REPORT

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) AIR QUALITY PERMIT APPLICATION FOR GREENHOUSE GASES (GHGs)

Skyline Landfill Expansion Project
Dallas and Ellis Counties, TX

Submitted To: United States Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202

Submitted By: Waste Management of Texas, Inc.
1201 North Central
Ferris, TX 75125

--and—

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Distribution:
4 Copies – US EPA, Region 6
1 Copy – TCEQ, Office of Permitting & Registration, Air Permits Division
2 Copies – Waste Management of Texas, Inc.
1 Copy – Waste Management Corporate
2 Copies – Beveridge & Diamond, P.C.

December 2013 **133-94188.0004**

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1.0 INTRODUCTION AND EXECUTIVE SUMMARY

Waste Management of Texas, Inc. (WMTX) is submitting this Prevention of Significant Deterioration ("PSD") Air Quality Permit Application (the Application) for greenhouse gases ("GHGs") to secure authorization from the United States Environmental Protection Agency, Region VI ("EPA-VI") for the GHG emissions expected to be associated with the construction and operation of an expansion to the disposal area and capacity of its Skyline Landfill (the "Skyline Landfill Expansion Project"). All GHG emissions associated with the proposed expansion will be fugitive emissions. Skyline Landfill is an existing municipal solid waste ("MSW") disposal facility located at 1201 North Central Street in Ferris, Texas ("Skyline Landfill"). The facility spans part of Dallas and Ellis Counties, within the city limits of Ferris, Texas, west of Old U.S. Highway 75 (Business IH 75).

While fugitive emissions typically are included in a PSD applicability analysis following a source becoming subject to the PSD program, because all of the GHG emissions for which authorization is requested in this Application are fugitive emissions there is a potentially applicable exemption embedded in the PSD rule at 40 CFR 52.21(i)(vii). This exemption from PSD applicability states that a source or modification that is made a PSD major source or modification "only if fugitive emissions, to the extent quantifiable, are considered in calculating the potential to emit of the stationary source or modification…", and this exemption is applicable to MSW landfills. WMTX believes this exemption is applicable to the Skyline Landfill Expansion Project, as described in Section 7.1 of this Application. Nevertheless, WMTX is presenting this Application as a completer PSD major source application for GHG emissions.

WMTX applied for and the Texas Commission on Environmental Quality ("TCEQ") on November 22, 2013 authorized, pursuant to the Standard Permit for MSW Landfills and Transfer Stations, the non-GHG air pollutant increases expected to be associated with the Skyline Landfill Expansion Project. A copy of the permit application and standard permit authorization issued by TCEQ on November 22, 2013 will be provided to EPA-VI.[1]

In December 2010, U.S. EPA ("EPA") finalized a rule that designates EPA-VI as the permitting authority for GHG emitting sources in Texas by declaring a partial disapproval of the Texas State Implementation Plan ("SIP"). This rule is in effect until the EPA approves a SIP that allows Texas to regulate GHGs. Further, EPA stated in its white paper entitled, "Issuing Permits for Sources with Dual PSD Permitting Authorities," dated April 19, 2011, "[i]n the case of a source or project that has both GHGs and non-GHGs that are subject to PSD . . . the State will issue the non-GHG portion of the permit and EPA-VI will issue the GHG portion."[2] This white paper was subsequently refined by a memorandum agreement between EPA-VI and TCEQ stating that, in a major source GHG PSD scenario, EPA-VI will issue the major source

[1] See Section 8.1 PSD and "Tailoring Rule" Applicability of this document for a detailed discussion of current air permitting authority associated with these two programs in the State of Texas.
[2] See *http://www.epa.gov/nsr/ghgqa.html*

GHG PSD permit and TCEQ will permit all underlying non-GHG air emissions, whether the emissions increase to be permitted is minor or major source for PSD.[3] At this time, EPA-VI is the designated permitting authority for all GHG PSD permits in Texas.

On June 14, 2013, Texas House Bill ("HB") 788, 83rd Legislature, became law. This legislation gives Texas the authority to develop rules to authorize major sources of GHG emissions to the extent required by federal law. In order to implement HB 788, several chapters in the Texas Administrative Code ("TAC") relating to air permitting and public notice will need to be amended. After the necessary rule changes are adopted by the TCEQ, they must be approved by EPA as part of the Texas SIP before TCEQ can begin reviewing applications and issuing permits for GHG emissions. At such time that EPA approves the SIP and then withdraws the FIP, TCEQ will be coordinating with EPA and EPA-VI regarding the transition period for accepting and processing GHG applications. At the end of the transition period, TCEQ will be the designated permitting authority for all GHG PSD permits in Texas. It is expected that this permit application will be processed before all of these events take place; therefore it is submitted to EPA and a copy provided to TCEQ.

1.1 Organization of Application

The remainder of this Application is structured as follows:

- A process description of the existing facility and proposed expansion are presented in Section 3.0;
- A regulatory applicability analysis for GHGs is presented in Section 7.0;
- GHG emission rate estimation calculations are described in Section 8.0;
- A Best Available Control Technology ("BACT") analysis performed in accordance with 40 CFR §52.21(j) for GHGs is presented in Section 9.0;
- Detailed GHG emission calculations are provided in Section 8.0;
- An area map is presented in Section 4.0, a preliminary plot plan showing proposed emission sources is included in Section 5.0, and a process flow diagram is included in Section 6.0;
- The TCEQ Form PI-1 and corresponding fee form are presented in Section 2.0;
- Other PSD requirements are addressed in Section 10.0; and
- Proposed GHG monitoring is presented in Section 11.0.

