01
2024	1.259E+03	1.008E+06	6.776E+01	3.364E+02	5.042E+05	3.388E+01
2025	1.210E+03	9.689E+05	6.510E+01	3.232E+02	4.845E+05	3.255E+01
2026	1.163E+03	9.309E+05	6.255E+01	3.105E+02	4.655E+05	3.127E+01
2027	1.117E+03	8.944E+05	6.010E+01	2.984E+02	4.472E+05	3.005E+01
2028	1.073E+03	8.594E+05	5.774E+01	2.867E+02	4.297E+05	2.887E+01
2029	1.031E+03	8.257E+05	5.548E+01	2.754E+02	4.128E+05	2.774E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	9.907E+02	7.933E+05	5.330E+01	2.646E+02	3.966E+05	2.665E+01
2031	9.518E+02	7.622E+05	5.121E+01	2.542E+02	3.811E+05	2.561E+01
2032	9.145E+02	7.323E+05	4.920E+01	2.443E+02	3.661E+05	2.460E+01
2033	8.786E+02	7.036E+05	4.727E+01	2.347E+02	3.518E+05	2.364E+01
2034	8.442E+02	6.760E+05	4.542E+01	2.255E+02	3.380E+05	2.271E+01
2035	8.111E+02	6.495E+05	4.364E+01	2.167E+02	3.247E+05	2.182E+01
2036	7.793E+02	6.240E+05	4.193E+01	2.082E+02	3.120E+05	2.096E+01
2037	7.487E+02	5.996E+05	4.028E+01	2.000E+02	2.998E+05	2.014E+01
2038	7.194E+02	5.760E+05	3.870E+01	1.922E+02	2.880E+05	1.935E+01
2039	6.912E+02	5.535E+05	3.719E+01	1.846E+02	2.767E+05	1.859E+01
2040	6.641E+02	5.318E+05	3.573E+01	1.774E+02	2.659E+05	1.786E+01
2041	6.380E+02	5.109E+05	3.433E+01	1.704E+02	2.555E+05	1.716E+01
2042	6.130E+02	4.909E+05	3.298E+01	1.637E+02	2.454E+05	1.649E+01
2043	5.890E+02	4.716E+05	3.169E+01	1.573E+02	2.358E+05	1.584E+01
2044	5.659E+02	4.531E+05	3.045E+01	1.512E+02	2.266E+05	1.522E+01
2045	5.437E+02	4.354E+05	2.925E+01	1.452E+02	2.177E+05	1.463E+01
2046	5.224E+02	4.183E+05	2.810E+01	1.395E+02	2.091E+05	1.405E+01
2047	5.019E+02	4.019E+05	2.700E+01	1.341E+02	2.009E+05	1.350E+01
2048	4.822E+02	3.861E+05	2.594E+01	1.288E+02	1.931E+05	1.297E+01
2049	4.633E+02	3.710E+05	2.493E+01	1.238E+02	1.855E+05	1.246E+01
2050	4.451E+02	3.564E+05	2.395E+01	1.189E+02	1.782E+05	1.197E+01
2051	4.277E+02	3.425E+05	2.301E+01	1.142E+02	1.712E+05	1.151E+01
2052	4.109E+02	3.290E+05	2.211E+01	1.098E+02	1.645E+05	1.105E+01
2053	3.948E+02	3.161E+05	2.124E+01	1.055E+02	1.581E+05	1.062E+01
2054	3.793E+02	3.037E+05	2.041E+01	1.013E+02	1.519E+05	1.020E+01
2055	3.644E+02	2.918E+05	1.961E+01	9.735E+01	1.459E+05	9.804E+00
2056	3.502E+02	2.804E+05	1.884E+01	9.353E+01	1.402E+05	9.420E+00
2057	3.364E+02	2.694E+05	1.810E+01	8.986E+01	1.347E+05	9.050E+00
2058	3.232E+02	2.588E+05	1.739E+01	8.634E+01	1.294E+05	8.695E+00
2059	3.106E+02	2.487E+05	1.671E+01	8.295E+01	1.243E+05	8.354E+00
2060	2.984E+02	2.389E+05	1.605E+01	7.970E+01	1.195E+05	8.027E+00
2061	2.867E+02	2.296E+05	1.542E+01	7.658E+01	1.148E+05	7.712E+00
2062	2.754E+02	2.206E+05	1.482E+01	7.357E+01	1.103E+05	7.410E+00
2063	2.646E+02	2.119E+05	1.424E+01	7.069E+01	1.060E+05	7.119E+00
2064	2.543E+02	2.036E+05	1.368E+01	6.792E+01	1.018E+05	6.840E+00
2065	2.443E+02	1.956E+05	1.314E+01	6.525E+01	9.781E+04	6.572E+00
2066	2.347E+02	1.880E+05	1.263E+01	6.270E+01	9.398E+04	6.314E+00
2067	2.255E+02	1.806E+05	1.213E+01	6.024E+01	9.029E+04	6.067E+00
2068	2.167E+02	1.735E+05	1.166E+01	5.788E+01	8.675E+04	5.829E+00
2069	2.082E+02	1.667E+05	1.120E+01	5.561E+01	8.335E+04	5.600E+00
2070	2.000E+02	1.602E+05	1.076E+01	5.343E+01	8.008E+04	5.381E+00
2071	1.922E+02	1.539E+05	1.034E+01	5.133E+01	7.694E+04	5.170E+00
2072	1.846E+02	1.478E+05	9.934E+00	4.932E+01	7.392E+04	4.967E+00
2073	1.774E+02	1.421E+05	9.544E+00	4.738E+01	7.103E+04	4.772E+00
2074	1.704E+02	1.365E+05	9.170E+00	4.553E+01	6.824E+04	4.585E+00
2075	1.638E+02	1.311E+05	8.811E+00	4.374E+01	6.556E+04	4.405E+00
2076	1.573E+02	1.260E+05	8.465E+00	4.203E+01	6.299E+04	4.233E+00
2077	1.512E+02	1.210E+05	8.133E+00	4.038E+01	6.052E+04	4.067E+00
2078	1.452E+02	1.163E+05	7.814E+00	3.879E+01	5.815E+04	3.907E+00
2079	1.395E+02	1.117E+05	7.508E+00	3.727E+01	5.587E+04	3.754E+00
2080	1.341E+02	1.074E+05	7.213E+00	3.581E+01	5.368E+04	3.607E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	1.288E+02	1.031E+05	6.931E+00	3.441E+01	5.157E+04	3.465E+00
2082	1.238E+02	9.910E+04	6.659E+00	3.306E+01	4.955E+04	3.329E+00
2083	1.189E+02	9.522E+04	6.398E+00	3.176E+01	4.761E+04	3.199E+00
2084	1.142E+02	9.149E+04	6.147E+00	3.052E+01	4.574E+04	3.073E+00
2085	1.098E+02	8.790E+04	5.906E+00	2.932E+01	4.395E+04	2.953E+00
2086	1.055E+02	8.445E+04	5.674E+00	2.817E+01	4.223E+04	2.837E+00
2087	1.013E+02	8.114E+04	5.452E+00	2.707E+01	4.057E+04	2.726E+00
2088	9.736E+01	7.796E+04	5.238E+00	2.601E+01	3.898E+04	2.619E+00
2089	9.354E+01	7.490E+04	5.033E+00	2.499E+01	3.745E+04	2.516E+00
2090	8.987E+01	7.196E+04	4.835E+00	2.401E+01	3.598E+04	2.418E+00
2091	8.635E+01	6.914E+04	4.646E+00	2.306E+01	3.457E+04	2.323E+00
2092	8.296E+01	6.643E+04	4.464E+00	2.216E+01	3.322E+04	2.232E+00
2093	7.971E+01	6.383E+04	4.289E+00	2.129E+01	3.191E+04	2.144E+00
2094	7.658E+01	6.132E+04	4.120E+00	2.046E+01	3.066E+04	2.060E+00
2095	7.358E+01	5.892E+04	3.959E+00	1.965E+01	2.946E+04	1.979E+00
2096	7.070E+01	5.661E+04	3.804E+00	1.888E+01	2.830E+04	1.902E+00
2097	6.792E+01	5.439E+04	3.654E+00	1.814E+01	2.719E+04	1.827E+00
2098	6.526E+01	5.226E+04	3.511E+00	1.743E+01	2.613E+04	1.756E+00
2099	6.270E+01	5.021E+04	3.373E+00	1.675E+01	2.510E+04	1.687E+00
2100	6.024E+01	4.824E+04	3.241E+00	1.609E+01	2.412E+04	1.621E+00
2101	5.788E+01	4.635E+04	3.114E+00	1.546E+01	2.317E+04	1.557E+00
2102	5.561E+01	4.453E+04	2.992E+00	1.485E+01	2.227E+04	1.496E+00
2103	5.343E+01	4.278E+04	2.875E+00	1.427E+01	2.139E+04	1.437E+00
2104	5.134E+01	4.111E+04	2.762E+00	1.371E+01	2.055E+04	1.381E+00
2105	4.932E+01	3.950E+04	2.654E+00	1.317E+01	1.975E+04	1.327E+00
2106	4.739E+01	3.795E+04	2.550E+00	1.266E+01	1.897E+04	1.275E+00
2107	4.553E+01	3.646E+04	2.450E+00	1.216E+01	1.823E+04	1.225E+00
2108	4.375E+01	3.503E+04	2.354E+00	1.168E+01	1.751E+04	1.177E+00
2109	4.203E+01	3.366E+04	2.261E+00	1.123E+01	1.683E+04	1.131E+00
2110	4.038E+01	3.234E+04	2.173E+00	1.079E+01	1.617E+04	1.086E+00
2111	3.880E+01	3.107E+04	2.087E+00	1.036E+01	1.553E+04	1.044E+00
2112	3.728E+01	2.985E+04	2.006E+00	9.957E+00	1.492E+04	1.003E+00
2113	3.582E+01	2.868E+04	1.927E+00	9.567E+00	1.434E+04	9.635E-01
2114	3.441E+01	2.755E+04	1.851E+00	9.192E+00	1.378E+04	9.257E-01
2115	3.306E+01	2.647E+04	1.779E+00	8.831E+00	1.324E+04	8.894E-01
2116	3.177E+01	2.544E+04	1.709E+00	8.485E+00	1.272E+04	8.545E-01
2117	3.052E+01	2.444E+04	1.642E+00	8.152E+00	1.222E+04	8.210E-01
2118	2.932E+01	2.348E+04	1.578E+00	7.833E+00	1.174E+04	7.888E-01
2119	2.817E+01	2.256E+04	1.516E+00	7.525E+00	1.128E+04	7.579E-01
2120	2.707E+01	2.168E+04	1.456E+00	7.230E+00	1.084E+04	7.282E-01

Results (Continued)

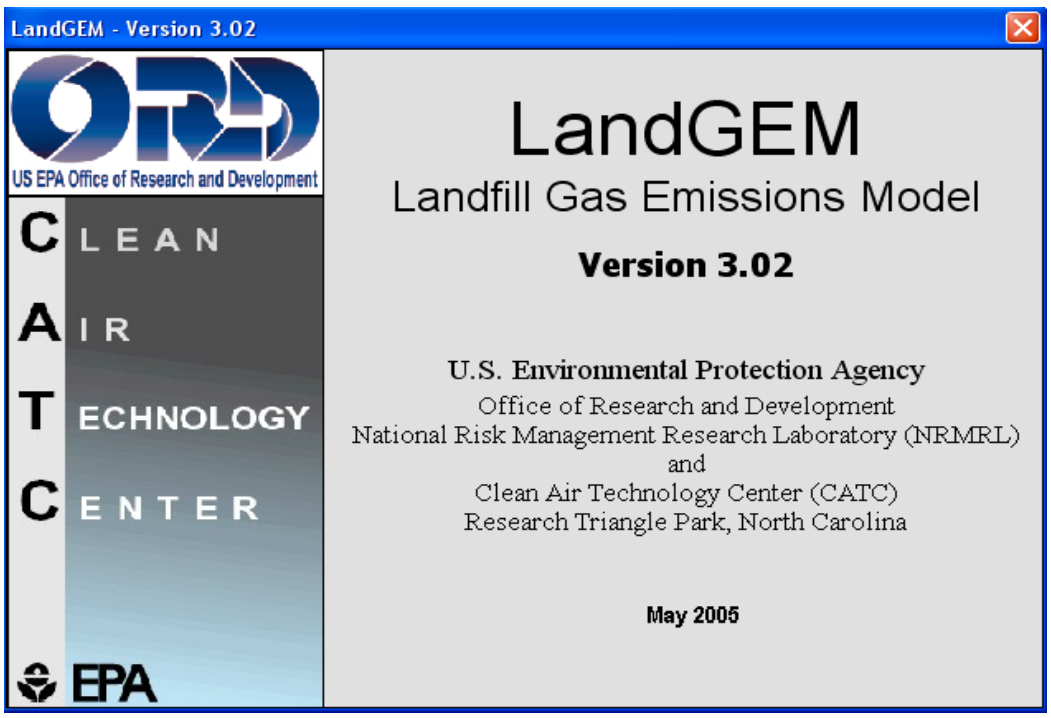
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	8.745E+01	4.777E+04	3.210E+00	1.370E+00	3.822E+02	2.568E-02
1982	2.207E+02	1.205E+05	8.099E+00	3.457E+00	9.643E+02	6.479E-02
1983	3.512E+02	1.919E+05	1.289E+01	5.502E+00	1.535E+03	1.031E-01
1984	4.759E+02	2.600E+05	1.747E+01	7.455E+00	2.080E+03	1.397E-01
1985	5.971E+02	3.262E+05	2.192E+01	9.354E+00	2.610E+03	1.753E-01
1986	7.284E+02	3.979E+05	2.674E+01	1.141E+01	3.183E+03	2.139E-01
1987	9.050E+02	4.944E+05	3.322E+01	1.418E+01	3.955E+03	2.658E-01
1988	1.109E+03	6.059E+05	4.071E+01	1.738E+01	4.847E+03	3.257E-01
1989	1.346E+03	7.350E+05	4.939E+01	2.108E+01	5.880E+03	3.951E-01
1990	1.593E+03	8.705E+05	5.849E+01	2.496E+01	6.964E+03	4.679E-01
1991	1.783E+03	9.742E+05	6.545E+01	2.793E+01	7.793E+03	5.236E-01
1992	1.861E+03	1.016E+06	6.830E+01	2.915E+01	8.132E+03	5.464E-01
1993	1.900E+03	1.038E+06	6.975E+01	2.977E+01	8.305E+03	5.580E-01
1994	1.949E+03	1.065E+06	7.155E+01	3.054E+01	8.519E+03	5.724E-01
1995	1.961E+03	1.071E+06	7.197E+01	3.072E+01	8.569E+03	5.758E-01
1996	1.986E+03	1.085E+06	7.290E+01	3.111E+01	8.679E+03	5.832E-01
1997	2.004E+03	1.095E+06	7.356E+01	3.139E+01	8.758E+03	5.885E-01
1998	2.037E+03	1.113E+06	7.477E+01	3.191E+01	8.903E+03	5.982E-01
1999	2.072E+03	1.132E+06	7.604E+01	3.245E+01	9.053E+03	6.083E-01
2000	2.107E+03	1.151E+06	7.734E+01	3.301E+01	9.208E+03	6.187E-01
2001	2.163E+03	1.182E+06	7.939E+01	3.388E+01	9.452E+03	6.351E-01
2002	2.225E+03	1.216E+06	8.168E+01	3.486E+01	9.725E+03	6.534E-01
2003	2.138E+03	1.168E+06	7.848E+01	3.349E+01	9.344E+03	6.278E-01
2004	2.054E+03	1.122E+06	7.540E+01	3.218E+01	8.977E+03	6.032E-01
2005	1.974E+03	1.078E+06	7.244E+01	3.092E+01	8.625E+03	5.795E-01
2006	1.896E+03	1.036E+06	6.960E+01	2.971E+01	8.287E+03	5.568E-01
2007	1.822E+03	9.953E+05	6.687E+01	2.854E+01	7.962E+03	5.350E-01
2008	1.750E+03	9.563E+05	6.425E+01	2.742E+01	7.650E+03	5.140E-01
2009	1.682E+03	9.188E+05	6.173E+01	2.635E+01	7.350E+03	4.939E-01
2010	1.616E+03	8.827E+05	5.931E+01	2.531E+01	7.062E+03	4.745E-01
2011	1.552E+03	8.481E+05	5.699E+01	2.432E+01	6.785E+03	4.559E-01
2012	1.492E+03	8.149E+05	5.475E+01	2.337E+01	6.519E+03	4.380E-01
2013	1.433E+03	7.829E+05	5.260E+01	2.245E+01	6.263E+03	4.208E-01
2014	1.377E+03	7.522E+05	5.054E+01	2.157E+01	6.018E+03	4.043E-01
2015	1.323E+03	7.227E+05	4.856E+01	2.072E+01	5.782E+03	3.885E-01
2016	1.271E+03	6.944E+05	4.666E+01	1.991E+01	5.555E+03	3.732E-01
2017	1.221E+03	6.672E+05	4.483E+01	1.913E+01	5.337E+03	3.586E-01
2018	1.173E+03	6.410E+05	4.307E+01	1.838E+01	5.128E+03	3.446E-01
2019	1.127E+03	6.159E+05	4.138E+01	1.766E+01	4.927E+03	3.310E-01
2020	1.083E+03	5.917E+05	3.976E+01	1.697E+01	4.734E+03	3.181E-01
2021	1.041E+03	5.685E+05	3.820E+01	1.630E+01	4.548E+03	3.056E-01
2022	9.999E+02	5.462E+05	3.670E+01	1.566E+01	4.370E+03	2.936E-01
2023	9.607E+02	5.248E+05	3.526E+01	1.505E+01	4.198E+03	2.821E-01
2024	9.230E+02	5.042E+05	3.388E+01	1.446E+01	4.034E+03	2.710E-01
2025	8.868E+02	4.845E+05	3.255E+01	1.389E+01	3.876E+03	2.604E-01
2026	8.520E+02	4.655E+05	3.127E+01	1.335E+01	3.724E+03	2.502E-01
2027	8.186E+02	4.472E+05	3.005E+01	1.282E+01	3.578E+03	2.404E-01
2028	7.865E+02	4.297E+05	2.887E+01	1.232E+01	3.437E+03	2.310E-01
2029	7.557E+02	4.128E+05	2.774E+01	1.184E+01	3.303E+03	2.219E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	7.261E+02	3.966E+05	2.665E+01	1.137E+01	3.173E+03	2.132E-01
2031	6.976E+02	3.811E+05	2.561E+01	1.093E+01	3.049E+03	2.048E-01
2032	6.702E+02	3.661E+05	2.460E+01	1.050E+01	2.929E+03	1.968E-01
2033	6.439E+02	3.518E+05	2.364E+01	1.009E+01	2.814E+03	1.891E-01
2034	6.187E+02	3.380E+05	2.271E+01	9.692E+00	2.704E+03	1.817E-01
2035	5.944E+02	3.247E+05	2.182E+01	9.312E+00	2.598E+03	1.746E-01
2036	5.711E+02	3.120E+05	2.096E+01	8.947E+00	2.496E+03	1.677E-01
2037	5.487E+02	2.998E+05	2.014E+01	8.596E+00	2.398E+03	1.611E-01
2038	5.272E+02	2.880E+05	1.935E+01	8.259E+00	2.304E+03	1.548E-01
2039	5.065E+02	2.767E+05	1.859E+01	7.935E+00	2.214E+03	1.487E-01
2040	4.867E+02	2.659E+05	1.786E+01	7.624E+00	2.127E+03	1.429E-01
2041	4.676E+02	2.555E+05	1.716E+01	7.325E+00	2.044E+03	1.373E-01
2042	4.493E+02	2.454E+05	1.649E+01	7.038E+00	1.963E+03	1.319E-01
2043	4.317E+02	2.358E+05	1.584E+01	6.762E+00	1.886E+03	1.268E-01
2044	4.147E+02	2.266E+05	1.522E+01	6.497E+00	1.813E+03	1.218E-01
2045	3.985E+02	2.177E+05	1.463E+01	6.242E+00	1.741E+03	1.170E-01
2046	3.828E+02	2.091E+05	1.405E+01	5.997E+00	1.673E+03	1.124E-01
2047	3.678E+02	2.009E+05	1.350E+01	5.762E+00	1.608E+03	1.080E-01
2048	3.534E+02	1.931E+05	1.297E+01	5.536E+00	1.545E+03	1.038E-01
2049	3.395E+02	1.855E+05	1.246E+01	5.319E+00	1.484E+03	9.971E-02
2050	3.262E+02	1.782E+05	1.197E+01	5.111E+00	1.426E+03	9.580E-02
2051	3.134E+02	1.712E+05	1.151E+01	4.910E+00	1.370E+03	9.204E-02
2052	3.012E+02	1.645E+05	1.105E+01	4.718E+00	1.316E+03	8.843E-02
2053	2.893E+02	1.581E+05	1.062E+01	4.533E+00	1.265E+03	8.497E-02
2054	2.780E+02	1.519E+05	1.020E+01	4.355E+00	1.215E+03	8.163E-02
2055	2.671E+02	1.459E+05	9.804E+00	4.184E+00	1.167E+03	7.843E-02
2056	2.566E+02	1.402E+05	9.420E+00	4.020E+00	1.122E+03	7.536E-02
2057	2.466E+02	1.347E+05	9.050E+00	3.863E+00	1.078E+03	7.240E-02
2058	2.369E+02	1.294E+05	8.695E+00	3.711E+00	1.035E+03	6.956E-02
2059	2.276E+02	1.243E+05	8.354E+00	3.566E+00	9.947E+02	6.684E-02
2060	2.187E+02	1.195E+05	8.027E+00	3.426E+00	9.557E+02	6.422E-02
2061	2.101E+02	1.148E+05	7.712E+00	3.291E+00	9.183E+02	6.170E-02
2062	2.019E+02	1.103E+05	7.410E+00	3.162E+00	8.822E+02	5.928E-02
2063	1.940E+02	1.060E+05	7.119E+00	3.038E+00	8.477E+02	5.695E-02
2064	1.863E+02	1.018E+05	6.840E+00	2.919E+00	8.144E+02	5.472E-02
2065	1.790E+02	9.781E+04	6.572E+00	2.805E+00	7.825E+02	5.258E-02
2066	1.720E+02	9.398E+04	6.314E+00	2.695E+00	7.518E+02	5.051E-02
2067	1.653E+02	9.029E+04	6.067E+00	2.589E+00	7.223E+02	4.853E-02
2068	1.588E+02	8.675E+04	5.829E+00	2.488E+00	6.940E+02	4.663E-02
2069	1.526E+02	8.335E+04	5.600E+00	2.390E+00	6.668E+02	4.480E-02
2070	1.466E+02	8.008E+04	5.381E+00	2.296E+00	6.406E+02	4.304E-02
2071	1.408E+02	7.694E+04	5.170E+00	2.206E+00	6.155E+02	4.136E-02
2072	1.353E+02	7.392E+04	4.967E+00	2.120E+00	5.914E+02	3.974E-02
2073	1.300E+02	7.103E+04	4.772E+00	2.037E+00	5.682E+02	3.818E-02
2074	1.249E+02	6.824E+04	4.585E+00	1.957E+00	5.459E+02	3.668E-02
2075	1.200E+02	6.556E+04	4.405E+00	1.880E+00	5.245E+02	3.524E-02
2076	1.153E+02	6.299E+04	4.233E+00	1.806E+00	5.039E+02	3.386E-02
2077	1.108E+02	6.052E+04	4.067E+00	1.736E+00	4.842E+02	3.253E-02
2078	1.064E+02	5.815E+04	3.907E+00	1.668E+00	4.652E+02	3.126E-02
2079	1.023E+02	5.587E+04	3.754E+00	1.602E+00	4.470E+02	3.003E-02
2080	9.826E+01	5.368E+04	3.607E+00	1.539E+00	4.294E+02	2.885E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	9.441E+01	5.157E+04	3.465E+00	1.479E+00	4.126E+02	2.772E-02
2082	9.071E+01	4.955E+04	3.329E+00	1.421E+00	3.964E+02	2.664E-02
2083	8.715E+01	4.761E+04	3.199E+00	1.365E+00	3.809E+02	2.559E-02
2084	8.373E+01	4.574E+04	3.073E+00	1.312E+00	3.659E+02	2.459E-02
2085	8.045E+01	4.395E+04	2.953E+00	1.260E+00	3.516E+02	2.362E-02
2086	7.729E+01	4.223E+04	2.837E+00	1.211E+00	3.378E+02	2.270E-02
2087	7.426E+01	4.057E+04	2.726E+00	1.163E+00	3.246E+02	2.181E-02
2088	7.135E+01	3.898E+04	2.619E+00	1.118E+00	3.118E+02	2.095E-02
2089	6.855E+01	3.745E+04	2.516E+00	1.074E+00	2.996E+02	2.013E-02
2090	6.587E+01	3.598E+04	2.418E+00	1.032E+00	2.879E+02	1.934E-02
2091	6.328E+01	3.457E+04	2.323E+00	9.914E-01	2.766E+02	1.858E-02
2092	6.080E+01	3.322E+04	2.232E+00	9.525E-01	2.657E+02	1.785E-02
2093	5.842E+01	3.191E+04	2.144E+00	9.151E-01	2.553E+02	1.715E-02
2094	5.613E+01	3.066E+04	2.060E+00	8.793E-01	2.453E+02	1.648E-02
2095	5.393E+01	2.946E+04	1.979E+00	8.448E-01	2.357E+02	1.584E-02
2096	5.181E+01	2.830E+04	1.902E+00	8.117E-01	2.264E+02	1.521E-02
2097	4.978E+01	2.719E+04	1.827E+00	7.798E-01	2.176E+02	1.462E-02
2098	4.783E+01	2.613E+04	1.756E+00	7.493E-01	2.090E+02	1.404E-02
2099	4.595E+01	2.510E+04	1.687E+00	7.199E-01	2.008E+02	1.349E-02
2100	4.415E+01	2.412E+04	1.621E+00	6.917E-01	1.930E+02	1.296E-02
2101	4.242E+01	2.317E+04	1.557E+00	6.645E-01	1.854E+02	1.246E-02
2102	4.076E+01	2.227E+04	1.496E+00	6.385E-01	1.781E+02	1.197E-02
2103	3.916E+01	2.139E+04	1.437E+00	6.134E-01	1.711E+02	1.150E-02
2104	3.762E+01	2.055E+04	1.381E+00	5.894E-01	1.644E+02	1.105E-02
2105	3.615E+01	1.975E+04	1.327E+00	5.663E-01	1.580E+02	1.061E-02
2106	3.473E+01	1.897E+04	1.275E+00	5.441E-01	1.518E+02	1.020E-02
2107	3.337E+01	1.823E+04	1.225E+00	5.227E-01	1.458E+02	9.799E-03
2108	3.206E+01	1.751E+04	1.177E+00	5.022E-01	1.401E+02	9.414E-03
2109	3.080E+01	1.683E+04	1.131E+00	4.825E-01	1.346E+02	9.045E-03
2110	2.960E+01	1.617E+04	1.086E+00	4.636E-01	1.293E+02	8.691E-03
2111	2.844E+01	1.553E+04	1.044E+00	4.454E-01	1.243E+02	8.350E-03
2112	2.732E+01	1.492E+04	1.003E+00	4.280E-01	1.194E+02	8.022E-03
2113	2.625E+01	1.434E+04	9.635E-01	4.112E-01	1.147E+02	7.708E-03
2114	2.522E+01	1.378E+04	9.257E-01	3.951E-01	1.102E+02	7.406E-03
2115	2.423E+01	1.324E+04	8.894E-01	3.796E-01	1.059E+02	7.115E-03
2116	2.328E+01	1.272E+04	8.545E-01	3.647E-01	1.017E+02	6.836E-03
2117	2.237E+01	1.222E+04	8.210E-01	3.504E-01	9.776E+01	6.568E-03
2118	2.149E+01	1.174E+04	7.888E-01	3.367E-01	9.392E+01	6.311E-03
2119	2.065E+01	1.128E+04	7.579E-01	3.235E-01	9.024E+01	6.063E-03
2120	1.984E+01	1.084E+04	7.282E-01	3.108E-01	8.670E+01	5.825E-03