[3] See "Memorandum to Zac Covar, Executive Director, TCEQ from Samuel Coleman, Deputy Regional Administrator, U.S. EPA, Region 6", dated 4 April 2013.

2.0 TCEQ FORM PI-1

In accordance with the air permitting requirements of the TCEQ, the form required to support an air permit to construct application, a PI-1 Form, is completed and provided in this Application section.

Skyline Landfill currently operates under a Standard Permit for MSW Landfills and Transfer Stations. However, because the activity to be permitted pursuant to this permit application, the expansion of the landfill, has the potential to emit ("PTE") GHGs in excess of the major source PSD threshold, the Standard Permit form is not appropriate for use to permit a major source of GHG emissions. Therefore, this Application is submitted as a stand-alone New Source Review Air Permit Application as described in 30 TAC 116.110. The applicable forms for a TCEQ New Source Review ("NSR") air permit application subject to the requirements of 30 TAC 116.110 rather than the applicable forms for a Standard Permit for MSW Landfills and Transfer Stations subject to the requirements of 30 TAC 330, Subchapter U, are provided in this Application.

Texas Commission on Environmental Quality
Form PI-1 General Application for
Air Preconstruction Permit and Amendment

Important Note: The agency requires that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.

I. Applicant Information		
A. Company or Other Legal Name: Waste Management of Texas, Inc., Skyline Landfill		
Texas Secretary of State Charter/Registration Number (if applicable):		
B. Company Official Contact Name: Donald J. Smith		
Title: Area President		
Mailing Address: 520 East Corporate Drive, Ste. 100		
City: Lewisville	State: Texas	ZIP Code: 75057
Telephone No.: (713) 365-2750	Fax No.: (713) 647-5450	E-mail Address: dsmith4@wm.com
C. Technical Contact Name: Paula Carboni		
Title: Area Environmental Protection Manager		
Company Name: Waste Management of Texas, Inc., Skyline RDF		
Mailing Address: P.O. Box 400		
City: Ferris	State: Texas	ZIP Code: 75125
Telephone No.: 972-842-5881	Fax No.: 972-842-2811	E-mail Address:pcarboni@wm.com
D. Site Name: Waste Management of Texas, Inc., Skyline RDF		
E. Area Name/Type of Facility: MSW Landfill		X Permanent ☐ Portable
F. Principal Company Product or Business: Municipal Solid Waste Management		
Principal Standard Industrial Classification Code (SIC): 4953		
Principal North American Industry Classification System (NAICS): 562212		
G. Projected Start of Construction Date: March 2014		
Projected Start of Operation Date: March 2014		
H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.):		
Street Address: 1201 N. Central Avenue		
City/Town: Ferris	County: Dallas	ZIP Code: 75125
Latitude (nearest second): N 32 32 48	Longitude (nearest second): W 96 39 57.4	

I.	**Applicant Information (continued)**	
I.	Account Identification Number (leave blank if new site or facility):	
J.	Core Data Form.	
Is the Core Data Form (Form 10400) attached? If No, provide customer reference number and regulated entity number (complete K and L).		☐ YES X NO
K.	Customer Reference Number (CN): **602242497**	
L.	Regulated Entity Number (RN): **100542232**	
II.	**General Information**	
A.	Is confidential information submitted with this application? If Yes, mark each confidential page confidential in large red letters at the bottom of each page.	☐ YES X NO
B.	Is this application in response to an investigation, notice of violation, or enforcement action? If Yes, attach a copy of any correspondence from the agency and provide the RN in section I.L. above.	☐ YES X NO
C.	Number of New Jobs: zero (0)	
D.	Provide the name of the State Senator and State Representative and district numbers for this facility site:	
State Senator: Brian Birdwell (22) and Royce West (23)		District No.: 22 and 23
State Representative: Jim Pitts (10) and Helen Giddings (109)		District No.: 10 and 109
III.	**Type of Permit Action Requested**	
A.	Mark the appropriate box indicating what type of action is requested. X Initial ☐ Amendment ☐ Revision (30 TAC 116.116(e) ☐ Change of Location ☐ Relocation	
B.	Permit Number (if existing):	
C.	Permit Type: Mark the appropriate box indicating what type of permit is requested. *(check all that apply, skip for change of location)* X Construction ☐ Flexible ☐ Multiple Plant ☐ Nonattainment ☐ Plant-Wide Applicability Limit X Prevention of Significant Deterioration ☐ Hazardous Air Pollutant Major Source ☐ Other:	
D.	Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC 116.315(c).	☐ YES X NO

III. Type of Permit Action Requested *(continued)*		
E. Is this application for a change of location of previously permitted facilities? If Yes, complete III.E.1 - III.E.4.0		☐ YES X NO
1. Current Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
City:	County:	ZIP Code:
2. Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
3. Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If "NO", attach detailed information.		☐ YES ☐ NO
4. Is the site where the facility is moving considered a major source of criteria pollutants or HAPs?		☐ YES ☐ NO
F. Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown.		
List: Standard Permit for MSW Landfills, application under review by TCEQ		
G. Are you permitting planned maintenance, startup, and shutdown emissions? If Yes, attach information on any changes to emissions under this application as specified in VII and VIII.		☐ YES X NO
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) Is this facility located at a site required to obtain a federal operating permit? If Yes, list all associated permit number(s), attach pages as needed).		X YES ☐ NO ☐ To be determined
Associated Permit No (s.): GOP – O – 01485		
1. Identify the requirements of 30 TAC Chapter 122 that will be triggered if this application is approved.		
☐ FOP Significant Revision	☐ FOP Minor	☐ Application for an FOP Revision
☐ Operational Flexibility/Off-Permit Notification		☐ Streamlined Revision for GOP
X To be Determined		☐ None

III. Type of Permit Action Requested *(continued)*	
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) *(continued)*	
2. Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site. ***(check all that apply)***	
X GOP Issued	☐ GOP application/revision application submitted or under APD review
☐ SOP Issued	☐ SOP application/revision application submitted or under APD review

IV. Public Notice Applicability	
A. Is this a new permit application or a change of location application?	X YES ☐ NO
B. Is this application for a concrete batch plant? If Yes, complete V.C.1 – V.C.2.	☐ YES X NO
C. Is this an application for a major modification of a PSD, nonattainment, FCAA 112(g) permit, or exceedance of a PAL permit?	☐ YES X NO
D. Is this application for a PSD or major modification of a PSD located within 100 kilometers or less of an affected state or Class I Area?	☐ YES X NO
If Yes, list the affected state(s) and/or Class I Area(s).	
List: Texas	
E. Is this a state permit amendment application? If Yes, complete IV.E.1. – IV.E.3.	
1. Is there any change in character of emissions in this application?	☐ YES ☐ NO
2. Is there a new air contaminant in this application?	☐ YES ☐ NO
3. Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?	☐ YES ☐ NO
F. List the total annual emission increases associated with the application ***(List all that apply and attach additional sheets as needed):***	
Volatile Organic Compounds (VOC):	
Sulfur Dioxide (SO2):	
Carbon Monoxide (CO):	
Nitrogen Oxides (NOx):	
Particulate Matter (PM):	
PM 10 microns or less (PM10):	
PM 2.5 microns or less (PM2.5):	
Lead (Pb):	
Hazardous Air Pollutants (HAPs):	

Other speciated air contaminants not listed above: GHGs: 117,091 tons per year (incl. biogenic CO2)

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V. Public Notice Information *(complete if applicable)*		
A. Public Notice Contact Name: Paula Carboni		
Title: Area Environmental Manager		
Mailing Address: P.O. Box 400		
City: Ferris	State: Texas	ZIP Code: 75125
B. Name of the Public Place: Ferris Public Library		
Physical Address (No P.O. Boxes): 514 S. Mable Street		
City: Ferris	County:	ZIP Code: 75125
The public place has granted authorization to place the application for public viewing and copying.	X YES ☐ NO	
The public place has internet access available for the public.	X YES ☐ NO	
C. Concrete Batch Plants, PSD, and Nonattainment Permits		
1. County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site.		
The Honorable: Clay Jenkins		
Mailing Address: 411 Elm Street		
City: Dallas	State: Texas	ZIP Code: 75202
2. Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? ***(For Concrete Batch Plants)***	☐ YES ☐ NO	
Presiding Officers Name(s):		
Title:		
Mailing Address:		
City:	State:	ZIP Code:
3. Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located.		
Chief Executive: Bill Pardue, Mayor		
Mailing Address: 100 Town Plaza Ferris		
City: Ferris	State: Texas	ZIP Code: 75125
Name of the Indian Governing Body: N/A		
Mailing Address:		

City:	State:	ZIP Code:

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V. Public Notice Information *(complete if applicable) (continued)*		
C. Concrete Batch Plants, PSD, and Nonattainment Permits		
3. Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located. *(continued)*		
Name of the Federal Land Manager(s): N/A		
D. Bilingual Notice		
Is a bilingual program required by the Texas Education Code in the School District?		X YES ☐ NO
Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district?		X YES ☐ NO
If Yes, list which languages are required by the bilingual program?	Spanish	
VI. Small Business Classification *(Required)*		
A. Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than $6 million in annual gross receipts?		☐ YES X NO
B. Is the site a major stationary source for federal air quality permitting?		X YES ☐ NO
C. Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy?		X YES ☐ NO
D. Are the site emissions of all regulated air pollutants combined less than 75 tpy?		☐ YES X NO
VII. Technical Information		
A. The following information must be submitted with your Form PI-1 ***(this is just a checklist to make sure you have included everything)***		
1. X Current Area Map		
2. X Plot Plan		
3. X Existing Authorizations		
4. X Process Flow Diagram		
5. X Process Description		
6. X Maximum Emissions Data and Calculations		
7. ☐ Air Permit Application Tables		
a. ☐ Table 1(a) (Form 10153) entitled, Emission Point Summary		
b. ☐ Table 2 (Form 10155) entitled, Material Balance		

c.	☐ Other equipment, process or control device tables	
B.	Are any schools located within 3,000 feet of this facility?	☐ YES XNO