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.096**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**127**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	31,140	34,254	468,810	515,691
2003	16,714	18,385	499,950	549,945
2004	16,163	17,779	516,664	568,330
2005	17,787	19,566	532,827	586,110
2006	23,965	26,362	550,614	605,675
2007	18,035	19,839	574,579	632,037
2008	19,200	21,120	592,614	651,875
2009	19,200	21,120	611,814	672,995
2010	19,200	21,120	631,014	694,115
2011	19,200	21,120	650,214	715,235
2012	19,200	21,120	669,414	736,355
2013	19,200	21,120	688,614	757,475
2014	19,200	21,120	707,814	778,595
2015	19,200	21,120	727,014	799,715
2016	19,200	21,120	746,214	820,835
2017	19,200	21,120	765,414	841,955
2018	19,200	21,120	784,614	863,075
2019	19,200	21,120	803,814	884,195

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	19,200	21,120	823,014	905,315
2021	19,200	21,120	842,214	926,435
2022	19,200	21,120	861,414	947,555
2023	19,200	21,120	880,614	968,675
2024	19,200	21,120	899,814	989,795
2025	19,200	21,120	919,014	1,010,915
2026	19,200	21,120	938,214	1,032,035
2027	19,200	21,120	957,414	1,053,155
2028	19,200	21,120	976,614	1,074,275
2029	19,200	21,120	995,814	1,095,395
2030	19,200	21,120	1,015,014	1,116,515
2031	19,200	21,120	1,034,214	1,137,635
2032	19,200	21,120	1,053,414	1,158,755
2033	19,200	21,120	1,072,614	1,179,875
2034	19,200	21,120	1,091,814	1,200,995
2035	19,200	21,120	1,111,014	1,222,115
2036	0	0	1,130,214	1,243,235
2037	0	0	1,130,214	1,243,235
2038	0	0	1,130,214	1,243,235
2039	0	0	1,130,214	1,243,235
2040	0	0	1,130,214	1,243,235
2041	0	0	1,130,214	1,243,235
2042	0	0	1,130,214	1,243,235
2043	0	0	1,130,214	1,243,235
2044	0	0	1,130,214	1,243,235
2045	0	0	1,130,214	1,243,235
2046	0	0	1,130,214	1,243,235
2047	0	0	1,130,214	1,243,235
2048	0	0	1,130,214	1,243,235
2049	0	0	1,130,214	1,243,235
2050	0	0	1,130,214	1,243,235
2051	0	0	1,130,214	1,243,235
2052	0	0	1,130,214	1,243,235
2053	0	0	1,130,214	1,243,235
2054	0	0	1,130,214	1,243,235
2055	0	0	1,130,214	1,243,235
2056	0	0	1,130,214	1,243,235
2057	0	0	1,130,214	1,243,235
2058	0	0	1,130,214	1,243,235
2059	0	0	1,130,214	1,243,235

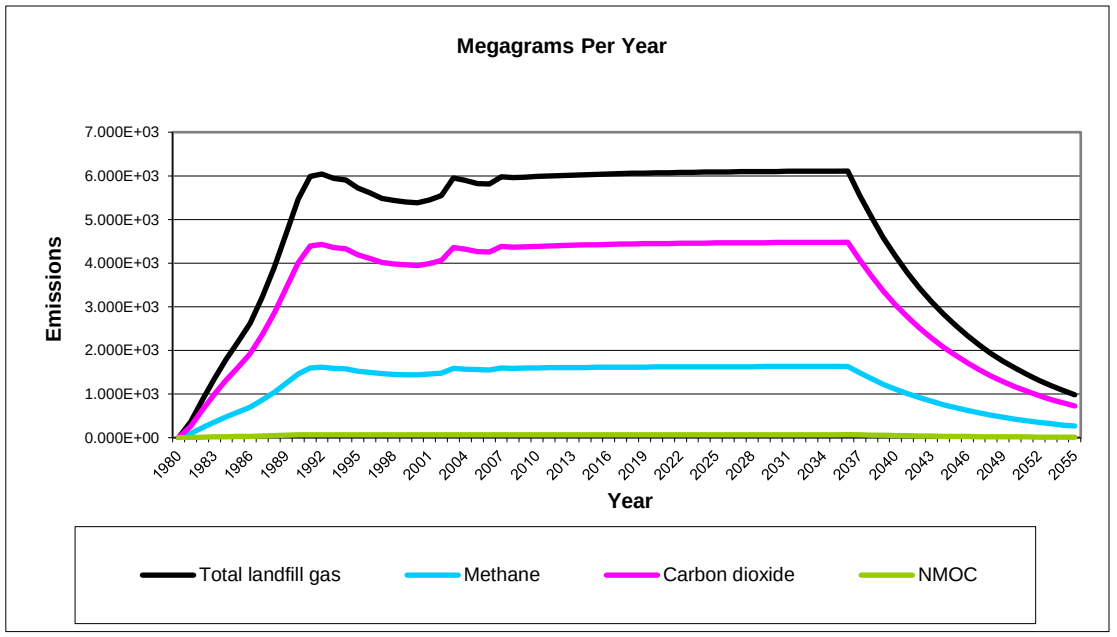
Pollutant Parameters

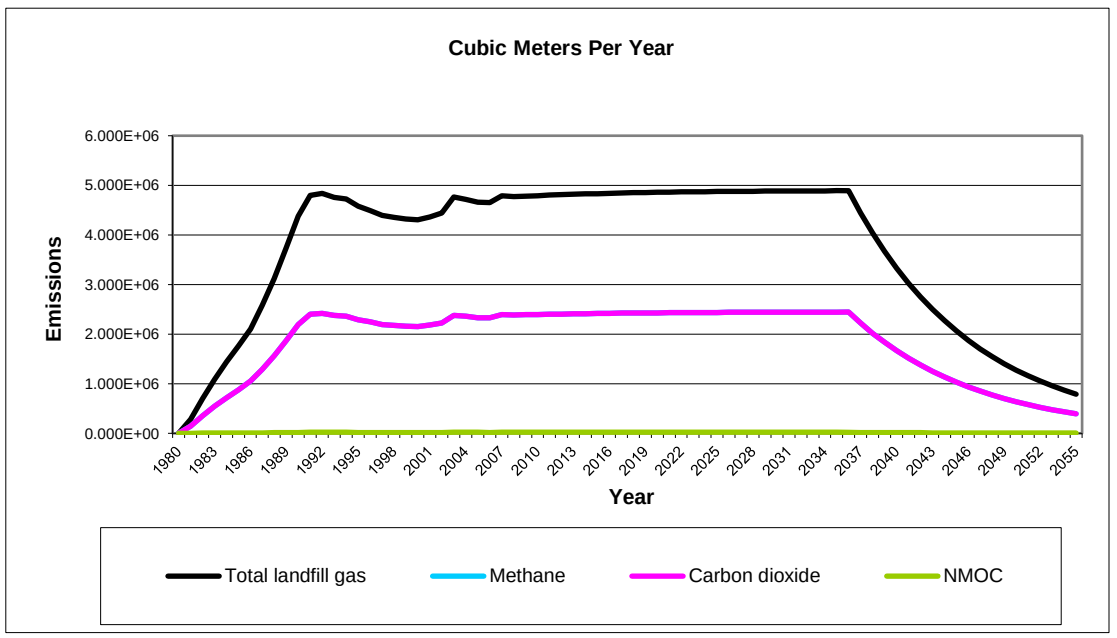
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