VII.	**Technical Information**			
C.	Maximum Operating Schedule:			
Hour(s): 24 per day	Day(s):365 per year	Week(s):52 per year	Year(s):	
Seasonal Operation? If Yes, please describe in the space provide below.				☐ YES X NO
D.	Have the planned MSS emissions been previously submitted as part of an emissions inventory?			☐ YES X NO
Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed.				
Landfill gas management does not have applicable TCEQ MSS requirements.				
All GHGs addressed in this application originate from landfill gas.				
E.	Does this application involve any air contaminants for which a disaster review is required?			☐ YES X NO
F.	Does this application include a pollutant of concern on the Air Pollutant Watch List (APWL)?			☐ YES X NO
VIII.	**State Regulatory Requirements** **Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.*			
A.	Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ?			X YES ☐ NO
B.	Will emissions of significant air contaminants from the facility be measured?			X YES ☐ NO
C.	Is the Best Available Control Technology (BACT) demonstration attached?			X YES ☐ NO
D.	Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods?			X YES ☐ NO
IX.	**Federal Regulatory Requirements** **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*			
A.	Does Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application?			X YES ☐ NO

B.	Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application?	X YES ☐ NO

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IX.	**Federal Regulatory Requirements** **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*	
C.	Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?	X YES ☐ NO
D.	Do nonattainment permitting requirements apply to this application?	☐ YES X NO
E.	Do prevention of significant deterioration permitting requirements apply to this application?	X YES ☐ NO
F.	Do Hazardous Air Pollutant Major Source [FCAA 112(g)] requirements apply to this application?	☐ YES X NO
G.	Is a Plant-wide Applicability Limit permit being requested?	☐ YES X NO
X.	**Professional Engineer (P.E.) Seal**	
Is the estimated capital cost of the project greater than $2 million dollars?		☐ YES X NO
If Yes, submit the application under the seal of a Texas licensed P.E.		
XI.	**Permit Fee Information**	
Check, Money Order, Transaction Number ,ePay Voucher Number:		Fee Amount: $0.00
Paid online?		☐ YES ☐ NO
Company name on check: N/A		
Is a copy of the check or money order attached to the original submittal of this application?		☐ YES ☐ NO ☐ N/A
Is a Table 30 (Form 10196) entitled, Estimated Capital Cost and Fee Verification, attached?		☐ YES ☐ NO ☐ N/A

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XII. Delinquent Fees and Penalties
This form will not be processed until all delinquent fees and/or penalties owed to the TCEQ or the Office of the Attorney General on behalf of the TCEQ is paid in accordance with the Delinquent Fee and Penalty Protocol. For more information regarding Delinquent Fees and Penalties, go to the TCEQ Web site at: www.tceq.texas.gov/agency/delin/index.html.
XIII. Signature
The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.
Name: Donald Smith
Signature: [signature] *Original Signature Required*
Date: 12-2-13

3.0 EXISTING FACILITY AND EXPANSION PROJECT PROCESS DESCRIPTION

WMTX is submitting this Application to authorize emissions associated with a proposed expansion of the existing landfill fill area at Skyline Landfill located in Ferris, Dallas and Ellis Counties, Texas. All GHG emissions associated with the proposed expansion will be fugitive emissions. The proposed expansion will reduce the current solid waste permitted boundary by 5.21 acres. The proposed expansion will remove approximately 20.1 acres of designated waste disposal area from the existing permit and add approximately 22.3 acres of designated waste disposal area in other locations for a net increase of 2.2 acres of waste disposal area after reconfiguration of the permit boundary and designated waste disposal area. See the Plot Plan provided in Section 5 of this Application for a depiction of this reconfiguration. The proposed expansion will increase Skyline Landfill's total remaining waste capacity by approximately 20,626,000 cubic yards and increase its remaining projected site life by approximately 12 years[4].

Skyline Landfill is a MSW landfill, the primary function of which is to accept and safely contain for the long term, in accordance with relevant EPA and TCEQ rules, MSW, special waste (in accordance with 30 TAC 330.171) and TCEQ Class 2 and 3 industrial wastes (in accordance with 30 TAC 330.173). Included among these are wastes resulting from or incidental to municipal, community, commercial, institutional and recreational activities in the surrounding community, including putrescible wastes, rubbish, ashes, brush, construction-demolition debris, and inert material. In addition, regulated asbestos containing material ("RACM") and non-regulated asbestos containing material ("non-RACM") are accepted by Skyline Landfill for disposal. Petroleum contaminated soil is accepted and treated in accordance with the on-site bioremediation treatment pad as approved and authorized by TCEQ. Skyline Landfill has not in the past accepted, and does not now accept, TCEQ-designated Class 1 industrial solid waste, except petroleum contaminated soil for bioremediation and RACM that has been designated Class 1 industrial waste solely due to its asbestos content, and there are no exclusive RACM/Class 1 cells. Skyline Landfill does not accept for disposal lead acid storage batteries; used motor vehicle oil; used oil filters; whole used or scrap tires; refrigerators, freezers, air conditioners or other items containing chlorinated fluorocarbons ("CFCs"); bulk or non-containerized liquid waste from non-household sources; regulated hazardous waste; polychlorinated biphenyls ("PCB") waste; radioactive materials; or other wastes prohibited by TCEQ solid waste regulations for a facility of this type.