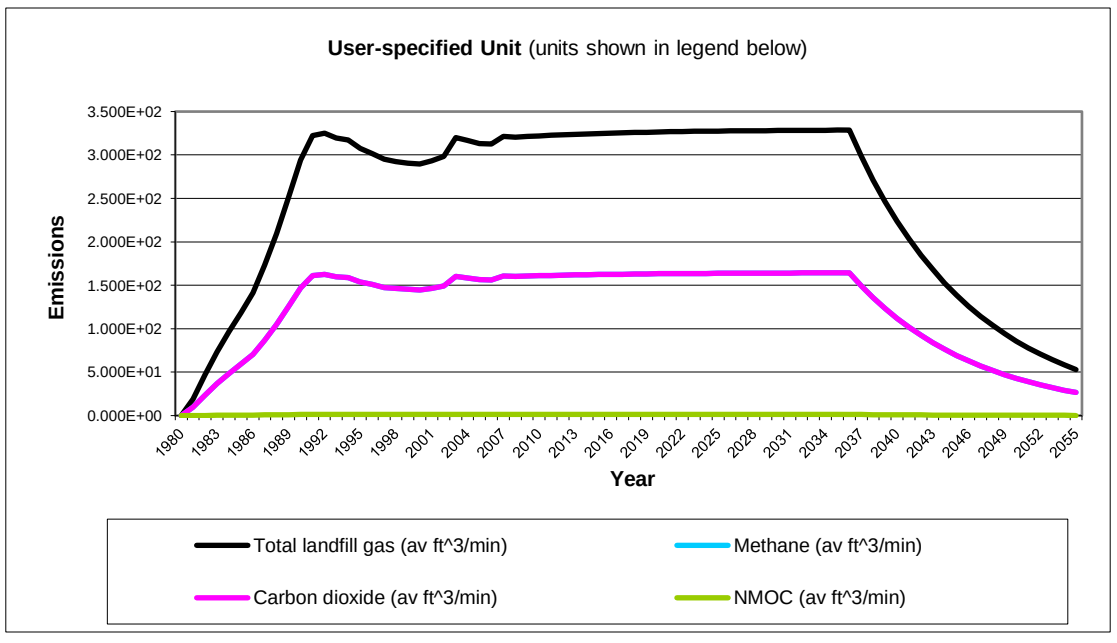
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
6.000E+06
5.000E+06
4.000E+06
3.000E+06
2.000E+06
1.000E+06
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.500E+02
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	3.547E+02	2.841E+05	1.909E+01	9.475E+01	1.420E+05	9.543E+00
1982	8.766E+02	7.019E+05	4.716E+01	2.341E+02	3.510E+05	2.358E+01
1983	1.361E+03	1.090E+06	7.323E+01	3.636E+02	5.450E+05	3.662E+01
1984	1.798E+03	1.440E+06	9.675E+01	4.803E+02	7.199E+05	4.837E+01
1985	2.201E+03	1.762E+06	1.184E+02	5.879E+02	8.812E+05	5.921E+01
1986	2.627E+03	2.104E+06	1.413E+02	7.017E+02	1.052E+06	7.067E+01
1987	3.219E+03	2.578E+06	1.732E+02	8.598E+02	1.289E+06	8.659E+01
1988	3.896E+03	3.120E+06	2.096E+02	1.041E+03	1.560E+06	1.048E+02
1989	4.675E+03	3.743E+06	2.515E+02	1.249E+03	1.872E+06	1.258E+02
1990	5.467E+03	4.377E+06	2.941E+02	1.460E+03	2.189E+06	1.471E+02
1991	5.990E+03	4.796E+06	3.223E+02	1.600E+03	2.398E+06	1.611E+02
1992	6.039E+03	4.836E+06	3.249E+02	1.613E+03	2.418E+06	1.625E+02
1993	5.943E+03	4.759E+06	3.198E+02	1.588E+03	2.380E+06	1.599E+02
1994	5.900E+03	4.724E+06	3.174E+02	1.576E+03	2.362E+06	1.587E+02
1995	5.716E+03	4.578E+06	3.076E+02	1.527E+03	2.289E+06	1.538E+02
1996	5.608E+03	4.490E+06	3.017E+02	1.498E+03	2.245E+06	1.509E+02
1997	5.483E+03	4.391E+06	2.950E+02	1.465E+03	2.195E+06	1.475E+02
1998	5.434E+03	4.352E+06	2.924E+02	1.452E+03	2.176E+06	1.462E+02
1999	5.401E+03	4.325E+06	2.906E+02	1.443E+03	2.162E+06	1.453E+02
2000	5.380E+03	4.308E+06	2.894E+02	1.437E+03	2.154E+06	1.447E+02
2001	5.449E+03	4.363E+06	2.932E+02	1.455E+03	2.182E+06	1.466E+02
2002	5.547E+03	4.442E+06	2.985E+02	1.482E+03	2.221E+06	1.492E+02
2003	5.948E+03	4.763E+06	3.200E+02	1.589E+03	2.381E+06	1.600E+02
2004	5.891E+03	4.717E+06	3.170E+02	1.574E+03	2.359E+06	1.585E+02
2005	5.824E+03	4.663E+06	3.133E+02	1.556E+03	2.332E+06	1.567E+02
2006	5.809E+03	4.652E+06	3.126E+02	1.552E+03	2.326E+06	1.563E+02
2007	5.977E+03	4.786E+06	3.216E+02	1.596E+03	2.393E+06	1.608E+02
2008	5.956E+03	4.769E+06	3.204E+02	1.591E+03	2.385E+06	1.602E+02
2009	5.971E+03	4.781E+06	3.212E+02	1.595E+03	2.391E+06	1.606E+02
2010	5.985E+03	4.792E+06	3.220E+02	1.599E+03	2.396E+06	1.610E+02
2011	5.997E+03	4.802E+06	3.226E+02	1.602E+03	2.401E+06	1.613E+02
2012	6.008E+03	4.811E+06	3.233E+02	1.605E+03	2.406E+06	1.616E+02
2013	6.018E+03	4.819E+06	3.238E+02	1.608E+03	2.410E+06	1.619E+02
2014	6.028E+03	4.827E+06	3.243E+02	1.610E+03	2.413E+06	1.621E+02
2015	6.036E+03	4.833E+06	3.248E+02	1.612E+03	2.417E+06	1.624E+02
2016	6.044E+03	4.839E+06	3.252E+02	1.614E+03	2.420E+06	1.626E+02
2017	6.051E+03	4.845E+06	3.255E+02	1.616E+03	2.423E+06	1.628E+02
2018	6.057E+03	4.850E+06	3.259E+02	1.618E+03	2.425E+06	1.629E+02
2019	6.063E+03	4.855E+06	3.262E+02	1.619E+03	2.427E+06	1.631E+02
2020	6.068E+03	4.859E+06	3.265E+02	1.621E+03	2.429E+06	1.632E+02
2021	6.073E+03	4.863E+06	3.267E+02	1.622E+03	2.431E+06	1.634E+02
2022	6.077E+03	4.866E+06	3.270E+02	1.623E+03	2.433E+06	1.635E+02
2023	6.081E+03	4.869E+06	3.272E+02	1.624E+03	2.435E+06	1.636E+02
2024	6.084E+03	4.872E+06	3.274E+02	1.625E+03	2.436E+06	1.637E+02
2025	6.088E+03	4.875E+06	3.275E+02	1.626E+03	2.437E+06	1.638E+02
2026	6.090E+03	4.877E+06	3.277E+02	1.627E+03	2.438E+06	1.638E+02
2027	6.093E+03	4.879E+06	3.278E+02	1.628E+03	2.440E+06	1.639E+02
2028	6.096E+03	4.881E+06	3.280E+02	1.628E+03	2.441E+06	1.640E+02
2029	6.098E+03	4.883E+06	3.281E+02	1.629E+03	2.441E+06	1.640E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	6.100E+03	4.884E+06	3.282E+02	1.629E+03	2.442E+06	1.641E+02
2031	6.102E+03	4.886E+06	3.283E+02	1.630E+03	2.443E+06	1.641E+02
2032	6.103E+03	4.887E+06	3.284E+02	1.630E+03	2.444E+06	1.642E+02
2033	6.105E+03	4.888E+06	3.284E+02	1.631E+03	2.444E+06	1.642E+02
2034	6.106E+03	4.889E+06	3.285E+02	1.631E+03	2.445E+06	1.643E+02
2035	6.107E+03	4.890E+06	3.286E+02	1.631E+03	2.445E+06	1.643E+02
2036	6.108E+03	4.891E+06	3.286E+02	1.632E+03	2.446E+06	1.643E+02
2037	5.549E+03	4.444E+06	2.986E+02	1.482E+03	2.222E+06	1.493E+02
2038	5.041E+03	4.037E+06	2.712E+02	1.347E+03	2.018E+06	1.356E+02
2039	4.580E+03	3.667E+06	2.464E+02	1.223E+03	1.834E+06	1.232E+02
2040	4.161E+03	3.332E+06	2.239E+02	1.111E+03	1.666E+06	1.119E+02
2041	3.780E+03	3.027E+06	2.034E+02	1.010E+03	1.513E+06	1.017E+02
2042	3.434E+03	2.750E+06	1.847E+02	9.172E+02	1.375E+06	9.237E+01
2043	3.119E+03	2.498E+06	1.678E+02	8.332E+02	1.249E+06	8.392E+01
2044	2.834E+03	2.269E+06	1.525E+02	7.570E+02	1.135E+06	7.624E+01
2045	2.575E+03	2.062E+06	1.385E+02	6.877E+02	1.031E+06	6.926E+01
2046	2.339E+03	1.873E+06	1.258E+02	6.247E+02	9.364E+05	6.292E+01
2047	2.125E+03	1.701E+06	1.143E+02	5.676E+02	8.507E+05	5.716E+01
2048	1.930E+03	1.546E+06	1.039E+02	5.156E+02	7.728E+05	5.193E+01
2049	1.754E+03	1.404E+06	9.435E+01	4.684E+02	7.021E+05	4.717E+01
2050	1.593E+03	1.276E+06	8.571E+01	4.255E+02	6.378E+05	4.286E+01
2051	1.447E+03	1.159E+06	7.787E+01	3.866E+02	5.794E+05	3.893E+01
2052	1.315E+03	1.053E+06	7.074E+01	3.512E+02	5.264E+05	3.537E+01
2053	1.194E+03	9.564E+05	6.426E+01	3.190E+02	4.782E+05	3.213E+01
2054	1.085E+03	8.689E+05	5.838E+01	2.898E+02	4.344E+05	2.919E+01
2055	9.858E+02	7.894E+05	5.304E+01	2.633E+02	3.947E+05	2.652E+01
2056	8.955E+02	7.171E+05	4.818E+01	2.392E+02	3.586E+05	2.409E+01
2057	8.136E+02	6.515E+05	4.377E+01	2.173E+02	3.257E+05	2.189E+01
2058	7.391E+02	5.918E+05	3.977E+01	1.974E+02	2.959E+05	1.988E+01
2059	6.714E+02	5.377E+05	3.613E+01	1.793E+02	2.688E+05	1.806E+01
2060	6.100E+02	4.884E+05	3.282E+01	1.629E+02	2.442E+05	1.641E+01
2061	5.541E+02	4.437E+05	2.981E+01	1.480E+02	2.219E+05	1.491E+01
2062	5.034E+02	4.031E+05	2.709E+01	1.345E+02	2.016E+05	1.354E+01
2063	4.573E+02	3.662E+05	2.461E+01	1.222E+02	1.831E+05	1.230E+01
2064	4.155E+02	3.327E+05	2.235E+01	1.110E+02	1.663E+05	1.118E+01
2065	3.774E+02	3.022E+05	2.031E+01	1.008E+02	1.511E+05	1.015E+01
2066	3.429E+02	2.746E+05	1.845E+01	9.159E+01	1.373E+05	9.224E+00
2067	3.115E+02	2.494E+05	1.676E+01	8.321E+01	1.247E+05	8.380E+00
2068	2.830E+02	2.266E+05	1.523E+01	7.559E+01	1.133E+05	7.613E+00
2069	2.571E+02	2.059E+05	1.383E+01	6.867E+01	1.029E+05	6.916E+00
2070	2.336E+02	1.870E+05	1.257E+01	6.239E+01	9.351E+04	6.283E+00
2071	2.122E+02	1.699E+05	1.142E+01	5.667E+01	8.495E+04	5.708E+00
2072	1.928E+02	1.543E+05	1.037E+01	5.149E+01	7.717E+04	5.185E+00
2073	1.751E+02	1.402E+05	9.421E+00	4.677E+01	7.011E+04	4.711E+00
2074	1.591E+02	1.274E+05	8.559E+00	4.249E+01	6.369E+04	4.280E+00
2075	1.445E+02	1.157E+05	7.776E+00	3.860E+01	5.786E+04	3.888E+00
2076	1.313E+02	1.051E+05	7.064E+00	3.507E+01	5.257E+04	3.532E+00
2077	1.193E+02	9.551E+04	6.417E+00	3.186E+01	4.775E+04	3.209E+00
2078	1.084E+02	8.677E+04	5.830E+00	2.894E+01	4.338E+04	2.915E+00
2079	9.844E+01	7.882E+04	5.296E+00	2.629E+01	3.941E+04	2.648E+00
2080	8.943E+01	7.161E+04	4.811E+00	2.389E+01	3.580E+04	2.406E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	8.124E+01	6.505E+04	4.371E+00	2.170E+01	3.253E+04	2.185E+00
2082	7.380E+01	5.910E+04	3.971E+00	1.971E+01	2.955E+04	1.985E+00
2083	6.705E+01	5.369E+04	3.607E+00	1.791E+01	2.684E+04	1.804E+00
2084	6.091E+01	4.878E+04	3.277E+00	1.627E+01	2.439E+04	1.639E+00
2085	5.534E+01	4.431E+04	2.977E+00	1.478E+01	2.216E+04	1.489E+00
2086	5.027E+01	4.025E+04	2.705E+00	1.343E+01	2.013E+04	1.352E+00
2087	4.567E+01	3.657E+04	2.457E+00	1.220E+01	1.828E+04	1.229E+00
2088	4.149E+01	3.322E+04	2.232E+00	1.108E+01	1.661E+04	1.116E+00
2089	3.769E+01	3.018E+04	2.028E+00	1.007E+01	1.509E+04	1.014E+00
2090	3.424E+01	2.742E+04	1.842E+00	9.146E+00	1.371E+04	9.211E-01
2091	3.111E+01	2.491E+04	1.674E+00	8.309E+00	1.245E+04	8.368E-01
2092	2.826E+01	2.263E+04	1.520E+00	7.548E+00	1.131E+04	7.602E-01
2093	2.567E+01	2.056E+04	1.381E+00	6.857E+00	1.028E+04	6.906E-01
2094	2.332E+01	1.868E+04	1.255E+00	6.230E+00	9.338E+03	6.274E-01
2095	2.119E+01	1.697E+04	1.140E+00	5.659E+00	8.483E+03	5.700E-01
2096	1.925E+01	1.541E+04	1.036E+00	5.141E+00	7.707E+03	5.178E-01
2097	1.749E+01	1.400E+04	9.408E-01	4.671E+00	7.001E+03	4.704E-01
2098	1.589E+01	1.272E+04	8.547E-01	4.243E+00	6.360E+03	4.273E-01
2099	1.443E+01	1.156E+04	7.765E-01	3.855E+00	5.778E+03	3.882E-01
2100	1.311E+01	1.050E+04	7.054E-01	3.502E+00	5.249E+03	3.527E-01
2101	1.191E+01	9.537E+03	6.408E-01	3.181E+00	4.769E+03	3.204E-01
2102	1.082E+01	8.664E+03	5.822E-01	2.890E+00	4.332E+03	2.911E-01
2103	9.830E+00	7.871E+03	5.289E-01	2.626E+00	3.936E+03	2.644E-01
2104	8.930E+00	7.151E+03	4.805E-01	2.385E+00	3.575E+03	2.402E-01
2105	8.113E+00	6.496E+03	4.365E-01	2.167E+00	3.248E+03	2.182E-01
2106	7.370E+00	5.902E+03	3.965E-01	1.969E+00	2.951E+03	1.983E-01
2107	6.695E+00	5.361E+03	3.602E-01	1.788E+00	2.681E+03	1.801E-01
2108	6.083E+00	4.871E+03	3.273E-01	1.625E+00	2.435E+03	1.636E-01
2109	5.526E+00	4.425E+03	2.973E-01	1.476E+00	2.212E+03	1.487E-01
2110	5.020E+00	4.020E+03	2.701E-01	1.341E+00	2.010E+03	1.350E-01
2111	4.560E+00	3.652E+03	2.454E-01	1.218E+00	1.826E+03	1.227E-01
2112	4.143E+00	3.318E+03	2.229E-01	1.107E+00	1.659E+03	1.115E-01
2113	3.764E+00	3.014E+03	2.025E-01	1.005E+00	1.507E+03	1.013E-01
2114	3.419E+00	2.738E+03	1.840E-01	9.133E-01	1.369E+03	9.198E-02
2115	3.106E+00	2.487E+03	1.671E-01	8.297E-01	1.244E+03	8.356E-02
2116	2.822E+00	2.260E+03	1.518E-01	7.538E-01	1.130E+03	7.591E-02
2117	2.564E+00	2.053E+03	1.379E-01	6.848E-01	1.026E+03	6.896E-02
2118	2.329E+00	1.865E+03	1.253E-01	6.221E-01	9.325E+02	6.265E-02
2119	2.116E+00	1.694E+03	1.138E-01	5.651E-01	8.471E+02	5.692E-02
2120	1.922E+00	1.539E+03	1.034E-01	5.134E-01	7.696E+02	5.171E-02

Results (Continued)

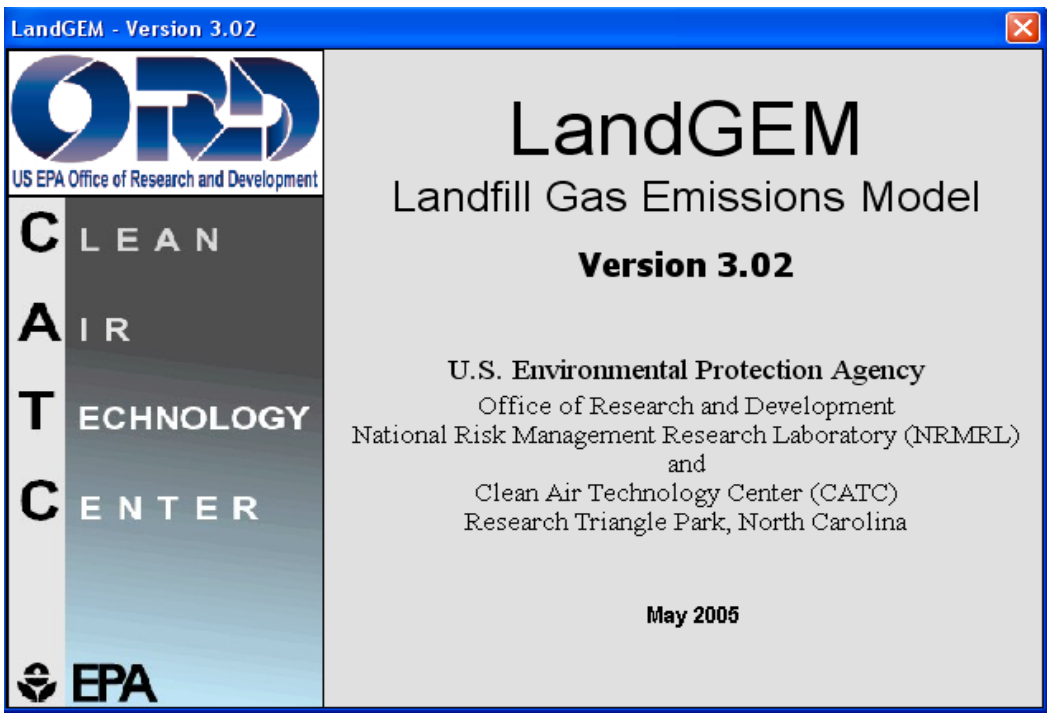
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	2.600E+02	1.420E+05	9.543E+00	4.073E+00	1.136E+03	7.634E-02
1982	6.424E+02	3.510E+05	2.358E+01	1.006E+01	2.808E+03	1.886E-01
1983	9.976E+02	5.450E+05	3.662E+01	1.563E+01	4.360E+03	2.929E-01
1984	1.318E+03	7.199E+05	4.837E+01	2.065E+01	5.760E+03	3.870E-01
1985	1.613E+03	8.812E+05	5.921E+01	2.527E+01	7.050E+03	4.737E-01
1986	1.925E+03	1.052E+06	7.067E+01	3.016E+01	8.415E+03	5.654E-01
1987	2.359E+03	1.289E+06	8.659E+01	3.696E+01	1.031E+04	6.928E-01
1988	2.856E+03	1.560E+06	1.048E+02	4.473E+01	1.248E+04	8.385E-01
1989	3.426E+03	1.872E+06	1.258E+02	5.367E+01	1.497E+04	1.006E+00
1990	4.006E+03	2.189E+06	1.471E+02	6.276E+01	1.751E+04	1.176E+00
1991	4.390E+03	2.398E+06	1.611E+02	6.877E+01	1.918E+04	1.289E+00
1992	4.426E+03	2.418E+06	1.625E+02	6.934E+01	1.934E+04	1.300E+00
1993	4.356E+03	2.380E+06	1.599E+02	6.824E+01	1.904E+04	1.279E+00
1994	4.324E+03	2.362E+06	1.587E+02	6.774E+01	1.890E+04	1.270E+00
1995	4.190E+03	2.289E+06	1.538E+02	6.563E+01	1.831E+04	1.230E+00
1996	4.110E+03	2.245E+06	1.509E+02	6.438E+01	1.796E+04	1.207E+00
1997	4.019E+03	2.195E+06	1.475E+02	6.295E+01	1.756E+04	1.180E+00
1998	3.983E+03	2.176E+06	1.462E+02	6.239E+01	1.741E+04	1.170E+00
1999	3.958E+03	2.162E+06	1.453E+02	6.201E+01	1.730E+04	1.162E+00
2000	3.943E+03	2.154E+06	1.447E+02	6.177E+01	1.723E+04	1.158E+00
2001	3.993E+03	2.182E+06	1.466E+02	6.256E+01	1.745E+04	1.173E+00
2002	4.066E+03	2.221E+06	1.492E+02	6.369E+01	1.777E+04	1.194E+00
2003	4.359E+03	2.381E+06	1.600E+02	6.829E+01	1.905E+04	1.280E+00
2004	4.318E+03	2.359E+06	1.585E+02	6.764E+01	1.887E+04	1.268E+00
2005	4.268E+03	2.332E+06	1.567E+02	6.686E+01	1.865E+04	1.253E+00
2006	4.258E+03	2.326E+06	1.563E+02	6.670E+01	1.861E+04	1.250E+00
2007	4.380E+03	2.393E+06	1.608E+02	6.862E+01	1.914E+04	1.286E+00
2008	4.365E+03	2.385E+06	1.602E+02	6.838E+01	1.908E+04	1.282E+00
2009	4.376E+03	2.391E+06	1.606E+02	6.855E+01	1.912E+04	1.285E+00
2010	4.386E+03	2.396E+06	1.610E+02	6.871E+01	1.917E+04	1.288E+00
2011	4.395E+03	2.401E+06	1.613E+02	6.885E+01	1.921E+04	1.291E+00
2012	4.403E+03	2.406E+06	1.616E+02	6.898E+01	1.924E+04	1.293E+00
2013	4.411E+03	2.410E+06	1.619E+02	6.910E+01	1.928E+04	1.295E+00
2014	4.418E+03	2.413E+06	1.621E+02	6.920E+01	1.931E+04	1.297E+00
2015	4.424E+03	2.417E+06	1.624E+02	6.930E+01	1.933E+04	1.299E+00
2016	4.429E+03	2.420E+06	1.626E+02	6.939E+01	1.936E+04	1.301E+00
2017	4.434E+03	2.423E+06	1.628E+02	6.947E+01	1.938E+04	1.302E+00
2018	4.439E+03	2.425E+06	1.629E+02	6.954E+01	1.940E+04	1.304E+00
2019	4.443E+03	2.427E+06	1.631E+02	6.961E+01	1.942E+04	1.305E+00
2020	4.447E+03	2.429E+06	1.632E+02	6.967E+01	1.944E+04	1.306E+00
2021	4.451E+03	2.431E+06	1.634E+02	6.972E+01	1.945E+04	1.307E+00
2022	4.454E+03	2.433E+06	1.635E+02	6.977E+01	1.946E+04	1.308E+00
2023	4.457E+03	2.435E+06	1.636E+02	6.981E+01	1.948E+04	1.309E+00
2024	4.459E+03	2.436E+06	1.637E+02	6.985E+01	1.949E+04	1.309E+00
2025	4.461E+03	2.437E+06	1.638E+02	6.989E+01	1.950E+04	1.310E+00
2026	4.464E+03	2.438E+06	1.638E+02	6.993E+01	1.951E+04	1.311E+00
2027	4.466E+03	2.440E+06	1.639E+02	6.996E+01	1.952E+04	1.311E+00
2028	4.467E+03	2.441E+06	1.640E+02	6.998E+01	1.952E+04	1.312E+00
2029	4.469E+03	2.441E+06	1.640E+02	7.001E+01	1.953E+04	1.312E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	4.470E+03	2.442E+06	1.641E+02	7.003E+01	1.954E+04	1.313E+00
2031	4.472E+03	2.443E+06	1.641E+02	7.005E+01	1.954E+04	1.313E+00
2032	4.473E+03	2.444E+06	1.642E+02	7.007E+01	1.955E+04	1.313E+00
2033	4.474E+03	2.444E+06	1.642E+02	7.009E+01	1.955E+04	1.314E+00
2034	4.475E+03	2.445E+06	1.643E+02	7.010E+01	1.956E+04	1.314E+00
2035	4.476E+03	2.445E+06	1.643E+02	7.012E+01	1.956E+04	1.314E+00
2036	4.477E+03	2.446E+06	1.643E+02	7.013E+01	1.957E+04	1.315E+00
2037	4.067E+03	2.222E+06	1.493E+02	6.371E+01	1.777E+04	1.194E+00
2038	3.695E+03	2.018E+06	1.356E+02	5.788E+01	1.615E+04	1.085E+00
2039	3.357E+03	1.834E+06	1.232E+02	5.258E+01	1.467E+04	9.856E-01
2040	3.049E+03	1.666E+06	1.119E+02	4.777E+01	1.333E+04	8.954E-01
2041	2.770E+03	1.513E+06	1.017E+02	4.340E+01	1.211E+04	8.134E-01
2042	2.517E+03	1.375E+06	9.237E+01	3.942E+01	1.100E+04	7.390E-01
2043	2.286E+03	1.249E+06	8.392E+01	3.582E+01	9.992E+03	6.713E-01
2044	2.077E+03	1.135E+06	7.624E+01	3.254E+01	9.077E+03	6.099E-01
2045	1.887E+03	1.031E+06	6.926E+01	2.956E+01	8.246E+03	5.541E-01
2046	1.714E+03	9.364E+05	6.292E+01	2.685E+01	7.491E+03	5.033E-01
2047	1.557E+03	8.507E+05	5.716E+01	2.439E+01	6.806E+03	4.573E-01
2048	1.415E+03	7.728E+05	5.193E+01	2.216E+01	6.183E+03	4.154E-01
2049	1.285E+03	7.021E+05	4.717E+01	2.013E+01	5.617E+03	3.774E-01
2050	1.168E+03	6.378E+05	4.286E+01	1.829E+01	5.103E+03	3.428E-01
2051	1.061E+03	5.794E+05	3.893E+01	1.662E+01	4.636E+03	3.115E-01
2052	9.636E+02	5.264E+05	3.537E+01	1.510E+01	4.211E+03	2.830E-01
2053	8.754E+02	4.782E+05	3.213E+01	1.371E+01	3.826E+03	2.571E-01
2054	7.953E+02	4.344E+05	2.919E+01	1.246E+01	3.476E+03	2.335E-01
2055	7.225E+02	3.947E+05	2.652E+01	1.132E+01	3.157E+03	2.121E-01
2056	6.563E+02	3.586E+05	2.409E+01	1.028E+01	2.868E+03	1.927E-01
2057	5.963E+02	3.257E+05	2.189E+01	9.341E+00	2.606E+03	1.751E-01
2058	5.417E+02	2.959E+05	1.988E+01	8.486E+00	2.367E+03	1.591E-01
2059	4.921E+02	2.688E+05	1.806E+01	7.709E+00	2.151E+03	1.445E-01
2060	4.470E+02	2.442E+05	1.641E+01	7.003E+00	1.954E+03	1.313E-01
2061	4.061E+02	2.219E+05	1.491E+01	6.362E+00	1.775E+03	1.193E-01
2062	3.690E+02	2.016E+05	1.354E+01	5.780E+00	1.612E+03	1.083E-01
2063	3.352E+02	1.831E+05	1.230E+01	5.251E+00	1.465E+03	9.842E-02
2064	3.045E+02	1.663E+05	1.118E+01	4.770E+00	1.331E+03	8.941E-02
2065	2.766E+02	1.511E+05	1.015E+01	4.333E+00	1.209E+03	8.123E-02
2066	2.513E+02	1.373E+05	9.224E+00	3.937E+00	1.098E+03	7.379E-02
2067	2.283E+02	1.247E+05	8.380E+00	3.576E+00	9.978E+02	6.704E-02
2068	2.074E+02	1.133E+05	7.613E+00	3.249E+00	9.064E+02	6.090E-02
2069	1.884E+02	1.029E+05	6.916E+00	2.952E+00	8.235E+02	5.533E-02
2070	1.712E+02	9.351E+04	6.283E+00	2.681E+00	7.481E+02	5.026E-02
2071	1.555E+02	8.495E+04	5.708E+00	2.436E+00	6.796E+02	4.566E-02
2072	1.413E+02	7.717E+04	5.185E+00	2.213E+00	6.174E+02	4.148E-02
2073	1.283E+02	7.011E+04	4.711E+00	2.010E+00	5.609E+02	3.769E-02
2074	1.166E+02	6.369E+04	4.280E+00	1.826E+00	5.095E+02	3.424E-02
2075	1.059E+02	5.786E+04	3.888E+00	1.659E+00	4.629E+02	3.110E-02
2076	9.622E+01	5.257E+04	3.532E+00	1.507E+00	4.205E+02	2.826E-02
2077	8.741E+01	4.775E+04	3.209E+00	1.369E+00	3.820E+02	2.567E-02
2078	7.941E+01	4.338E+04	2.915E+00	1.244E+00	3.471E+02	2.332E-02
2079	7.214E+01	3.941E+04	2.648E+00	1.130E+00	3.153E+02	2.118E-02
2080	6.554E+01	3.580E+04	2.406E+00	1.027E+00	2.864E+02	1.925E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	5.954E+01	3.253E+04	2.185E+00	9.327E-01	2.602E+02	1.748E-02
2082	5.409E+01	2.955E+04	1.985E+00	8.474E-01	2.364E+02	1.588E-02
2083	4.914E+01	2.684E+04	1.804E+00	7.698E-01	2.148E+02	1.443E-02
2084	4.464E+01	2.439E+04	1.639E+00	6.993E-01	1.951E+02	1.311E-02
2085	4.056E+01	2.216E+04	1.489E+00	6.353E-01	1.772E+02	1.191E-02
2086	3.684E+01	2.013E+04	1.352E+00	5.772E-01	1.610E+02	1.082E-02
2087	3.347E+01	1.828E+04	1.229E+00	5.243E-01	1.463E+02	9.828E-03
2088	3.041E+01	1.661E+04	1.116E+00	4.763E-01	1.329E+02	8.929E-03
2089	2.762E+01	1.509E+04	1.014E+00	4.327E-01	1.207E+02	8.111E-03
2090	2.509E+01	1.371E+04	9.211E-01	3.931E-01	1.097E+02	7.369E-03
2091	2.280E+01	1.245E+04	8.368E-01	3.571E-01	9.964E+01	6.694E-03
2092	2.071E+01	1.131E+04	7.602E-01	3.244E-01	9.051E+01	6.082E-03
2093	1.882E+01	1.028E+04	6.906E-01	2.947E-01	8.223E+01	5.525E-03
2094	1.709E+01	9.338E+03	6.274E-01	2.678E-01	7.470E+01	5.019E-03
2095	1.553E+01	8.483E+03	5.700E-01	2.433E-01	6.786E+01	4.560E-03
2096	1.411E+01	7.707E+03	5.178E-01	2.210E-01	6.165E+01	4.142E-03
2097	1.282E+01	7.001E+03	4.704E-01	2.008E-01	5.601E+01	3.763E-03
2098	1.164E+01	6.360E+03	4.273E-01	1.824E-01	5.088E+01	3.419E-03
2099	1.058E+01	5.778E+03	3.882E-01	1.657E-01	4.622E+01	3.106E-03
2100	9.609E+00	5.249E+03	3.527E-01	1.505E-01	4.199E+01	2.822E-03
2101	8.729E+00	4.769E+03	3.204E-01	1.367E-01	3.815E+01	2.563E-03
2102	7.930E+00	4.332E+03	2.911E-01	1.242E-01	3.466E+01	2.329E-03
2103	7.204E+00	3.936E+03	2.644E-01	1.129E-01	3.149E+01	2.115E-03
2104	6.545E+00	3.575E+03	2.402E-01	1.025E-01	2.860E+01	1.922E-03
2105	5.946E+00	3.248E+03	2.182E-01	9.314E-02	2.598E+01	1.746E-03
2106	5.401E+00	2.951E+03	1.983E-01	8.462E-02	2.361E+01	1.586E-03
2107	4.907E+00	2.681E+03	1.801E-01	7.687E-02	2.145E+01	1.441E-03
2108	4.458E+00	2.435E+03	1.636E-01	6.983E-02	1.948E+01	1.309E-03
2109	4.050E+00	2.212E+03	1.487E-01	6.344E-02	1.770E+01	1.189E-03
2110	3.679E+00	2.010E+03	1.350E-01	5.763E-02	1.608E+01	1.080E-03
2111	3.342E+00	1.826E+03	1.227E-01	5.236E-02	1.461E+01	9.815E-04
2112	3.036E+00	1.659E+03	1.115E-01	4.757E-02	1.327E+01	8.916E-04
2113	2.758E+00	1.507E+03	1.013E-01	4.321E-02	1.206E+01	8.100E-04
2114	2.506E+00	1.369E+03	9.198E-02	3.926E-02	1.095E+01	7.359E-04
2115	2.277E+00	1.244E+03	8.356E-02	3.566E-02	9.949E+00	6.685E-04
2116	2.068E+00	1.130E+03	7.591E-02	3.240E-02	9.039E+00	6.073E-04
2117	1.879E+00	1.026E+03	6.896E-02	2.943E-02	8.211E+00	5.517E-04
2118	1.707E+00	9.325E+02	6.265E-02	2.674E-02	7.460E+00	5.012E-04
2119	1.551E+00	8.471E+02	5.692E-02	2.429E-02	6.777E+00	4.553E-04
2120	1.409E+00	7.696E+02	5.171E-02	2.207E-02	6.157E+00	4.137E-04