Skyline Landfill currently receives approximately 1,040,000 tons of waste annually (about 3,333 tons per day). Although the North Central Texas Council of Governments' population projections for the combined population of Dallas and Ellis counties indicate an increasing waste acceptance rate for Skyline Landfill of 1.4 percent annually for the life of the landfill, WMTX projects that its waste acceptance rate will likely

[4] This conservatively assumes the site receives annually its anticipated maximum annual amount of waste (1,600,331 tons) in each of its remaining years of life.

decrease due to local recycling, waste reduction and beneficial use projects that either suppress waste generation per capita or redirect waste to outlets other than an MSW landfill[5].

Site operations at the Skyline Landfill include:

- Accepting, weighing and recording of waste (types described above) from public and private waste haulers and cover materials from material suppliers at the "gatehouse" near the entrance to the landfill;
- Direction of trucks hauling waste and cover materials to the currently active disposal location, reflecting current waste placement strategy, followed by the exit of the trucks after unloading;
- Unloading, distribution and compaction of waste and distribution and compaction of cover material using heavy industrial equipment;
- Preparation of unfilled areas for receipt of fill including excavation/contouring using heavy industrial equipment, and liner system installation;
- Closure of areas that have reached maximum fill including contouring and capping using heavy industrial equipment;
- Bioremediation of petroleum-contaminated soil on a treatment pad and relocation of treated soil to fill areas; and
- On-site support facilities (such as vehicle fueling, landfill gas recovery and management, etc. that support the primary waste management activities as discussed elsewhere in this permit application.

3.1 Facility and Permitting History

Skyline Landfill was originally permitted by Trinity Valley Reclamation in 1976; then acquired by WMTX in 1987. It is currently operating under a Solid Waste Permit[6] issued by the TCEQ in 1995 allowing for a permitted boundary of approximately 667 acres. The area within the Solid Waste Permit boundary consists of 286.4 acres of modern, lined disposal area, 68.3 acres of historical, now completely closed and capped, waste disposal area and 312.3 acres of buffer and other area. The 286.4 acres of modern disposal area now includes approximately 152 acres of area with at least some waste-in-place and approximately 134.4 acres of disposal area designated for future use, which allows for approximately 24 additional years of operation[7]. Skyline Landfill is seeking, concurrently with this Application, an amendment to its Solid Waste Permit to reduce the current Solid Waste Permit boundary by 5.21 acres, but reconfigure and increase the waste disposal area by 2.2 acres, allowing for approximately an additional twelve years of operation. The amendment does not propose an increase in the elevation of

[5] See Section 7.0, Regulatory Applicability, for a full description of policies and assumptions affecting the PSD major source status of this Application.
[6] Permit No. MSW 42C for a Type I landfill.
[7] This conservatively assumes the site receives annually its anticipated maximum annual amount of waste (1,600,331 tons) in each of its remaining years of life.

the landfill. The proposed amendment will increase the current waste disposal capacity of the landfill by approximately 20,626,000 cubic yards of waste and cover material[8].

In addition to current and future disposal areas, waste processing and storage facilities, the Skyline Landfill Solid Waste Permit boundaries include entrance facilities, a Type IX Beneficial Landfill Gas ("LFG") Recovery Facility[9], a citizen's convenience center, a leachate storage facility, a mud grate facility, a maintenance facility, access roads and surface water drainage facilities. The waste processing and storage facilities include a large item storage area, reusable materials storage area, liquid stabilization area and a bioremediation treatment pad. Refer to the Area Map in Section 4.0 and Plot Plan in Section 5.0 of this Application for drawings that depict the current and proposed Skyline Landfill Solid Waste Permit boundary, waste disposal footprint, solid waste unloading, solid waste storage, solid waste processing, buffer zones and easements to other entities.

As part of the proposed expansion of Skyline Landfill, an increase in allowable operating hours is being requested by the modification to the Solid Waste Permit for the expansion. Skyline Landfill is requesting authorization to accept waste 24 hours per day, Monday through Friday, and until 3:00 p.m. on Saturday. In addition, it is requesting authorization to transport materials and operate heavy equipment within its Solid Waste Permit boundaries 24 hours per day, seven days per week.

TCEQ issued its initial air emissions approval for Skyline Landfill to operate under the Standard Permit for MSW Landfills and Transfer Stations in May of 2006. This Standard Permit Number 78422 for the existing portion of the Skyline Landfill consolidated landfill operations/earthmoving equipment operations, seven storage tanks and the existing enclosed flare into one air permit. The Flare Standard Permit Number 54253 for the older utility flare used by Skyline Landfill from 2003 to 2008 was voided in October of 2008, so the current enclosed flare is the only remaining flare. Skyline Landfill also operates a bioremediation pad treatment unit under a Permit by Rule approved in March of 2000.

Also in May of 2006, TCEQ approved Waste Management Renewable Energy, L.L.C., who shares the ultimate parent company Waste Management, Inc., with WMTX, to operate an internal combustion ("IC") engine-based LFG reuse facility at Skyline Landfill under a Standard Permit for Small Electric Generators, Number 78639. This facility, which is also registered with TCEQ as a Type IX LFG Recovery Facility, uses LFG collected from Skyline Landfill to power four IC engines to generate renewable electricity which is distributed via the local electrical grid. The registration for the Standard Permit for Small Electric Generators was later amended as follows:

[8] Based on a March 4,2012, aerial topography study.
[9] Permitted under Type IX Registration No. 48018.

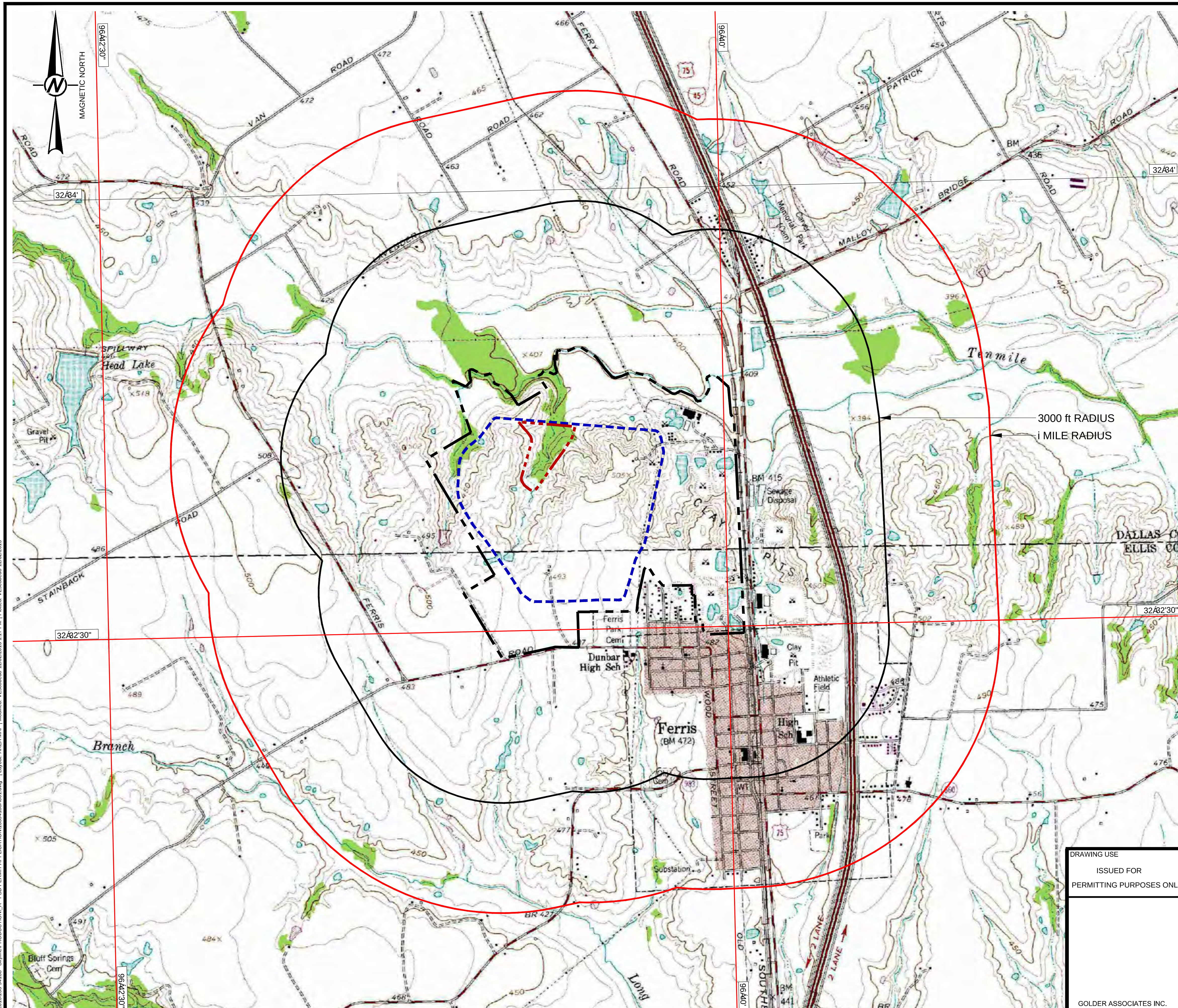
- May 2006 to add an engine;
- April 2005 to place a limit on engine operating hours below that allowed in the Standard Permit and adjust CO and sulfur oxides ("SOx") emissions;
- March 2009 to confirm the limit on engine operating hours below that allowed in the Standard Permit and adjust nitrous oxides ("NOx") and volatile organic compound ("VOC") emissions; and
- February 2013 to replace an engine with an identical engine with no change in emissions.

Because Skyline Landfill's existing facility air permits were issued and/or last amended for a change of emissions well in advance of the GHG permitting program's effective date of January 2, 2011, they were not subject to GHG permitting review.

Due to their commonality of ownership and control under the Waste Management suite of companies, the Waste Management Renewable Energy IC engines were added to Skyline Landfill's Title V General Operating Permit ("GOP") in February of 2011. Skyline Landfill's initial application for coverage under a General Operating Permit for MSW Landfills was approved by the TCEQ in June 2007, and was amended to add a parts washer in July of 2008 and remove the original utility flare in October of 2008 prior to the amendment to add the engines, which was filed in August of 2010 prior to its February 2011 approval by TCEQ. Skyline Landfill submitted its request for renewal of its GOP in accordance with mandated application deadlines, and TCEQ approved the renewal in February 2012, making the GOP's current expiration date February of 2017.