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.060**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**110**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	31,140	34,254	468,810	515,691
2003	16,714	18,385	499,950	549,945
2004	16,163	17,779	516,664	568,330
2005	17,787	19,566	532,827	586,110
2006	23,965	26,362	550,614	605,675
2007	18,035	19,839	574,579	632,037
2008	19,200	21,120	592,614	651,875
2009	19,200	21,120	611,814	672,995
2010	19,200	21,120	631,014	694,115
2011	19,200	21,120	650,214	715,235
2012	19,200	21,120	669,414	736,355
2013	19,200	21,120	688,614	757,475
2014	19,200	21,120	707,814	778,595
2015	19,200	21,120	727,014	799,715
2016	19,200	21,120	746,214	820,835
2017	19,200	21,120	765,414	841,955
2018	19,200	21,120	784,614	863,075
2019	19,200	21,120	803,814	884,195

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	19,200	21,120	823,014	905,315
2021	19,200	21,120	842,214	926,435
2022	19,200	21,120	861,414	947,555
2023	19,200	21,120	880,614	968,675
2024	19,200	21,120	899,814	989,795
2025	19,200	21,120	919,014	1,010,915
2026	19,200	21,120	938,214	1,032,035
2027	19,200	21,120	957,414	1,053,155
2028	19,200	21,120	976,614	1,074,275
2029	19,200	21,120	995,814	1,095,395
2030	19,200	21,120	1,015,014	1,116,515
2031	19,200	21,120	1,034,214	1,137,635
2032	19,200	21,120	1,053,414	1,158,755
2033	19,200	21,120	1,072,614	1,179,875
2034	19,200	21,120	1,091,814	1,200,995
2035	19,200	21,120	1,111,014	1,222,115
2036	0	0	1,130,214	1,243,235
2037	0	0	1,130,214	1,243,235
2038	0	0	1,130,214	1,243,235
2039	0	0	1,130,214	1,243,235
2040	0	0	1,130,214	1,243,235
2041	0	0	1,130,214	1,243,235
2042	0	0	1,130,214	1,243,235
2043	0	0	1,130,214	1,243,235
2044	0	0	1,130,214	1,243,235
2045	0	0	1,130,214	1,243,235
2046	0	0	1,130,214	1,243,235
2047	0	0	1,130,214	1,243,235
2048	0	0	1,130,214	1,243,235
2049	0	0	1,130,214	1,243,235
2050	0	0	1,130,214	1,243,235
2051	0	0	1,130,214	1,243,235
2052	0	0	1,130,214	1,243,235
2053	0	0	1,130,214	1,243,235
2054	0	0	1,130,214	1,243,235
2055	0	0	1,130,214	1,243,235
2056	0	0	1,130,214	1,243,235
2057	0	0	1,130,214	1,243,235
2058	0	0	1,130,214	1,243,235
2059	0	0	1,130,214	1,243,235

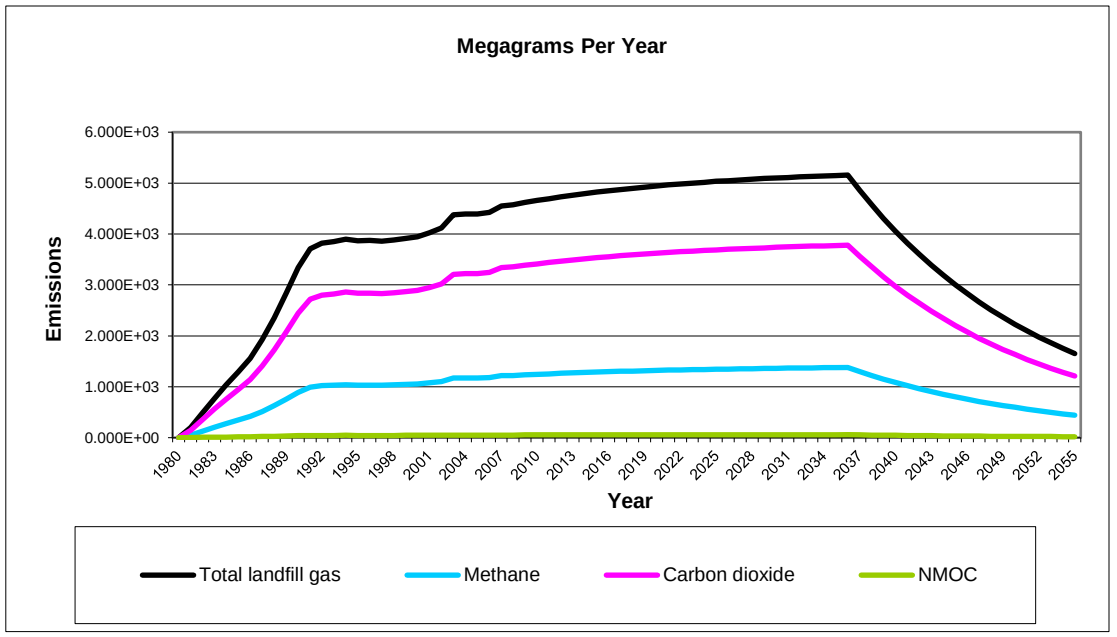
Pollutant Parameters

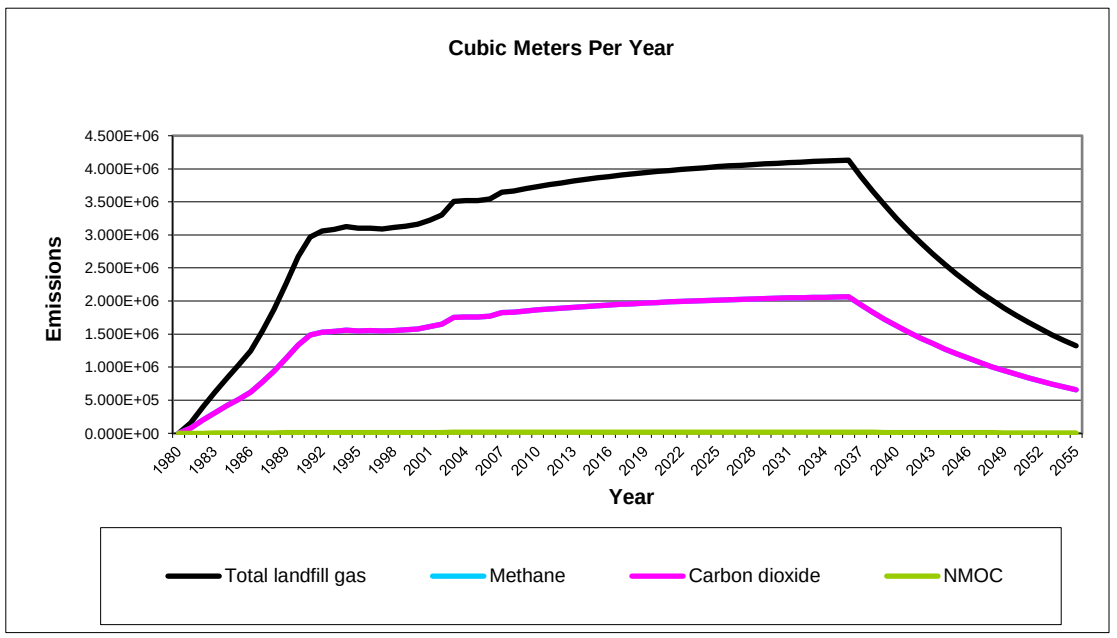
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

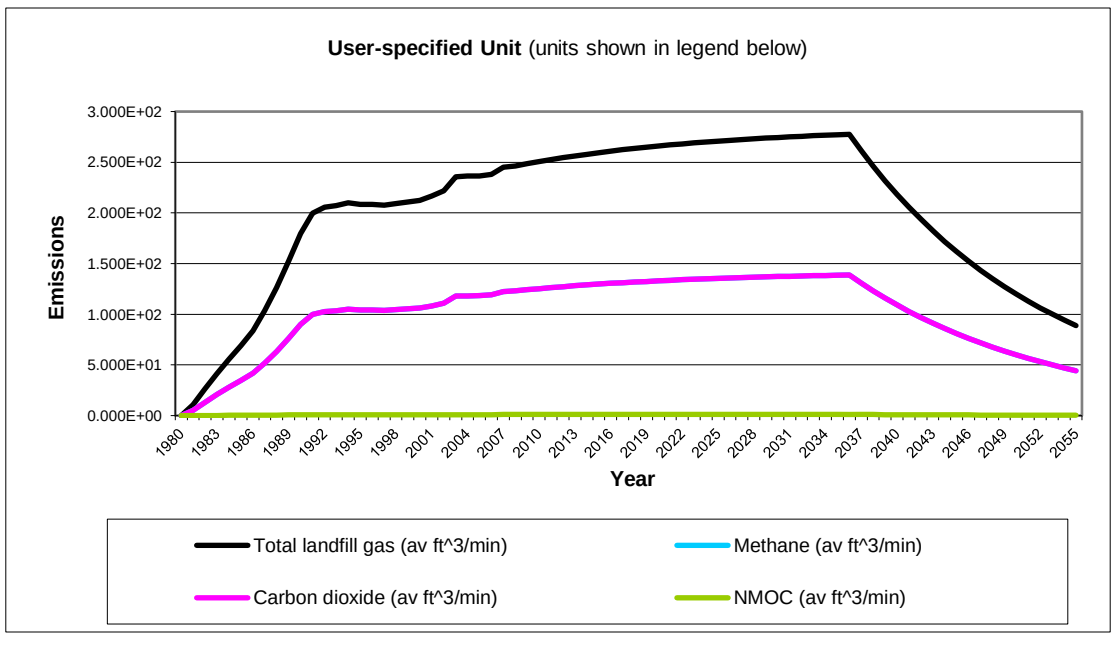
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1.000E+03
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
4.500E+06
4.000E+06
3.500E+06
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.951E+02	1.562E+05	1.050E+01	5.212E+01	7.812E+04	5.249E+00
1982	4.887E+02	3.913E+05	2.629E+01	1.305E+02	1.956E+05	1.315E+01
1983	7.709E+02	6.173E+05	4.147E+01	2.059E+02	3.086E+05	2.074E+01
1984	1.035E+03	8.287E+05	5.568E+01	2.764E+02	4.144E+05	2.784E+01
1985	1.287E+03	1.030E+06	6.923E+01	3.437E+02	5.152E+05	3.462E+01
1986	1.557E+03	1.247E+06	8.377E+01	4.159E+02	6.234E+05	4.189E+01
1987	1.924E+03	1.541E+06	1.035E+02	5.140E+02	7.704E+05	5.176E+01
1988	2.347E+03	1.879E+06	1.263E+02	6.269E+02	9.396E+05	6.313E+01
1989	2.835E+03	2.270E+06	1.525E+02	7.571E+02	1.135E+06	7.625E+01
1990	3.340E+03	2.675E+06	1.797E+02	8.922E+02	1.337E+06	8.986E+01
1991	3.709E+03	2.970E+06	1.995E+02	9.906E+02	1.485E+06	9.977E+01
1992	3.822E+03	3.060E+06	2.056E+02	1.021E+03	1.530E+06	1.028E+02
1993	3.850E+03	3.083E+06	2.072E+02	1.028E+03	1.542E+06	1.036E+02
1994	3.902E+03	3.124E+06	2.099E+02	1.042E+03	1.562E+06	1.050E+02
1995	3.870E+03	3.099E+06	2.082E+02	1.034E+03	1.550E+06	1.041E+02
1996	3.873E+03	3.101E+06	2.084E+02	1.035E+03	1.551E+06	1.042E+02
1997	3.861E+03	3.092E+06	2.078E+02	1.031E+03	1.546E+06	1.039E+02
1998	3.886E+03	3.112E+06	2.091E+02	1.038E+03	1.556E+06	1.045E+02
1999	3.915E+03	3.135E+06	2.106E+02	1.046E+03	1.567E+06	1.053E+02
2000	3.947E+03	3.161E+06	2.124E+02	1.054E+03	1.580E+06	1.062E+02
2001	4.026E+03	3.224E+06	2.166E+02	1.075E+03	1.612E+06	1.083E+02
2002	4.120E+03	3.299E+06	2.217E+02	1.101E+03	1.650E+06	1.108E+02
2003	4.380E+03	3.507E+06	2.356E+02	1.170E+03	1.754E+06	1.178E+02
2004	4.393E+03	3.518E+06	2.364E+02	1.173E+03	1.759E+06	1.182E+02
2005	4.397E+03	3.521E+06	2.365E+02	1.174E+03	1.760E+06	1.183E+02
2006	4.426E+03	3.544E+06	2.381E+02	1.182E+03	1.772E+06	1.191E+02
2007	4.553E+03	3.646E+06	2.450E+02	1.216E+03	1.823E+06	1.225E+02
2008	4.577E+03	3.665E+06	2.463E+02	1.223E+03	1.833E+06	1.231E+02
2009	4.619E+03	3.698E+06	2.485E+02	1.234E+03	1.849E+06	1.242E+02
2010	4.658E+03	3.730E+06	2.506E+02	1.244E+03	1.865E+06	1.253E+02
2011	4.695E+03	3.759E+06	2.526E+02	1.254E+03	1.880E+06	1.263E+02
2012	4.729E+03	3.787E+06	2.545E+02	1.263E+03	1.894E+06	1.272E+02
2013	4.762E+03	3.813E+06	2.562E+02	1.272E+03	1.907E+06	1.281E+02
2014	4.793E+03	3.838E+06	2.579E+02	1.280E+03	1.919E+06	1.289E+02
2015	4.822E+03	3.861E+06	2.594E+02	1.288E+03	1.931E+06	1.297E+02
2016	4.849E+03	3.883E+06	2.609E+02	1.295E+03	1.942E+06	1.304E+02
2017	4.875E+03	3.904E+06	2.623E+02	1.302E+03	1.952E+06	1.311E+02
2018	4.899E+03	3.923E+06	2.636E+02	1.309E+03	1.962E+06	1.318E+02
2019	4.922E+03	3.941E+06	2.648E+02	1.315E+03	1.971E+06	1.324E+02
2020	4.943E+03	3.958E+06	2.660E+02	1.320E+03	1.979E+06	1.330E+02
2021	4.964E+03	3.975E+06	2.671E+02	1.326E+03	1.987E+06	1.335E+02
2022	4.983E+03	3.990E+06	2.681E+02	1.331E+03	1.995E+06	1.340E+02
2023	5.001E+03	4.004E+06	2.690E+02	1.336E+03	2.002E+06	1.345E+02
2024	5.018E+03	4.018E+06	2.700E+02	1.340E+03	2.009E+06	1.350E+02
2025	5.033E+03	4.031E+06	2.708E+02	1.344E+03	2.015E+06	1.354E+02
2026	5.048E+03	4.043E+06	2.716E+02	1.349E+03	2.021E+06	1.358E+02
2027	5.063E+03	4.054E+06	2.724E+02	1.352E+03	2.027E+06	1.362E+02
2028	5.076E+03	4.065E+06	2.731E+02	1.356E+03	2.032E+06	1.365E+02
2029	5.088E+03	4.075E+06	2.738E+02	1.359E+03	2.037E+06	1.369E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	5.100E+03	4.084E+06	2.744E+02	1.362E+03	2.042E+06	1.372E+02
2031	5.111E+03	4.093E+06	2.750E+02	1.365E+03	2.046E+06	1.375E+02
2032	5.122E+03	4.101E+06	2.756E+02	1.368E+03	2.051E+06	1.378E+02
2033	5.132E+03	4.109E+06	2.761E+02	1.371E+03	2.055E+06	1.380E+02
2034	5.141E+03	4.117E+06	2.766E+02	1.373E+03	2.058E+06	1.383E+02
2035	5.150E+03	4.124E+06	2.771E+02	1.376E+03	2.062E+06	1.385E+02
2036	5.158E+03	4.130E+06	2.775E+02	1.378E+03	2.065E+06	1.388E+02
2037	4.857E+03	3.890E+06	2.613E+02	1.297E+03	1.945E+06	1.307E+02
2038	4.575E+03	3.663E+06	2.461E+02	1.222E+03	1.832E+06	1.231E+02
2039	4.308E+03	3.450E+06	2.318E+02	1.151E+03	1.725E+06	1.159E+02
2040	4.057E+03	3.249E+06	2.183E+02	1.084E+03	1.624E+06	1.091E+02
2041	3.821E+03	3.060E+06	2.056E+02	1.021E+03	1.530E+06	1.028E+02
2042	3.599E+03	2.882E+06	1.936E+02	9.612E+02	1.441E+06	9.680E+01
2043	3.389E+03	2.714E+06	1.823E+02	9.052E+02	1.357E+06	9.117E+01
2044	3.192E+03	2.556E+06	1.717E+02	8.525E+02	1.278E+06	8.586E+01
2045	3.006E+03	2.407E+06	1.617E+02	8.029E+02	1.203E+06	8.086E+01
2046	2.831E+03	2.267E+06	1.523E+02	7.561E+02	1.133E+06	7.615E+01
2047	2.666E+03	2.135E+06	1.434E+02	7.121E+02	1.067E+06	7.171E+01
2048	2.511E+03	2.010E+06	1.351E+02	6.706E+02	1.005E+06	6.754E+01
2049	2.364E+03	1.893E+06	1.272E+02	6.316E+02	9.466E+05	6.361E+01
2050	2.227E+03	1.783E+06	1.198E+02	5.948E+02	8.915E+05	5.990E+01
2051	2.097E+03	1.679E+06	1.128E+02	5.601E+02	8.396E+05	5.641E+01
2052	1.975E+03	1.581E+06	1.063E+02	5.275E+02	7.907E+05	5.313E+01
2053	1.860E+03	1.489E+06	1.001E+02	4.968E+02	7.447E+05	5.003E+01
2054	1.752E+03	1.403E+06	9.424E+01	4.679E+02	7.013E+05	4.712E+01
2055	1.650E+03	1.321E+06	8.875E+01	4.406E+02	6.605E+05	4.438E+01
2056	1.554E+03	1.244E+06	8.358E+01	4.150E+02	6.220E+05	4.179E+01
2057	1.463E+03	1.172E+06	7.872E+01	3.908E+02	5.858E+05	3.936E+01
2058	1.378E+03	1.103E+06	7.413E+01	3.680E+02	5.517E+05	3.707E+01
2059	1.298E+03	1.039E+06	6.981E+01	3.466E+02	5.195E+05	3.491E+01
2060	1.222E+03	9.786E+05	6.575E+01	3.264E+02	4.893E+05	3.287E+01
2061	1.151E+03	9.216E+05	6.192E+01	3.074E+02	4.608E+05	3.096E+01
2062	1.084E+03	8.679E+05	5.831E+01	2.895E+02	4.339E+05	2.916E+01
2063	1.021E+03	8.174E+05	5.492E+01	2.726E+02	4.087E+05	2.746E+01
2064	9.613E+02	7.698E+05	5.172E+01	2.568E+02	3.849E+05	2.586E+01
2065	9.053E+02	7.249E+05	4.871E+01	2.418E+02	3.625E+05	2.435E+01
2066	8.526E+02	6.827E+05	4.587E+01	2.277E+02	3.414E+05	2.294E+01
2067	8.029E+02	6.430E+05	4.320E+01	2.145E+02	3.215E+05	2.160E+01
2068	7.562E+02	6.055E+05	4.068E+01	2.020E+02	3.028E+05	2.034E+01
2069	7.121E+02	5.702E+05	3.831E+01	1.902E+02	2.851E+05	1.916E+01
2070	6.707E+02	5.370E+05	3.608E+01	1.791E+02	2.685E+05	1.804E+01
2071	6.316E+02	5.058E+05	3.398E+01	1.687E+02	2.529E+05	1.699E+01
2072	5.948E+02	4.763E+05	3.200E+01	1.589E+02	2.382E+05	1.600E+01
2073	5.602E+02	4.486E+05	3.014E+01	1.496E+02	2.243E+05	1.507E+01
2074	5.276E+02	4.225E+05	2.838E+01	1.409E+02	2.112E+05	1.419E+01
2075	4.968E+02	3.978E+05	2.673E+01	1.327E+02	1.989E+05	1.337E+01
2076	4.679E+02	3.747E+05	2.517E+01	1.250E+02	1.873E+05	1.259E+01
2077	4.407E+02	3.529E+05	2.371E+01	1.177E+02	1.764E+05	1.185E+01
2078	4.150E+02	3.323E+05	2.233E+01	1.109E+02	1.662E+05	1.116E+01
2079	3.908E+02	3.130E+05	2.103E+01	1.044E+02	1.565E+05	1.051E+01
2080	3.681E+02	2.947E+05	1.980E+01	9.832E+01	1.474E+05	9.902E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	3.466E+02	2.776E+05	1.865E+01	9.259E+01	1.388E+05	9.325E+00
2082	3.264E+02	2.614E+05	1.756E+01	8.720E+01	1.307E+05	8.782E+00
2083	3.074E+02	2.462E+05	1.654E+01	8.212E+01	1.231E+05	8.270E+00
2084	2.895E+02	2.318E+05	1.558E+01	7.734E+01	1.159E+05	7.789E+00
2085	2.727E+02	2.183E+05	1.467E+01	7.283E+01	1.092E+05	7.335E+00
2086	2.568E+02	2.056E+05	1.382E+01	6.859E+01	1.028E+05	6.908E+00
2087	2.418E+02	1.937E+05	1.301E+01	6.460E+01	9.683E+04	6.506E+00
2088	2.278E+02	1.824E+05	1.225E+01	6.084E+01	9.119E+04	6.127E+00
2089	2.145E+02	1.718E+05	1.154E+01	5.729E+01	8.588E+04	5.770E+00
2090	2.020E+02	1.618E+05	1.087E+01	5.396E+01	8.088E+04	5.434E+00
2091	1.902E+02	1.523E+05	1.024E+01	5.081E+01	7.617E+04	5.118E+00
2092	1.792E+02	1.435E+05	9.639E+00	4.786E+01	7.173E+04	4.820E+00
2093	1.687E+02	1.351E+05	9.078E+00	4.507E+01	6.755E+04	4.539E+00
2094	1.589E+02	1.272E+05	8.549E+00	4.244E+01	6.362E+04	4.275E+00
2095	1.496E+02	1.198E+05	8.051E+00	3.997E+01	5.991E+04	4.026E+00
2096	1.409E+02	1.129E+05	7.582E+00	3.764E+01	5.643E+04	3.791E+00
2097	1.327E+02	1.063E+05	7.141E+00	3.545E+01	5.314E+04	3.570E+00
2098	1.250E+02	1.001E+05	6.725E+00	3.339E+01	5.005E+04	3.363E+00
2099	1.177E+02	9.426E+04	6.333E+00	3.144E+01	4.713E+04	3.167E+00
2100	1.109E+02	8.877E+04	5.965E+00	2.961E+01	4.439E+04	2.982E+00
2101	1.044E+02	8.360E+04	5.617E+00	2.789E+01	4.180E+04	2.809E+00
2102	9.832E+01	7.873E+04	5.290E+00	2.626E+01	3.937E+04	2.645E+00
2103	9.260E+01	7.415E+04	4.982E+00	2.473E+01	3.707E+04	2.491E+00
2104	8.721E+01	6.983E+04	4.692E+00	2.329E+01	3.492E+04	2.346E+00
2105	8.213E+01	6.576E+04	4.419E+00	2.194E+01	3.288E+04	2.209E+00
2106	7.734E+01	6.193E+04	4.161E+00	2.066E+01	3.097E+04	2.081E+00
2107	7.284E+01	5.833E+04	3.919E+00	1.946E+01	2.916E+04	1.960E+00
2108	6.860E+01	5.493E+04	3.691E+00	1.832E+01	2.747E+04	1.845E+00
2109	6.460E+01	5.173E+04	3.476E+00	1.726E+01	2.587E+04	1.738E+00
2110	6.084E+01	4.872E+04	3.273E+00	1.625E+01	2.436E+04	1.637E+00
2111	5.730E+01	4.588E+04	3.083E+00	1.531E+01	2.294E+04	1.541E+00
2112	5.396E+01	4.321E+04	2.903E+00	1.441E+01	2.161E+04	1.452E+00
2113	5.082E+01	4.069E+04	2.734E+00	1.357E+01	2.035E+04	1.367E+00
2114	4.786E+01	3.832E+04	2.575E+00	1.278E+01	1.916E+04	1.287E+00
2115	4.507E+01	3.609E+04	2.425E+00	1.204E+01	1.805E+04	1.213E+00
2116	4.245E+01	3.399E+04	2.284E+00	1.134E+01	1.700E+04	1.142E+00
2117	3.998E+01	3.201E+04	2.151E+00	1.068E+01	1.601E+04	1.075E+00
2118	3.765E+01	3.015E+04	2.026E+00	1.006E+01	1.507E+04	1.013E+00
2119	3.546E+01	2.839E+04	1.908E+00	9.471E+00	1.420E+04	9.538E-01
2120	3.339E+01	2.674E+04	1.796E+00	8.919E+00	1.337E+04	8.982E-01

Results (Continued)

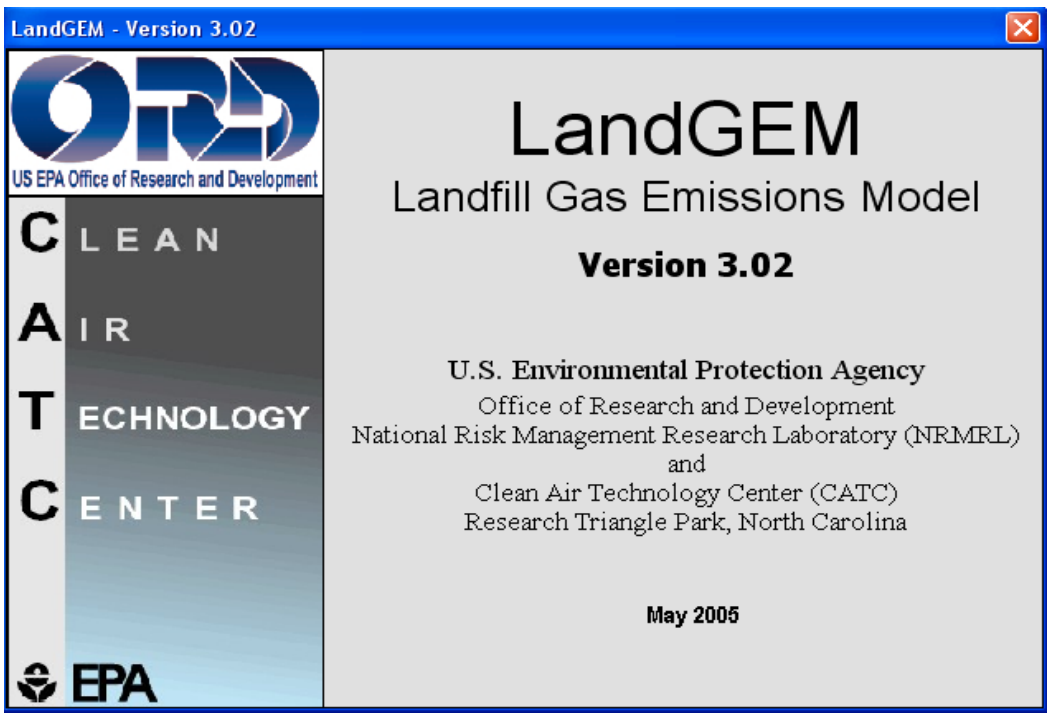
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.430E+02	7.812E+04	5.249E+00	2.240E+00	6.250E+02	4.199E-02
1982	3.581E+02	1.956E+05	1.315E+01	5.610E+00	1.565E+03	1.052E-01
1983	5.650E+02	3.086E+05	2.074E+01	8.850E+00	2.469E+03	1.659E-01
1984	7.585E+02	4.144E+05	2.784E+01	1.188E+01	3.315E+03	2.227E-01
1985	9.430E+02	5.152E+05	3.462E+01	1.477E+01	4.121E+03	2.769E-01
1986	1.141E+03	6.234E+05	4.189E+01	1.788E+01	4.987E+03	3.351E-01
1987	1.410E+03	7.704E+05	5.176E+01	2.209E+01	6.163E+03	4.141E-01
1988	1.720E+03	9.396E+05	6.313E+01	2.694E+01	7.517E+03	5.051E-01
1989	2.077E+03	1.135E+06	7.625E+01	3.254E+01	9.079E+03	6.100E-01
1990	2.448E+03	1.337E+06	8.986E+01	3.835E+01	1.070E+04	7.189E-01
1991	2.718E+03	1.485E+06	9.977E+01	4.258E+01	1.188E+04	7.982E-01
1992	2.801E+03	1.530E+06	1.028E+02	4.388E+01	1.224E+04	8.224E-01
1993	2.822E+03	1.542E+06	1.036E+02	4.421E+01	1.233E+04	8.286E-01
1994	2.859E+03	1.562E+06	1.050E+02	4.479E+01	1.250E+04	8.397E-01
1995	2.837E+03	1.550E+06	1.041E+02	4.444E+01	1.240E+04	8.330E-01
1996	2.838E+03	1.551E+06	1.042E+02	4.447E+01	1.241E+04	8.335E-01
1997	2.830E+03	1.546E+06	1.039E+02	4.433E+01	1.237E+04	8.310E-01
1998	2.848E+03	1.556E+06	1.045E+02	4.461E+01	1.245E+04	8.363E-01
1999	2.869E+03	1.567E+06	1.053E+02	4.494E+01	1.254E+04	8.424E-01
2000	2.893E+03	1.580E+06	1.062E+02	4.532E+01	1.264E+04	8.494E-01
2001	2.951E+03	1.612E+06	1.083E+02	4.622E+01	1.290E+04	8.664E-01
2002	3.020E+03	1.650E+06	1.108E+02	4.730E+01	1.320E+04	8.867E-01
2003	3.210E+03	1.754E+06	1.178E+02	5.029E+01	1.403E+04	9.426E-01
2004	3.220E+03	1.759E+06	1.182E+02	5.044E+01	1.407E+04	9.454E-01
2005	3.222E+03	1.760E+06	1.183E+02	5.048E+01	1.408E+04	9.462E-01
2006	3.244E+03	1.772E+06	1.191E+02	5.082E+01	1.418E+04	9.525E-01
2007	3.337E+03	1.823E+06	1.225E+02	5.227E+01	1.458E+04	9.798E-01
2008	3.355E+03	1.833E+06	1.231E+02	5.255E+01	1.466E+04	9.850E-01
2009	3.385E+03	1.849E+06	1.242E+02	5.303E+01	1.479E+04	9.940E-01
2010	3.414E+03	1.865E+06	1.253E+02	5.348E+01	1.492E+04	1.002E+00
2011	3.441E+03	1.880E+06	1.263E+02	5.390E+01	1.504E+04	1.010E+00
2012	3.466E+03	1.894E+06	1.272E+02	5.430E+01	1.515E+04	1.018E+00
2013	3.490E+03	1.907E+06	1.281E+02	5.467E+01	1.525E+04	1.025E+00
2014	3.513E+03	1.919E+06	1.289E+02	5.503E+01	1.535E+04	1.031E+00
2015	3.534E+03	1.931E+06	1.297E+02	5.536E+01	1.544E+04	1.038E+00
2016	3.554E+03	1.942E+06	1.304E+02	5.567E+01	1.553E+04	1.044E+00
2017	3.573E+03	1.952E+06	1.311E+02	5.597E+01	1.561E+04	1.049E+00
2018	3.591E+03	1.962E+06	1.318E+02	5.625E+01	1.569E+04	1.054E+00
2019	3.607E+03	1.971E+06	1.324E+02	5.651E+01	1.577E+04	1.059E+00
2020	3.623E+03	1.979E+06	1.330E+02	5.676E+01	1.583E+04	1.064E+00
2021	3.638E+03	1.987E+06	1.335E+02	5.699E+01	1.590E+04	1.068E+00
2022	3.652E+03	1.995E+06	1.340E+02	5.721E+01	1.596E+04	1.072E+00
2023	3.665E+03	2.002E+06	1.345E+02	5.741E+01	1.602E+04	1.076E+00
2024	3.677E+03	2.009E+06	1.350E+02	5.761E+01	1.607E+04	1.080E+00
2025	3.689E+03	2.015E+06	1.354E+02	5.779E+01	1.612E+04	1.083E+00
2026	3.700E+03	2.021E+06	1.358E+02	5.796E+01	1.617E+04	1.086E+00
2027	3.710E+03	2.027E+06	1.362E+02	5.812E+01	1.622E+04	1.090E+00
2028	3.720E+03	2.032E+06	1.365E+02	5.828E+01	1.626E+04	1.092E+00
2029	3.729E+03	2.037E+06	1.369E+02	5.842E+01	1.630E+04	1.095E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	3.738E+03	2.042E+06	1.372E+02	5.856E+01	1.634E+04	1.098E+00
2031	3.746E+03	2.046E+06	1.375E+02	5.868E+01	1.637E+04	1.100E+00
2032	3.754E+03	2.051E+06	1.378E+02	5.880E+01	1.641E+04	1.102E+00
2033	3.761E+03	2.055E+06	1.380E+02	5.892E+01	1.644E+04	1.104E+00
2034	3.768E+03	2.058E+06	1.383E+02	5.902E+01	1.647E+04	1.106E+00
2035	3.774E+03	2.062E+06	1.385E+02	5.912E+01	1.649E+04	1.108E+00
2036	3.780E+03	2.065E+06	1.388E+02	5.922E+01	1.652E+04	1.110E+00
2037	3.560E+03	1.945E+06	1.307E+02	5.577E+01	1.556E+04	1.045E+00
2038	3.353E+03	1.832E+06	1.231E+02	5.252E+01	1.465E+04	9.845E-01
2039	3.157E+03	1.725E+06	1.159E+02	4.946E+01	1.380E+04	9.272E-01
2040	2.974E+03	1.624E+06	1.091E+02	4.658E+01	1.300E+04	8.732E-01
2041	2.800E+03	1.530E+06	1.028E+02	4.387E+01	1.224E+04	8.223E-01
2042	2.637E+03	1.441E+06	9.680E+01	4.131E+01	1.153E+04	7.744E-01
2043	2.484E+03	1.357E+06	9.117E+01	3.891E+01	1.085E+04	7.293E-01
2044	2.339E+03	1.278E+06	8.586E+01	3.664E+01	1.022E+04	6.869E-01
2045	2.203E+03	1.203E+06	8.086E+01	3.451E+01	9.627E+03	6.469E-01
2046	2.075E+03	1.133E+06	7.615E+01	3.250E+01	9.067E+03	6.092E-01
2047	1.954E+03	1.067E+06	7.171E+01	3.061E+01	8.539E+03	5.737E-01
2048	1.840E+03	1.005E+06	6.754E+01	2.882E+01	8.041E+03	5.403E-01
2049	1.733E+03	9.466E+05	6.361E+01	2.715E+01	7.573E+03	5.088E-01
2050	1.632E+03	8.915E+05	5.990E+01	2.556E+01	7.132E+03	4.792E-01
2051	1.537E+03	8.396E+05	5.641E+01	2.408E+01	6.717E+03	4.513E-01
2052	1.447E+03	7.907E+05	5.313E+01	2.267E+01	6.326E+03	4.250E-01
2053	1.363E+03	7.447E+05	5.003E+01	2.135E+01	5.957E+03	4.003E-01
2054	1.284E+03	7.013E+05	4.712E+01	2.011E+01	5.610E+03	3.770E-01
2055	1.209E+03	6.605E+05	4.438E+01	1.894E+01	5.284E+03	3.550E-01
2056	1.139E+03	6.220E+05	4.179E+01	1.784E+01	4.976E+03	3.343E-01
2057	1.072E+03	5.858E+05	3.936E+01	1.680E+01	4.686E+03	3.149E-01
2058	1.010E+03	5.517E+05	3.707E+01	1.582E+01	4.413E+03	2.965E-01
2059	9.510E+02	5.195E+05	3.491E+01	1.490E+01	4.156E+03	2.793E-01
2060	8.956E+02	4.893E+05	3.287E+01	1.403E+01	3.914E+03	2.630E-01
2061	8.435E+02	4.608E+05	3.096E+01	1.321E+01	3.686E+03	2.477E-01
2062	7.943E+02	4.339E+05	2.916E+01	1.244E+01	3.472E+03	2.333E-01
2063	7.481E+02	4.087E+05	2.746E+01	1.172E+01	3.269E+03	2.197E-01
2064	7.045E+02	3.849E+05	2.586E+01	1.104E+01	3.079E+03	2.069E-01
2065	6.635E+02	3.625E+05	2.435E+01	1.039E+01	2.900E+03	1.948E-01
2066	6.249E+02	3.414E+05	2.294E+01	9.789E+00	2.731E+03	1.835E-01
2067	5.885E+02	3.215E+05	2.160E+01	9.219E+00	2.572E+03	1.728E-01
2068	5.542E+02	3.028E+05	2.034E+01	8.682E+00	2.422E+03	1.627E-01
2069	5.219E+02	2.851E+05	1.916E+01	8.176E+00	2.281E+03	1.533E-01
2070	4.915E+02	2.685E+05	1.804E+01	7.700E+00	2.148E+03	1.443E-01
2071	4.629E+02	2.529E+05	1.699E+01	7.252E+00	2.023E+03	1.359E-01
2072	4.359E+02	2.382E+05	1.600E+01	6.829E+00	1.905E+03	1.280E-01
2073	4.106E+02	2.243E+05	1.507E+01	6.432E+00	1.794E+03	1.206E-01
2074	3.866E+02	2.112E+05	1.419E+01	6.057E+00	1.690E+03	1.135E-01
2075	3.641E+02	1.989E+05	1.337E+01	5.704E+00	1.591E+03	1.069E-01
2076	3.429E+02	1.873E+05	1.259E+01	5.372E+00	1.499E+03	1.007E-01
2077	3.230E+02	1.764E+05	1.185E+01	5.059E+00	1.411E+03	9.483E-02
2078	3.041E+02	1.662E+05	1.116E+01	4.765E+00	1.329E+03	8.931E-02
2079	2.864E+02	1.565E+05	1.051E+01	4.487E+00	1.252E+03	8.411E-02
2080	2.698E+02	1.474E+05	9.902E+00	4.226E+00	1.179E+03	7.921E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	2.540E+02	1.388E+05	9.325E+00	3.980E+00	1.110E+03	7.460E-02
2082	2.393E+02	1.307E+05	8.782E+00	3.748E+00	1.046E+03	7.026E-02
2083	2.253E+02	1.231E+05	8.270E+00	3.530E+00	9.847E+02	6.616E-02
2084	2.122E+02	1.159E+05	7.789E+00	3.324E+00	9.274E+02	6.231E-02
2085	1.998E+02	1.092E+05	7.335E+00	3.131E+00	8.734E+02	5.868E-02
2086	1.882E+02	1.028E+05	6.908E+00	2.948E+00	8.225E+02	5.526E-02
2087	1.772E+02	9.683E+04	6.506E+00	2.777E+00	7.746E+02	5.205E-02
2088	1.669E+02	9.119E+04	6.127E+00	2.615E+00	7.295E+02	4.902E-02
2089	1.572E+02	8.588E+04	5.770E+00	2.463E+00	6.870E+02	4.616E-02
2090	1.480E+02	8.088E+04	5.434E+00	2.319E+00	6.470E+02	4.347E-02
2091	1.394E+02	7.617E+04	5.118E+00	2.184E+00	6.093E+02	4.094E-02
2092	1.313E+02	7.173E+04	4.820E+00	2.057E+00	5.738E+02	3.856E-02
2093	1.237E+02	6.755E+04	4.539E+00	1.937E+00	5.404E+02	3.631E-02
2094	1.165E+02	6.362E+04	4.275E+00	1.824E+00	5.090E+02	3.420E-02
2095	1.097E+02	5.991E+04	4.026E+00	1.718E+00	4.793E+02	3.221E-02
2096	1.033E+02	5.643E+04	3.791E+00	1.618E+00	4.514E+02	3.033E-02
2097	9.727E+01	5.314E+04	3.570E+00	1.524E+00	4.251E+02	2.856E-02
2098	9.161E+01	5.005E+04	3.363E+00	1.435E+00	4.004E+02	2.690E-02
2099	8.627E+01	4.713E+04	3.167E+00	1.352E+00	3.770E+02	2.533E-02
2100	8.125E+01	4.439E+04	2.982E+00	1.273E+00	3.551E+02	2.386E-02
2101	7.652E+01	4.180E+04	2.809E+00	1.199E+00	3.344E+02	2.247E-02
2102	7.206E+01	3.937E+04	2.645E+00	1.129E+00	3.149E+02	2.116E-02
2103	6.786E+01	3.707E+04	2.491E+00	1.063E+00	2.966E+02	1.993E-02
2104	6.391E+01	3.492E+04	2.346E+00	1.001E+00	2.793E+02	1.877E-02
2105	6.019E+01	3.288E+04	2.209E+00	9.429E-01	2.631E+02	1.767E-02
2106	5.669E+01	3.097E+04	2.081E+00	8.880E-01	2.477E+02	1.665E-02
2107	5.338E+01	2.916E+04	1.960E+00	8.363E-01	2.333E+02	1.568E-02
2108	5.028E+01	2.747E+04	1.845E+00	7.876E-01	2.197E+02	1.476E-02
2109	4.735E+01	2.587E+04	1.738E+00	7.417E-01	2.069E+02	1.390E-02
2110	4.459E+01	2.436E+04	1.637E+00	6.985E-01	1.949E+02	1.309E-02
2111	4.199E+01	2.294E+04	1.541E+00	6.578E-01	1.835E+02	1.233E-02
2112	3.955E+01	2.161E+04	1.452E+00	6.195E-01	1.728E+02	1.161E-02
2113	3.724E+01	2.035E+04	1.367E+00	5.835E-01	1.628E+02	1.094E-02
2114	3.508E+01	1.916E+04	1.287E+00	5.495E-01	1.533E+02	1.030E-02
2115	3.303E+01	1.805E+04	1.213E+00	5.175E-01	1.444E+02	9.700E-03
2116	3.111E+01	1.700E+04	1.142E+00	4.873E-01	1.360E+02	9.135E-03
2117	2.930E+01	1.601E+04	1.075E+00	4.590E-01	1.280E+02	8.603E-03
2118	2.759E+01	1.507E+04	1.013E+00	4.322E-01	1.206E+02	8.102E-03
2119	2.598E+01	1.420E+04	9.538E-01	4.071E-01	1.136E+02	7.630E-03
2120	2.447E+01	1.337E+04	8.982E-01	3.834E-01	1.070E+02	7.186E-03