4.0 AREA MAP

An area map of the proposed Skyline Landfill Expansion Project, shown concurrently with the existing Skyline Landfill boundary, is included on the following page. There are no schools within a radius of one mile of Skyline Landfill.



LEGEND

- SOLID WASTE PERMIT BOUNDARY
- LANDFILL FOOTPRINT
- EXPANSION FOOTPRINT
- 1 MILE RADIUS
- 3000 ft RADIUS
- 450 EXISTING 10' GROUND CONTOUR
- SURFACE WATER BODY OR OTHER WATER

NOTES

1. TOPOGRAPHIC BASE MAP DOWNLOADED FROM USGS WEBSITE ON JANUARY 31, 2012.

REFERENCES / SPECIFICATIONS

USGS 7.5 SERIES TOPOQUAD: FERRIS, TEXAS, SW/4 SEAGOVILLE 15' QUADRANGLE, 1959, PHOTOREVISED 1968.

SCALE 0 1000 2000 3000 FEET

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

DRAWING USE

ISSUED FOR PERMITTING PURPOSES ONLY

PROJECT

WASTE MANAGEMENT OF TEXAS, INC.
SKYLINE LANDFILL

TITLE

AREA MAP

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

Golder Associates

PROJECT No.	133-94188.0010		FILE No. 13394188A001
DESIGN	XJS	2013-07-23	SCALE AS SHOWN
CADD	ML	2013-07-23	FIGURE
CHECK	XJS	2013-07-23	2
REVIEW	TRM	2013-07-23	

J:_2013\133-94188 - Skyline\PRODUCTION_A - PSD PERMIT APPLICATION\13394188A001.dwg | Layout: AREA MAP | Modified: VEscobedo 12/02/2013 1:17 PM | Plotted: VEscobedo 12/02/2013

5.0 PLOT PLAN

A preliminary plot plan of the Skyline Landfill property showing the proposed expansion area and project equipment, including air pollutant emission points, is included on the following page.

Site operations that will be performed within the proposed expansion area include:

- Management of LFG generated by waste, including collection of the gas via wells and a vacuum system and combustion of the collected gas using existing, installed combustion equipment. Combustion is achieved by both a flare, for destruction only, and IC engines, for destruction and generation of renewable electricity that is distributed to the grid for use;
- Routine maintenance of haul roads and other facility infrastructure;
- Routine maintenance of vehicles, heavy industrial equipment and LFG combustion units; and
- Routine office and business administration functions.

The expansion area for which this permit modification is being sought is currently designated as a future fill area and will not feature infrastructure elements other than an access road, a liner system, and eventually, a form of LFG control system in those areas where MSW is eventually deposited.

LEGEND

- SOLID WASTE PERMIT BOUNDARY
- EXISTING LANDFILL FOOTPRINT
- PROPOSED LANDFILL FOOTPRINT
- 550 — EXISTING 10' GROUND CONTOUR
- N 323000 — STATE PLANE GRID (NAD 27)
- SITE MON — SITE BENCHMARK
- PRE-SUBTITLE D AREA WITH FINAL COVER
- EXPANSION AREA
- FOOTPRINT REMOVED SIMULTANEOUSLY WITH EXPANSION

NOTES

1. EXISTING CONTOURS COMPILED BY AEROMETRIC FROM AERIAL PHOTOGRAPHY. FLOWN MARCH 6, 2011. COORDINATE SYSTEM IS BASED ON TEXAS STATE PLANE NAD 27, TEXAS NORTH CENTRAL ZONE, US FEET.
2. LANDFILL PERMIT BOUNDARY REVISED: 661.74 ACRES.
3. PROPOSED LANDFILL FOOTPRINT PHASES 1 THROUGH 3: 284.4 ACRES.
4. LANDFILL FOOTPRINT PHASE 5: 4.2 ACRES.
5. PRE-SUBTITLE D AREA: 68.3 ACRES.

SITE BENCHMARKS

I.D.	NORTHING	EASTING	ELEV.
SITE MON	321169.44	2257006.03	438.78
MON C	318971.67	2253518.44	485.62
MON B	322362.77	2253589.96	484.42
MON D	322815.45	2250595.01	475.06
MON A	324396.42	2253799.49	404.67

LANDFILL FOOTPRINT

PERMITTED FOOTPRINT	286.4 Ac.
FOOTPRINT REMOVED	-20.1 Ac.
FOOTPRINT ADDED	+22.3 Ac.
PROPOSED FOOTPRINT	288.6 Ac.

PERMIT BOUNDARY

CURRENT BOUNDARY	666.95 Ac.
BOUNDARY REMOVED	-5.21 Ac.
PROPOSED BOUNDARY	661.74 Ac.