Summary Report

Landfill Name or Identifier: CLK Lindsay Ops

Date: Wednesday, November 27, 2019

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation: $$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2035**	
Actual Closure Year (without limit)	***2035***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*year $^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,159	13,375	0	0
1981	18,999	20,899	12,159	13,375
1982	19,359	21,295	31,158	34,274
1983	19,251	21,176	50,517	55,569
1984	19,449	21,394	69,768	76,745
1985	21,510	23,661	89,217	98,139
1986	28,530	31,383	110,727	121,800
1987	33,319	36,651	139,257	153,183
1988	38,909	42,800	172,576	189,834
1989	41,806	45,987	211,485	232,634
1990	35,075	38,583	253,291	278,620
1991	20,489	22,538	288,366	317,203
1992	15,665	17,232	308,855	339,741
1993	17,164	18,880	324,520	356,972
1994	12,220	13,442	341,684	375,852
1995	14,201	15,621	353,904	389,294
1996	13,334	14,667	368,105	404,916
1997	15,532	17,085	381,439	419,583
1998	15,892	17,481	396,971	436,668
1999	16,226	17,849	412,863	454,149
2000	19,242	21,166	429,089	471,998
2001	20,479	22,527	448,331	493,164
2002	31,140	34,254	468,810	515,691
2003	16,714	18,385	499,950	549,945
2004	16,163	17,779	516,664	568,330
2005	17,787	19,566	532,827	586,110
2006	23,965	26,362	550,614	605,675
2007	18,035	19,839	574,579	632,037
2008	19,200	21,120	592,614	651,875
2009	19,200	21,120	611,814	672,995
2010	19,200	21,120	631,014	694,115
2011	19,200	21,120	650,214	715,235
2012	19,200	21,120	669,414	736,355
2013	19,200	21,120	688,614	757,475
2014	19,200	21,120	707,814	778,595
2015	19,200	21,120	727,014	799,715
2016	19,200	21,120	746,214	820,835
2017	19,200	21,120	765,414	841,955
2018	19,200	21,120	784,614	863,075
2019	19,200	21,120	803,814	884,195

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2020	19,200	21,120	823,014	905,315
2021	19,200	21,120	842,214	926,435
2022	19,200	21,120	861,414	947,555
2023	19,200	21,120	880,614	968,675
2024	19,200	21,120	899,814	989,795
2025	19,200	21,120	919,014	1,010,915
2026	19,200	21,120	938,214	1,032,035
2027	19,200	21,120	957,414	1,053,155
2028	19,200	21,120	976,614	1,074,275
2029	19,200	21,120	995,814	1,095,395
2030	19,200	21,120	1,015,014	1,116,515
2031	19,200	21,120	1,034,214	1,137,635
2032	19,200	21,120	1,053,414	1,158,755
2033	19,200	21,120	1,072,614	1,179,875
2034	19,200	21,120	1,091,814	1,200,995
2035	19,200	21,120	1,111,014	1,222,115
2036	0	0	1,130,214	1,243,235
2037	0	0	1,130,214	1,243,235
2038	0	0	1,130,214	1,243,235
2039	0	0	1,130,214	1,243,235
2040	0	0	1,130,214	1,243,235
2041	0	0	1,130,214	1,243,235
2042	0	0	1,130,214	1,243,235
2043	0	0	1,130,214	1,243,235
2044	0	0	1,130,214	1,243,235
2045	0	0	1,130,214	1,243,235
2046	0	0	1,130,214	1,243,235
2047	0	0	1,130,214	1,243,235
2048	0	0	1,130,214	1,243,235
2049	0	0	1,130,214	1,243,235
2050	0	0	1,130,214	1,243,235
2051	0	0	1,130,214	1,243,235
2052	0	0	1,130,214	1,243,235
2053	0	0	1,130,214	1,243,235
2054	0	0	1,130,214	1,243,235
2055	0	0	1,130,214	1,243,235
2056	0	0	1,130,214	1,243,235
2057	0	0	1,130,214	1,243,235
2058	0	0	1,130,214	1,243,235
2059	0	0	1,130,214	1,243,235

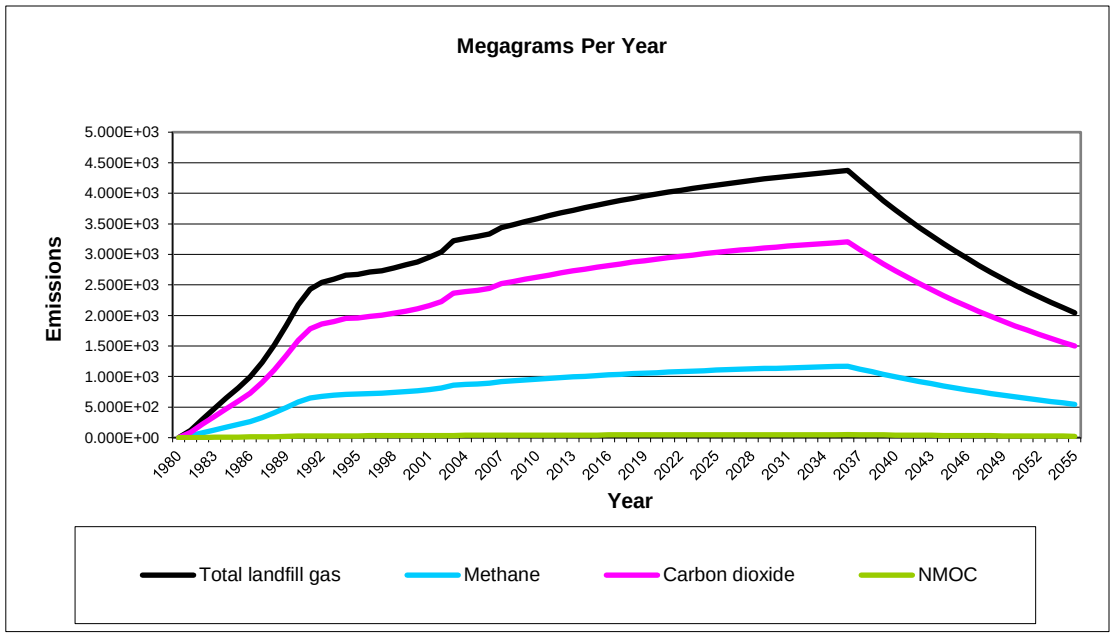
Pollutant Parameters

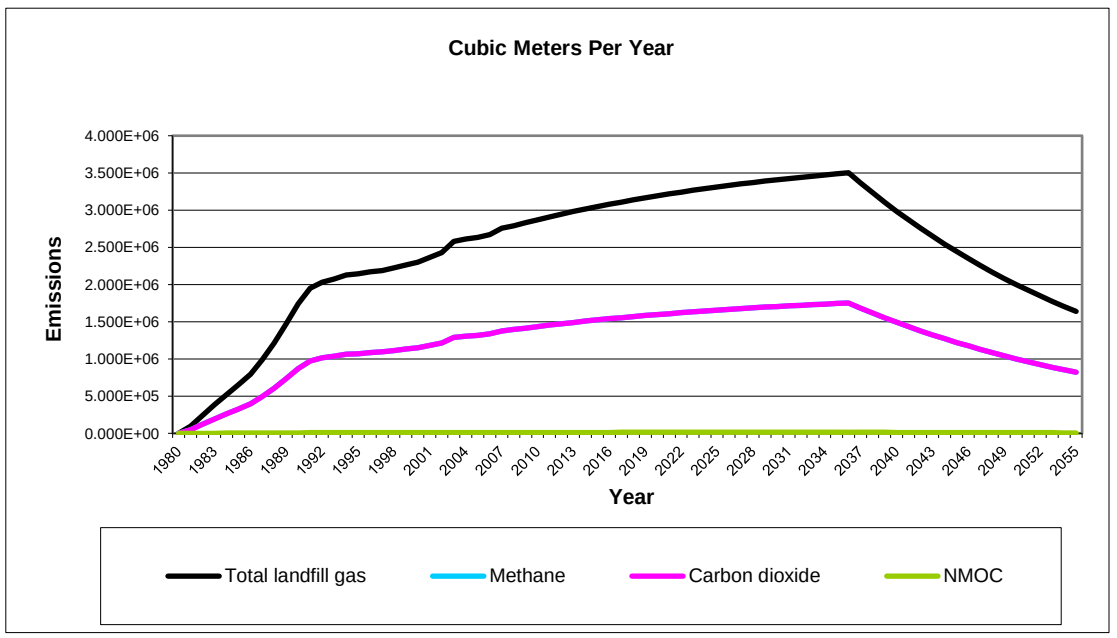
		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

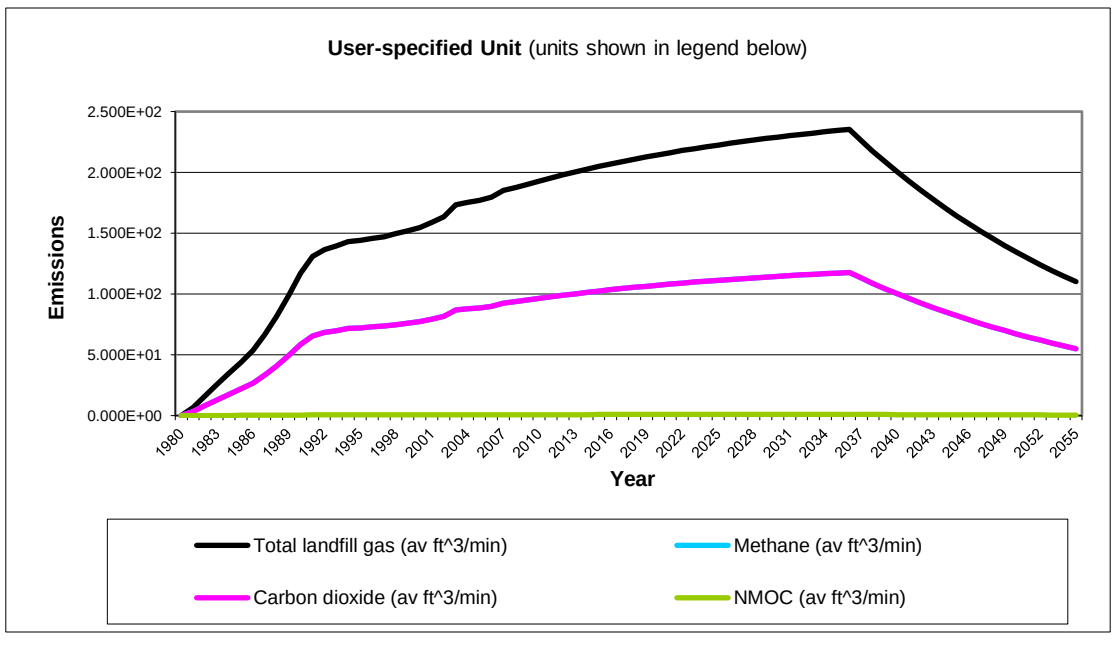
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
5.000E+03
4.500E+03
4.000E+03
3.500E+03
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
4.000E+06
3.500E+06
3.000E+06
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.193E+02	9.554E+04	6.420E+00	3.187E+01	4.777E+04	3.210E+00
1982	3.011E+02	2.411E+05	1.620E+01	8.042E+01	1.205E+05	8.099E+00
1983	4.792E+02	3.838E+05	2.578E+01	1.280E+02	1.919E+05	1.289E+01
1984	6.494E+02	5.200E+05	3.494E+01	1.735E+02	2.600E+05	1.747E+01
1985	8.148E+02	6.524E+05	4.384E+01	2.176E+02	3.262E+05	2.192E+01
1986	9.939E+02	7.959E+05	5.347E+01	2.655E+02	3.979E+05	2.674E+01
1987	1.235E+03	9.888E+05	6.644E+01	3.298E+02	4.944E+05	3.322E+01
1988	1.513E+03	1.212E+06	8.143E+01	4.042E+02	6.059E+05	4.071E+01
1989	1.836E+03	1.470E+06	9.878E+01	4.904E+02	7.350E+05	4.939E+01
1990	2.174E+03	1.741E+06	1.170E+02	5.807E+02	8.705E+05	5.849E+01
1991	2.433E+03	1.948E+06	1.309E+02	6.499E+02	9.742E+05	6.545E+01
1992	2.539E+03	2.033E+06	1.366E+02	6.781E+02	1.016E+06	6.830E+01
1993	2.593E+03	2.076E+06	1.395E+02	6.926E+02	1.038E+06	6.975E+01
1994	2.660E+03	2.130E+06	1.431E+02	7.104E+02	1.065E+06	7.155E+01
1995	2.675E+03	2.142E+06	1.439E+02	7.146E+02	1.071E+06	7.197E+01
1996	2.710E+03	2.170E+06	1.458E+02	7.238E+02	1.085E+06	7.290E+01
1997	2.734E+03	2.190E+06	1.471E+02	7.304E+02	1.095E+06	7.356E+01
1998	2.780E+03	2.226E+06	1.495E+02	7.424E+02	1.113E+06	7.477E+01
1999	2.827E+03	2.263E+06	1.521E+02	7.550E+02	1.132E+06	7.604E+01
2000	2.875E+03	2.302E+06	1.547E+02	7.679E+02	1.151E+06	7.734E+01
2001	2.951E+03	2.363E+06	1.588E+02	7.882E+02	1.182E+06	7.939E+01
2002	3.036E+03	2.431E+06	1.634E+02	8.110E+02	1.216E+06	8.168E+01
2003	3.223E+03	2.581E+06	1.734E+02	8.608E+02	1.290E+06	8.670E+01
2004	3.260E+03	2.611E+06	1.754E+02	8.709E+02	1.305E+06	8.771E+01
2005	3.291E+03	2.635E+06	1.771E+02	8.791E+02	1.318E+06	8.854E+01
2006	3.337E+03	2.672E+06	1.795E+02	8.913E+02	1.336E+06	8.976E+01
2007	3.441E+03	2.755E+06	1.851E+02	9.191E+02	1.378E+06	9.257E+01
2008	3.483E+03	2.789E+06	1.874E+02	9.304E+02	1.395E+06	9.370E+01
2009	3.535E+03	2.831E+06	1.902E+02	9.442E+02	1.415E+06	9.509E+01
2010	3.585E+03	2.870E+06	1.929E+02	9.575E+02	1.435E+06	9.643E+01
2011	3.633E+03	2.909E+06	1.954E+02	9.703E+02	1.454E+06	9.772E+01
2012	3.679E+03	2.946E+06	1.979E+02	9.826E+02	1.473E+06	9.896E+01
2013	3.723E+03	2.981E+06	2.003E+02	9.944E+02	1.490E+06	1.001E+02
2014	3.765E+03	3.015E+06	2.026E+02	1.006E+03	1.507E+06	1.013E+02
2015	3.806E+03	3.048E+06	2.048E+02	1.017E+03	1.524E+06	1.024E+02
2016	3.845E+03	3.079E+06	2.069E+02	1.027E+03	1.539E+06	1.034E+02
2017	3.883E+03	3.109E+06	2.089E+02	1.037E+03	1.555E+06	1.045E+02
2018	3.919E+03	3.138E+06	2.108E+02	1.047E+03	1.569E+06	1.054E+02
2019	3.954E+03	3.166E+06	2.127E+02	1.056E+03	1.583E+06	1.064E+02
2020	3.987E+03	3.193E+06	2.145E+02	1.065E+03	1.596E+06	1.073E+02
2021	4.019E+03	3.218E+06	2.162E+02	1.074E+03	1.609E+06	1.081E+02
2022	4.050E+03	3.243E+06	2.179E+02	1.082E+03	1.622E+06	1.089E+02
2023	4.080E+03	3.267E+06	2.195E+02	1.090E+03	1.633E+06	1.097E+02
2024	4.108E+03	3.289E+06	2.210E+02	1.097E+03	1.645E+06	1.105E+02
2025	4.135E+03	3.311E+06	2.225E+02	1.105E+03	1.656E+06	1.112E+02
2026	4.162E+03	3.332E+06	2.239E+02	1.112E+03	1.666E+06	1.120E+02
2027	4.187E+03	3.353E+06	2.253E+02	1.118E+03	1.676E+06	1.126E+02
2028	4.211E+03	3.372E+06	2.266E+02	1.125E+03	1.686E+06	1.133E+02
2029	4.234E+03	3.391E+06	2.278E+02	1.131E+03	1.695E+06	1.139E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	4.257E+03	3.409E+06	2.290E+02	1.137E+03	1.704E+06	1.145E+02
2031	4.278E+03	3.426E+06	2.302E+02	1.143E+03	1.713E+06	1.151E+02
2032	4.299E+03	3.442E+06	2.313E+02	1.148E+03	1.721E+06	1.156E+02
2033	4.319E+03	3.458E+06	2.324E+02	1.154E+03	1.729E+06	1.162E+02
2034	4.338E+03	3.474E+06	2.334E+02	1.159E+03	1.737E+06	1.167E+02
2035	4.356E+03	3.488E+06	2.344E+02	1.164E+03	1.744E+06	1.172E+02
2036	4.374E+03	3.502E+06	2.353E+02	1.168E+03	1.751E+06	1.177E+02
2037	4.202E+03	3.365E+06	2.261E+02	1.122E+03	1.682E+06	1.130E+02
2038	4.037E+03	3.233E+06	2.172E+02	1.078E+03	1.617E+06	1.086E+02
2039	3.879E+03	3.106E+06	2.087E+02	1.036E+03	1.553E+06	1.044E+02
2040	3.727E+03	2.984E+06	2.005E+02	9.955E+02	1.492E+06	1.003E+02
2041	3.581E+03	2.867E+06	1.927E+02	9.565E+02	1.434E+06	9.633E+01
2042	3.441E+03	2.755E+06	1.851E+02	9.190E+02	1.377E+06	9.255E+01
2043	3.306E+03	2.647E+06	1.778E+02	8.830E+02	1.323E+06	8.892E+01
2044	3.176E+03	2.543E+06	1.709E+02	8.483E+02	1.272E+06	8.544E+01
2045	3.051E+03	2.443E+06	1.642E+02	8.151E+02	1.222E+06	8.209E+01
2046	2.932E+03	2.348E+06	1.577E+02	7.831E+02	1.174E+06	7.887E+01
2047	2.817E+03	2.256E+06	1.516E+02	7.524E+02	1.128E+06	7.578E+01
2048	2.706E+03	2.167E+06	1.456E+02	7.229E+02	1.084E+06	7.281E+01
2049	2.600E+03	2.082E+06	1.399E+02	6.946E+02	1.041E+06	6.995E+01
2050	2.498E+03	2.001E+06	1.344E+02	6.673E+02	1.000E+06	6.721E+01
2051	2.400E+03	1.922E+06	1.291E+02	6.412E+02	9.610E+05	6.457E+01
2052	2.306E+03	1.847E+06	1.241E+02	6.160E+02	9.234E+05	6.204E+01
2053	2.216E+03	1.774E+06	1.192E+02	5.919E+02	8.872E+05	5.961E+01
2054	2.129E+03	1.705E+06	1.145E+02	5.687E+02	8.524E+05	5.727E+01
2055	2.045E+03	1.638E+06	1.101E+02	5.464E+02	8.190E+05	5.503E+01
2056	1.965E+03	1.574E+06	1.057E+02	5.249E+02	7.868E+05	5.287E+01
2057	1.888E+03	1.512E+06	1.016E+02	5.044E+02	7.560E+05	5.079E+01
2058	1.814E+03	1.453E+06	9.761E+01	4.846E+02	7.263E+05	4.880E+01
2059	1.743E+03	1.396E+06	9.378E+01	4.656E+02	6.979E+05	4.689E+01
2060	1.675E+03	1.341E+06	9.010E+01	4.473E+02	6.705E+05	4.505E+01
2061	1.609E+03	1.288E+06	8.657E+01	4.298E+02	6.442E+05	4.328E+01
2062	1.546E+03	1.238E+06	8.317E+01	4.129E+02	6.189E+05	4.159E+01
2063	1.485E+03	1.189E+06	7.991E+01	3.967E+02	5.947E+05	3.996E+01
2064	1.427E+03	1.143E+06	7.678E+01	3.812E+02	5.714E+05	3.839E+01
2065	1.371E+03	1.098E+06	7.377E+01	3.662E+02	5.490E+05	3.688E+01
2066	1.317E+03	1.055E+06	7.088E+01	3.519E+02	5.274E+05	3.544E+01
2067	1.266E+03	1.014E+06	6.810E+01	3.381E+02	5.068E+05	3.405E+01
2068	1.216E+03	9.738E+05	6.543E+01	3.248E+02	4.869E+05	3.271E+01
2069	1.168E+03	9.356E+05	6.286E+01	3.121E+02	4.678E+05	3.143E+01
2070	1.123E+03	8.989E+05	6.040E+01	2.998E+02	4.494E+05	3.020E+01
2071	1.079E+03	8.637E+05	5.803E+01	2.881E+02	4.318E+05	2.901E+01
2072	1.036E+03	8.298E+05	5.575E+01	2.768E+02	4.149E+05	2.788E+01
2073	9.956E+02	7.973E+05	5.357E+01	2.659E+02	3.986E+05	2.678E+01
2074	9.566E+02	7.660E+05	5.147E+01	2.555E+02	3.830E+05	2.573E+01
2075	9.191E+02	7.360E+05	4.945E+01	2.455E+02	3.680E+05	2.472E+01
2076	8.830E+02	7.071E+05	4.751E+01	2.359E+02	3.535E+05	2.375E+01
2077	8.484E+02	6.794E+05	4.565E+01	2.266E+02	3.397E+05	2.282E+01
2078	8.152E+02	6.527E+05	4.386E+01	2.177E+02	3.264E+05	2.193E+01
2079	7.832E+02	6.271E+05	4.214E+01	2.092E+02	3.136E+05	2.107E+01
2080	7.525E+02	6.026E+05	4.049E+01	2.010E+02	3.013E+05	2.024E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	7.230E+02	5.789E+05	3.890E+01	1.931E+02	2.895E+05	1.945E+01
2082	6.946E+02	5.562E+05	3.737E+01	1.855E+02	2.781E+05	1.869E+01
2083	6.674E+02	5.344E+05	3.591E+01	1.783E+02	2.672E+05	1.795E+01
2084	6.412E+02	5.135E+05	3.450E+01	1.713E+02	2.567E+05	1.725E+01
2085	6.161E+02	4.933E+05	3.315E+01	1.646E+02	2.467E+05	1.657E+01
2086	5.919E+02	4.740E+05	3.185E+01	1.581E+02	2.370E+05	1.592E+01
2087	5.687E+02	4.554E+05	3.060E+01	1.519E+02	2.277E+05	1.530E+01
2088	5.464E+02	4.375E+05	2.940E+01	1.460E+02	2.188E+05	1.470E+01
2089	5.250E+02	4.204E+05	2.825E+01	1.402E+02	2.102E+05	1.412E+01
2090	5.044E+02	4.039E+05	2.714E+01	1.347E+02	2.020E+05	1.357E+01
2091	4.846E+02	3.881E+05	2.607E+01	1.294E+02	1.940E+05	1.304E+01
2092	4.656E+02	3.728E+05	2.505E+01	1.244E+02	1.864E+05	1.253E+01
2093	4.474E+02	3.582E+05	2.407E+01	1.195E+02	1.791E+05	1.203E+01
2094	4.298E+02	3.442E+05	2.313E+01	1.148E+02	1.721E+05	1.156E+01
2095	4.130E+02	3.307E+05	2.222E+01	1.103E+02	1.653E+05	1.111E+01
2096	3.968E+02	3.177E+05	2.135E+01	1.060E+02	1.589E+05	1.067E+01
2097	3.812E+02	3.053E+05	2.051E+01	1.018E+02	1.526E+05	1.026E+01
2098	3.663E+02	2.933E+05	1.971E+01	9.783E+01	1.466E+05	9.853E+00
2099	3.519E+02	2.818E+05	1.893E+01	9.400E+01	1.409E+05	9.467E+00
2100	3.381E+02	2.707E+05	1.819E+01	9.031E+01	1.354E+05	9.096E+00
2101	3.249E+02	2.601E+05	1.748E+01	8.677E+01	1.301E+05	8.739E+00
2102	3.121E+02	2.499E+05	1.679E+01	8.337E+01	1.250E+05	8.396E+00
2103	2.999E+02	2.401E+05	1.613E+01	8.010E+01	1.201E+05	8.067E+00
2104	2.881E+02	2.307E+05	1.550E+01	7.696E+01	1.154E+05	7.751E+00
2105	2.768E+02	2.217E+05	1.489E+01	7.394E+01	1.108E+05	7.447E+00
2106	2.660E+02	2.130E+05	1.431E+01	7.104E+01	1.065E+05	7.155E+00
2107	2.555E+02	2.046E+05	1.375E+01	6.826E+01	1.023E+05	6.874E+00
2108	2.455E+02	1.966E+05	1.321E+01	6.558E+01	9.830E+04	6.605E+00
2109	2.359E+02	1.889E+05	1.269E+01	6.301E+01	9.445E+04	6.346E+00
2110	2.266E+02	1.815E+05	1.219E+01	6.054E+01	9.074E+04	6.097E+00
2111	2.178E+02	1.744E+05	1.172E+01	5.816E+01	8.718E+04	5.858E+00
2112	2.092E+02	1.675E+05	1.126E+01	5.588E+01	8.377E+04	5.628E+00
2113	2.010E+02	1.610E+05	1.082E+01	5.369E+01	8.048E+04	5.408E+00
2114	1.931E+02	1.547E+05	1.039E+01	5.159E+01	7.733E+04	5.195E+00
2115	1.856E+02	1.486E+05	9.984E+00	4.956E+01	7.429E+04	4.992E+00
2116	1.783E+02	1.428E+05	9.592E+00	4.762E+01	7.138E+04	4.796E+00
2117	1.713E+02	1.372E+05	9.216E+00	4.575E+01	6.858E+04	4.608E+00
2118	1.646E+02	1.318E+05	8.855E+00	4.396E+01	6.589E+04	4.427E+00
2119	1.581E+02	1.266E+05	8.507E+00	4.224E+01	6.331E+04	4.254E+00
2120	1.519E+02	1.217E+05	8.174E+00	4.058E+01	6.083E+04	4.087E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	8.745E+01	4.777E+04	3.210E+00	1.370E+00	3.822E+02	2.568E-02
1982	2.207E+02	1.205E+05	8.099E+00	3.457E+00	9.643E+02	6.479E-02
1983	3.512E+02	1.919E+05	1.289E+01	5.502E+00	1.535E+03	1.031E-01
1984	4.759E+02	2.600E+05	1.747E+01	7.455E+00	2.080E+03	1.397E-01
1985	5.971E+02	3.262E+05	2.192E+01	9.354E+00	2.610E+03	1.753E-01
1986	7.284E+02	3.979E+05	2.674E+01	1.141E+01	3.183E+03	2.139E-01
1987	9.050E+02	4.944E+05	3.322E+01	1.418E+01	3.955E+03	2.658E-01
1988	1.109E+03	6.059E+05	4.071E+01	1.738E+01	4.847E+03	3.257E-01
1989	1.346E+03	7.350E+05	4.939E+01	2.108E+01	5.880E+03	3.951E-01
1990	1.593E+03	8.705E+05	5.849E+01	2.496E+01	6.964E+03	4.679E-01
1991	1.783E+03	9.742E+05	6.545E+01	2.793E+01	7.793E+03	5.236E-01
1992	1.861E+03	1.016E+06	6.830E+01	2.915E+01	8.132E+03	5.464E-01
1993	1.900E+03	1.038E+06	6.975E+01	2.977E+01	8.305E+03	5.580E-01
1994	1.949E+03	1.065E+06	7.155E+01	3.054E+01	8.519E+03	5.724E-01
1995	1.961E+03	1.071E+06	7.197E+01	3.072E+01	8.569E+03	5.758E-01
1996	1.986E+03	1.085E+06	7.290E+01	3.111E+01	8.679E+03	5.832E-01
1997	2.004E+03	1.095E+06	7.356E+01	3.139E+01	8.758E+03	5.885E-01
1998	2.037E+03	1.113E+06	7.477E+01	3.191E+01	8.903E+03	5.982E-01
1999	2.072E+03	1.132E+06	7.604E+01	3.245E+01	9.053E+03	6.083E-01
2000	2.107E+03	1.151E+06	7.734E+01	3.301E+01	9.208E+03	6.187E-01
2001	2.163E+03	1.182E+06	7.939E+01	3.388E+01	9.452E+03	6.351E-01
2002	2.225E+03	1.216E+06	8.168E+01	3.486E+01	9.725E+03	6.534E-01
2003	2.362E+03	1.290E+06	8.670E+01	3.700E+01	1.032E+04	6.936E-01
2004	2.390E+03	1.305E+06	8.771E+01	3.743E+01	1.044E+04	7.017E-01
2005	2.412E+03	1.318E+06	8.854E+01	3.779E+01	1.054E+04	7.083E-01
2006	2.445E+03	1.336E+06	8.976E+01	3.831E+01	1.069E+04	7.181E-01
2007	2.522E+03	1.378E+06	9.257E+01	3.951E+01	1.102E+04	7.405E-01
2008	2.553E+03	1.395E+06	9.370E+01	3.999E+01	1.116E+04	7.496E-01
2009	2.591E+03	1.415E+06	9.509E+01	4.058E+01	1.132E+04	7.607E-01
2010	2.627E+03	1.435E+06	9.643E+01	4.116E+01	1.148E+04	7.715E-01
2011	2.662E+03	1.454E+06	9.772E+01	4.171E+01	1.164E+04	7.818E-01
2012	2.696E+03	1.473E+06	9.896E+01	4.223E+01	1.178E+04	7.917E-01
2013	2.728E+03	1.490E+06	1.001E+02	4.274E+01	1.192E+04	8.012E-01
2014	2.759E+03	1.507E+06	1.013E+02	4.323E+01	1.206E+04	8.103E-01
2015	2.789E+03	1.524E+06	1.024E+02	4.370E+01	1.219E+04	8.191E-01
2016	2.818E+03	1.539E+06	1.034E+02	4.415E+01	1.232E+04	8.275E-01
2017	2.846E+03	1.555E+06	1.045E+02	4.458E+01	1.244E+04	8.356E-01
2018	2.872E+03	1.569E+06	1.054E+02	4.499E+01	1.255E+04	8.434E-01
2019	2.898E+03	1.583E+06	1.064E+02	4.539E+01	1.266E+04	8.509E-01
2020	2.922E+03	1.596E+06	1.073E+02	4.578E+01	1.277E+04	8.581E-01
2021	2.946E+03	1.609E+06	1.081E+02	4.614E+01	1.287E+04	8.650E-01
2022	2.968E+03	1.622E+06	1.089E+02	4.650E+01	1.297E+04	8.716E-01
2023	2.990E+03	1.633E+06	1.097E+02	4.684E+01	1.307E+04	8.780E-01
2024	3.011E+03	1.645E+06	1.105E+02	4.716E+01	1.316E+04	8.841E-01
2025	3.031E+03	1.656E+06	1.112E+02	4.748E+01	1.325E+04	8.900E-01
2026	3.050E+03	1.666E+06	1.120E+02	4.778E+01	1.333E+04	8.956E-01
2027	3.068E+03	1.676E+06	1.126E+02	4.807E+01	1.341E+04	9.010E-01
2028	3.086E+03	1.686E+06	1.133E+02	4.835E+01	1.349E+04	9.063E-01
2029	3.103E+03	1.695E+06	1.139E+02	4.862E+01	1.356E+04	9.113E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	3.120E+03	1.704E+06	1.145E+02	4.887E+01	1.363E+04	9.161E-01
2031	3.135E+03	1.713E+06	1.151E+02	4.912E+01	1.370E+04	9.207E-01
2032	3.151E+03	1.721E+06	1.156E+02	4.936E+01	1.377E+04	9.252E-01
2033	3.165E+03	1.729E+06	1.162E+02	4.958E+01	1.383E+04	9.294E-01
2034	3.179E+03	1.737E+06	1.167E+02	4.980E+01	1.389E+04	9.335E-01
2035	3.193E+03	1.744E+06	1.172E+02	5.001E+01	1.395E+04	9.375E-01
2036	3.205E+03	1.751E+06	1.177E+02	5.022E+01	1.401E+04	9.413E-01
2037	3.080E+03	1.682E+06	1.130E+02	4.825E+01	1.346E+04	9.044E-01
2038	2.959E+03	1.617E+06	1.086E+02	4.635E+01	1.293E+04	8.689E-01
2039	2.843E+03	1.553E+06	1.044E+02	4.454E+01	1.242E+04	8.348E-01
2040	2.732E+03	1.492E+06	1.003E+02	4.279E+01	1.194E+04	8.021E-01
2041	2.624E+03	1.434E+06	9.633E+01	4.111E+01	1.147E+04	7.706E-01
2042	2.522E+03	1.377E+06	9.255E+01	3.950E+01	1.102E+04	7.404E-01
2043	2.423E+03	1.323E+06	8.892E+01	3.795E+01	1.059E+04	7.114E-01
2044	2.328E+03	1.272E+06	8.544E+01	3.646E+01	1.017E+04	6.835E-01
2045	2.236E+03	1.222E+06	8.209E+01	3.503E+01	9.774E+03	6.567E-01
2046	2.149E+03	1.174E+06	7.887E+01	3.366E+01	9.391E+03	6.310E-01
2047	2.064E+03	1.128E+06	7.578E+01	3.234E+01	9.022E+03	6.062E-01
2048	1.983E+03	1.084E+06	7.281E+01	3.107E+01	8.669E+03	5.824E-01
2049	1.906E+03	1.041E+06	6.995E+01	2.985E+01	8.329E+03	5.596E-01
2050	1.831E+03	1.000E+06	6.721E+01	2.868E+01	8.002E+03	5.377E-01
2051	1.759E+03	9.610E+05	6.457E+01	2.756E+01	7.688E+03	5.166E-01
2052	1.690E+03	9.234E+05	6.204E+01	2.648E+01	7.387E+03	4.963E-01
2053	1.624E+03	8.872E+05	5.961E+01	2.544E+01	7.097E+03	4.769E-01
2054	1.560E+03	8.524E+05	5.727E+01	2.444E+01	6.819E+03	4.582E-01
2055	1.499E+03	8.190E+05	5.503E+01	2.348E+01	6.552E+03	4.402E-01
2056	1.440E+03	7.868E+05	5.287E+01	2.256E+01	6.295E+03	4.229E-01
2057	1.384E+03	7.560E+05	5.079E+01	2.168E+01	6.048E+03	4.064E-01
2058	1.330E+03	7.263E+05	4.880E+01	2.083E+01	5.811E+03	3.904E-01
2059	1.277E+03	6.979E+05	4.689E+01	2.001E+01	5.583E+03	3.751E-01
2060	1.227E+03	6.705E+05	4.505E+01	1.923E+01	5.364E+03	3.604E-01
2061	1.179E+03	6.442E+05	4.328E+01	1.847E+01	5.154E+03	3.463E-01
2062	1.133E+03	6.189E+05	4.159E+01	1.775E+01	4.952E+03	3.327E-01
2063	1.089E+03	5.947E+05	3.996E+01	1.705E+01	4.757E+03	3.197E-01
2064	1.046E+03	5.714E+05	3.839E+01	1.638E+01	4.571E+03	3.071E-01
2065	1.005E+03	5.490E+05	3.688E+01	1.574E+01	4.392E+03	2.951E-01
2066	9.655E+02	5.274E+05	3.544E+01	1.512E+01	4.219E+03	2.835E-01
2067	9.276E+02	5.068E+05	3.405E+01	1.453E+01	4.054E+03	2.724E-01
2068	8.912E+02	4.869E+05	3.271E+01	1.396E+01	3.895E+03	2.617E-01
2069	8.563E+02	4.678E+05	3.143E+01	1.341E+01	3.742E+03	2.514E-01
2070	8.227E+02	4.494E+05	3.020E+01	1.289E+01	3.596E+03	2.416E-01
2071	7.905E+02	4.318E+05	2.901E+01	1.238E+01	3.455E+03	2.321E-01
2072	7.595E+02	4.149E+05	2.788E+01	1.190E+01	3.319E+03	2.230E-01
2073	7.297E+02	3.986E+05	2.678E+01	1.143E+01	3.189E+03	2.143E-01
2074	7.011E+02	3.830E+05	2.573E+01	1.098E+01	3.064E+03	2.059E-01
2075	6.736E+02	3.680E+05	2.472E+01	1.055E+01	2.944E+03	1.978E-01
2076	6.472E+02	3.535E+05	2.375E+01	1.014E+01	2.828E+03	1.900E-01
2077	6.218E+02	3.397E+05	2.282E+01	9.741E+00	2.717E+03	1.826E-01
2078	5.974E+02	3.264E+05	2.193E+01	9.359E+00	2.611E+03	1.754E-01
2079	5.740E+02	3.136E+05	2.107E+01	8.992E+00	2.509E+03	1.686E-01
2080	5.515E+02	3.013E+05	2.024E+01	8.639E+00	2.410E+03	1.619E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2081	5.299E+02	2.895E+05	1.945E+01	8.301E+00	2.316E+03	1.556E-01
2082	5.091E+02	2.781E+05	1.869E+01	7.975E+00	2.225E+03	1.495E-01
2083	4.891E+02	2.672E+05	1.795E+01	7.662E+00	2.138E+03	1.436E-01
2084	4.699E+02	2.567E+05	1.725E+01	7.362E+00	2.054E+03	1.380E-01
2085	4.515E+02	2.467E+05	1.657E+01	7.073E+00	1.973E+03	1.326E-01
2086	4.338E+02	2.370E+05	1.592E+01	6.796E+00	1.896E+03	1.274E-01
2087	4.168E+02	2.277E+05	1.530E+01	6.529E+00	1.822E+03	1.224E-01
2088	4.005E+02	2.188E+05	1.470E+01	6.273E+00	1.750E+03	1.176E-01
2089	3.848E+02	2.102E+05	1.412E+01	6.027E+00	1.682E+03	1.130E-01
2090	3.697E+02	2.020E+05	1.357E+01	5.791E+00	1.616E+03	1.086E-01
2091	3.552E+02	1.940E+05	1.304E+01	5.564E+00	1.552E+03	1.043E-01
2092	3.412E+02	1.864E+05	1.253E+01	5.346E+00	1.491E+03	1.002E-01
2093	3.279E+02	1.791E+05	1.203E+01	5.136E+00	1.433E+03	9.628E-02
2094	3.150E+02	1.721E+05	1.156E+01	4.935E+00	1.377E+03	9.250E-02
2095	3.027E+02	1.653E+05	1.111E+01	4.741E+00	1.323E+03	8.888E-02
2096	2.908E+02	1.589E+05	1.067E+01	4.555E+00	1.271E+03	8.539E-02
2097	2.794E+02	1.526E+05	1.026E+01	4.377E+00	1.221E+03	8.204E-02
2098	2.684E+02	1.466E+05	9.853E+00	4.205E+00	1.173E+03	7.883E-02
2099	2.579E+02	1.409E+05	9.467E+00	4.040E+00	1.127E+03	7.573E-02
2100	2.478E+02	1.354E+05	9.096E+00	3.882E+00	1.083E+03	7.276E-02
2101	2.381E+02	1.301E+05	8.739E+00	3.730E+00	1.041E+03	6.991E-02
2102	2.287E+02	1.250E+05	8.396E+00	3.583E+00	9.997E+02	6.717E-02
2103	2.198E+02	1.201E+05	8.067E+00	3.443E+00	9.605E+02	6.454E-02
2104	2.112E+02	1.154E+05	7.751E+00	3.308E+00	9.228E+02	6.201E-02
2105	2.029E+02	1.108E+05	7.447E+00	3.178E+00	8.867E+02	5.957E-02
2106	1.949E+02	1.065E+05	7.155E+00	3.054E+00	8.519E+02	5.724E-02
2107	1.873E+02	1.023E+05	6.874E+00	2.934E+00	8.185E+02	5.499E-02
2108	1.799E+02	9.830E+04	6.605E+00	2.819E+00	7.864E+02	5.284E-02
2109	1.729E+02	9.445E+04	6.346E+00	2.708E+00	7.556E+02	5.077E-02
2110	1.661E+02	9.074E+04	6.097E+00	2.602E+00	7.259E+02	4.878E-02
2111	1.596E+02	8.718E+04	5.858E+00	2.500E+00	6.975E+02	4.686E-02
2112	1.533E+02	8.377E+04	5.628E+00	2.402E+00	6.701E+02	4.503E-02
2113	1.473E+02	8.048E+04	5.408E+00	2.308E+00	6.438E+02	4.326E-02
2114	1.415E+02	7.733E+04	5.195E+00	2.217E+00	6.186E+02	4.156E-02
2115	1.360E+02	7.429E+04	4.992E+00	2.130E+00	5.943E+02	3.993E-02
2116	1.307E+02	7.138E+04	4.796E+00	2.047E+00	5.710E+02	3.837E-02
2117	1.255E+02	6.858E+04	4.608E+00	1.967E+00	5.487E+02	3.686E-02
2118	1.206E+02	6.589E+04	4.427E+00	1.890E+00	5.271E+02	3.542E-02
2119	1.159E+02	6.331E+04	4.254E+00	1.815E+00	5.065E+02	3.403E-02
2120	1.113E+02	6.083E+04	4.087E+00	1.744E+00	4.866E+02	3.270E-02