0 400 800 1200
SCALE FEET

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

DRAWING USE
ISSUED FOR PERMITTING PURPOSES ONLY

PROJECT
WASTE MANAGEMENT OF TEXAS, INC. SKYLINE LANDFILL

TITLE
PLOT PLAN

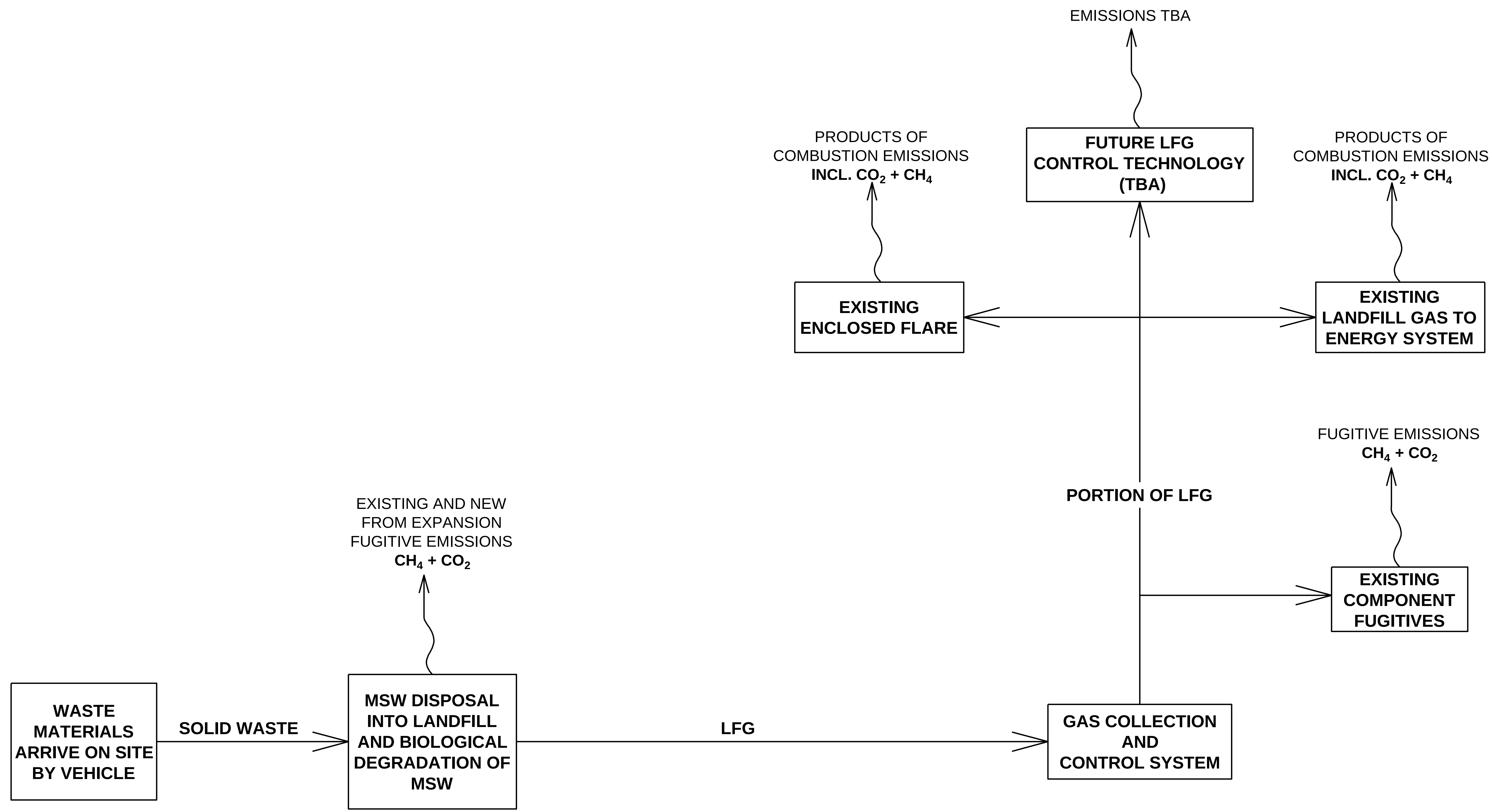
PROJECT No.	133-94188.0010		FILE No.	13394188A002
DESIGN	XJS	2013-07-23	SCALE	AS SHOWN
CADD	ML	2013-07-23	FIGURE	
CHECK	XJS	2013-07-23		3
REVIEW	TRM	2013-07-23		

Golder Associates

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

6.0 PROCESS FLOW DIAGRAM

A process flow diagram of the proposed Skyline Landfill Expansion Project is included on the following page.



LEGEND

MSW............MUNICIPAL SOLID WASTE
LFG..............LANDFILL GAS

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
1	2013-08-01	REMOVED UTILITY FLARE (VOIDED) AND ADDED LFGTE	JS	ML	JS	TRM

DRAWING USE
ISSUED FOR PERMITTING PURPOSES ONLY

PROJECT
WASTE MANAGEMENT OF TEXAS, INC.
SKYLINE LANDFILL

TITLE
PROCESS FLOW DIAGRAM

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

Golder Associates

PROJECT No.	133-94188.0010		FILE No.	13394188A003
DESIGN	XJS	2013-08-01	SCALE	AS SHOWN
CADD	ML	2013-08-01	FIGURE	
CHECK	XJS	2013-08-01		1
REVIEW	TRM	2013-08-01		

7.0 REGULATORY APPLICABILITY

Following are detailed descriptions of the applicability of Federal and State of Texas air regulations to the construction and operation of the Skyline Landfill Expansion Project, the continuing operation of the existing facility, and this permit application itself. The discussion of the applicability of PSD regulations and GHG PSD permitting regulations (also referred to as the "GHG Tailoring Rule") includes significant technical and policy information, beyond simple applicability statements.

7.1 PSD Permitting Applicability

Under