Appendix B

Wintek Report

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ELECTRICAL ENGINEERING SOLUTIONS

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March 20, 2020

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CC:
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Project Name: City of Kawartha Lakes – Lindsay OPS Landfill – Nuisance Trips Investigation Report - SEL-351

WINTEK Reference: WW20-128.03

The City of Kawartha retained WINTEK Engineering Ltd. to investigate the cause of nuisance tripping of the SEL-351 relay at the Lindsay OPS Landfill.

1. Background

The City of Kawartha Lakes provided WINTEK Engineering Ltd. with a record of 39 SEL Event files recorded over a period from May 6, 2019 to December 1, 2019. These events were generated by the SEL-351 protection relay and provide a short 245ms (approximately 15 cycle) snapshot of the operating conditions during each event. It should be noted that only 65ms (approximately 4 cycles) of the operating conditions are captured before the event is triggered. Therefore, although the data provides a snapshot of information regarding the operating conditions before the events were triggered, it does not allow for an in-depth analysis of the cause of the events.

On February 18, 2020, WINTEK Engineering Ltd. was on site to gather additional information and complete testing on different operating procedures at the plant. At that time, WINTEK downloaded an additional 30 Event files recorded between December 11, 2019 and February 14, 2020. WINTEK was also able to capture 4 events while completing our testing.

2. Observations

2.1. SEL Events

The SEL-351 relay is programmed to generate an event file when an overcurrent and / or TRIP signal is detected. When an event file is triggered, the current and voltage waveforms, along with any change in value of the TRIP or protection signals are recorded and stored for the 245ms period after the event trigger. Approximately 65ms of that data includes the operating conditions before the event is triggered is also captured. Of the 69 Event files that we were able to obtain, 34

of the files included a TRIP signal. If a TRIP signal is initiated, the landfill gas generator breaker will be opened by the SEL-351, and the generator will be taken offline. Note that the SEL-351 can initiate a TRIP signal independently of the landfill gas generator, and will open the landfill gas generator breaker even when the landfill gas generator is not operating.

Although the TRIP signal can be initiated by multiple protection settings, it was observed that the main cause of these signals was from the 3PWR1 setting, which monitors the reverse reactive power of the wave form. The reverse reactive power relay was the cause for approximately 80% of the TRIP signals recorded. Further review of these event files shows that in all cases the TRIP signal functioned properly, as the reactive power was above the allowable limit as directed by Hydro One. By observing the current and voltage waveforms in these event files, there were three typical patterns noted:

- Voltage and current appear in normal steady state with no apparent changes after the TRIP signal is initiated.
- Voltage appears in normal steady state and the current increases after the TRIP signal is initiated.
- Voltage appears in normal steady state and the current decreases after the TRIP signal is initiated.

The second most prevalent cause of the TRIP signals were due to the SV2T setting which monitors under voltage. Review of these files validates that the voltage and current waveforms dropped to zero, which is consistent with a loss of Utility power.

2.2. Generator and SEL-351 Conditions

In addition to the SEL-351 protection, the landfill gas generator has its own protection to ensure that it operates within its designated ranges. For this reason, the landfill gas generator can receive an internal fault and shutdown without any input or TRIP signal from the SEL-351. Similarly, the SEL-351 logic is not tied to the landfill gas generators operation. This means that the SEL-351 can initiate a TRIP signal and open the landfill gas generator breaker even when the generator is offline.

The landfill gas generator is set to output power at a unity power factor. From the data received from COMCOR, it was observed that the reactive power output ranged between -20kVAR and 30kVAR at a wide variety of generating levels. This corresponds to a general power factor of greater than 0.99 either lagging or leading.

During our site visit, we discovered that there is an operating condition where the landfill gas generator has low fuel pressure which can cause the generator to stop generating resulting in the generator motor acting as a load. During this condition, the landfill gas generator is not able to control the power factor. It will run for a short time prior to the SEL-351 initiating a TRIP signal and / or the generator controller shutting down the generator. We were able to confirm the occurrence of this condition by comparing the SEL Event files and the generators operation log.

2.3. Power Factor Correction & Aerators

The treatment plant currently operates with approximately 12 aerators, each of which are approximately 20HP, drawing typically around 20Amps at 600Volts during full rated operation.

These aerators generally all run at the same time and switching is performed manually to repair or maintain the aerators.

To offset the low power factor of the aerators, the plant has a power factor correction capacitor banks installed. The controls for the bank are designed to measure the power factor and then calculate what is needed to get the system as close to unity power factor as possible within the limits of the hardware. The correction hardware consists of 3 banks of capacitors:

125 kVAR
40 kVAR
40 kVAR

The power factor correction logic operates by switching on and off combinations of the capacitors. This offers the following correction possibilities as needed to offset the aerators that are online:

kVARs correction	Approx. number of aerators
40	2
80	4
125	6
165	8
205	10

From the controls narrative, there is a power factor set point, plus a power factor dead band that determines how the switching takes place. The logic narrative explains that to turn the capacitors on, the power factor must be less than 0.96 (lagging) minus the 0.02 dead band. At this point, the controls will turn on the next available correction value (increasing kVARs). Similarly, when the power factor is above 0.96 (lagging) plus the dead band, the controls will step down to the next lowest correction setting (removing kVARs). All of this happens slowly since the capacitors cannot be switched on and off quickly (using the arrangement in this design). The time variable in the controls narrative is listed as 30 seconds.

During our recent site visit, we tested the theory that shutting off multiple aerators within a short period of time could be one cause of the reverse reactive power trip. In order to rule out the aerators as the cause, the capacitor controls were disabled and aerators turned on and off. No trips were observed while switching 5 aerators on and off.

The next step was to repeat the test with the capacitor controls enabled. With the capacitor controls enabled the same test was repeated (aerators switched off and then back on again) and the SEL-351 relay tripped. Both of these tests were performed while the land fill gas generator was operating.

3. Analysis

The main cause of the SEL TRIP signals is due to the reverse reactive power setting which is required by Hydro One. With only a small 65ms snapshot of the waveform before the TRIP signal is sent, it is difficult to gain a full understanding of the operating conditions that cause the TRIP by viewing the data.

As noted in the observations there were three patterns of waveforms detected in the Event files.

The Events where the voltage and current waveforms are stable and in steady state would likely indicated that the landfill gas generator was either at a very low output or not operating at the time of the TRIP. Without additional information, it is not possible to identify the cause of the high reverse reactive power values which cause the SEL-351 to TRIP. If the landfill gas generator is at a low power output, or starting up, it may not be able to control its power factor accurately. This could lead to the landfill gas generator unintentionally supplying reactive power for a short period of time and therefore causing a TRIP from the SEL-351. The other possible case could be that the landfill gas generator is not online and the SEL-351 produces a trip signal due to operational conditions within the plant. This case is not within the intended protection scheme of the SEL-351, as it is only required to provide monitoring for the generation.

The Events where the voltage is stable and in steady state, but the current increases after the TRIP signal is initiated is consistent with the landfill gas generator being taken offline as the generator breaker is opened by the SEL-351. Although it was observed that the SEL-351 responded properly, since the reverse reactive current was above the Hydro One limit, without additional information it is not possible to isolate the cause for these TRIP signals. With the landfill gas generator running at higher capacities, its power factor control should be able to keep the generator output close to unity. After speaking with staff, it is possible that these events can be attributed to switching on and off some of the aerators for maintenance and / or repair.

Our testing of the aerator switching proved two facts. The first is that the there is high probability that simply shutting off multiple aerators with the capacitors under automatic control will cause the SEL-351 relay to trip. The second is that even with the land fill gas generator online and in theory maintaining the power factor at unity, the SEL-351 still tripped (likely due to low load on the generator).

It is clear that the power factor correction logic presently implemented and operating with the land fill gas generator may be contributing to the problem. The controls narrative indicates that the capacitors are controlled based on the power factor. It is assumed that the power factor is measured at the “customer metering” as shown on the single line drawing E-002 Lindsay Water & Sewer Commission Lindsay WCP Upgrade. These controls pre-date the landfill gas generator installation and operated as intended when installed, however, with the land fill gas generator supplying most of the load, controlling the capacitors based on the PF from the small (40-50 kW) Utility only contribution is not appropriate.

If multiple aerators are switched off within a short period of time, due to the relative slow switching reaction time of the capacitor bank, it is possible for the capacitors to overcompensate and produce reverse reactive power which is sent into the Utilities grid. Since the reverse reactive power relay of the SEL-351 operates much faster, the system does not have time to re-stabilize before a TRIP signal is sent to isolate the landfill gas generator.

Finally, the last event pattern occurs when the voltage appears in normal steady state and the current decreases after the TRIP signal is initiated. This sequence is likely due to the landfill gas generator operation during a low fuel pressure condition. COMCOR had noted that during a low fuel pressure condition, the landfill gas generator can act as a load for a short period of time before it either recovers or shuts down. When this happens, the generator cannot properly control its power factor and is likely the cause of the SEL-351 TRIP condition.

4. Recommendations

The TRIP events generated by the SEL-351 that are attributed to a loss of Utility (grid) power are not avoidable. Although they require the SEL-351 to be reset before the landfill gas generator can be turned on, this protection is required to ensure that the generator does not generate during a loss of Utility power. This is a HONI requirement.

Similarly, the low fuel pressure condition which causes the landfill gas generator to act as a load also cannot be avoided (from an electrical engineering standpoint). The landfill gas generator controls do have a delay to allow the generator a period of time to recover in this low-pressure situation, but the reverse reactive power setting on the SEL relay will act before the generator is taken offline if the reactive power produced by the Generator is above the Hydro One limit requirements.

Recommendation 1: We recommend a consultation with the Generator Manufacturer to discuss the options of changing the delay settings to perhaps limit or eliminate the reverse reactive power produced by the generator during this low-pressure situation (i.e. shutting the generator faster on low pressure situations). This may not be possible as but is worth a discussion with the generator manufacturer to investigate options.

The power factor correction capacitor banks are responsible for the SEL-351 TRIP during the switching of aerators for maintenance and repair.

Recommendation 2: In order to limit tripping in this scenario, we recommend that a procedure is developed and implemented. The procedure shall ensure that the capacitor banks are temporarily taken offline during any maintenance or switching of the aerators. This can be implemented by posting the procedure and training maintenance staff. The capacitor banks shall be manually disabled before performing any switching of aerators. Alternatively, a maintenance switch could be designed and installed with the capacitor bank controller PLC which would allow maintenance staff to select maintenance mode, automatically disabling the capacitor banks while in maintenance mode. This would limit the number of nuisance TRIP events that occur do to operations within the plant.

Recommendation 3: A review of the cost / benefits of the existing power factor correction system should be considered. It may be worth considering eliminating the capacitor banks but without a detailed cost / benefit analysis, it is difficult to evaluate the cost implications of doing this.

It could potentially be more cost effective to replace the existing capacitor banks with a more sophisticated system. A capacitor bank system with the ability to react more quickly, more accurately track the plant's power factor, reduce the chance of overcompensating and possibly causing the SEL-351 to TRIP.

A simpler solution may be to simply disable the power factor correction whenever the land fill gas generator is running. The PLC would need an input to monitor the operation of the land fill gas generator and disable the capacitor bank during its operation. It is not clear from the drawings provided if the PLC that controls the capacitor banks can tell if the landfill gas generator is producing power, so this signal may need to be added.

Alternatively, if an analysis is completed which recommends that the power factor correction stay active during the landfill gas generators operation, the amount of available PF correction should be limited based on the amount of power being consumed from the Utility. For example, if the plant is operating at

400kW then all 205kVAR of the capacitor bank can be utilized. If the landfill gas generator is operating at 300kW, therefore reducing the Utility consumption to 100kW, then only 80kVAR of the capacitor bank should be available for power factor correction. This would reduce the chances of the capacitor bank overcompensating at causing a reverse reactive power condition. As mentioned above it is not advisable to make any decisions without completing additional testing and having a good understanding of the cost / benefit of the power factor correction.

Recommendation 4: Since the SEL-351 is only required to provide protection to the Utility from the landfill gas generator, additional logic should be implemented to 'AND' any TRIP signal with a status signal from the landfill gas generator. This would avoid any TRIP signals being sent while the landfill gas generator is offline. Although this would not reduce the nuisance TRIPs, it would reduce the frequency of the SEL-351 requiring a reset in order to start generation. Similarly, as there are currently no requirements for resetting the SEL-351, it would be beneficial to implement an automatic reset sequence. This would eliminate the need for staff to reset the SEL-351 before starting the landfill gas generator.

Recommendation 5: Finally, to provide a better understanding and allow for further analysis in the future, it is recommended that the SEL-351 setting for generating event files be modified. Currently the settings for the length of events is set at the minimum which only provides 15 cycles (245ms) of operating conditions during an event. This setting can be increased to 30 or 60 cycles to provide more information and allow for better diagnoses in the future. Similarly, the setting for the length of pre-fault in the event report is 4 cycles (65ms). This setting can be increased to up to 14 cycles to provide additional information and insight into the operating conditions before the Event occurs allowing for greater analysis.

It is recommended that any modifications to the SEL-351 settings be discussed with Hydro One and approved before implementing. It is also important the re-programming of the relay be completed by a qualified third party.

If there are any questions / concerns, please do not hesitate to contact the undersigned.

Best regards,

WINTEK Engineering Ltd.

Per:
Chris Politis, P.Eng.
Principal

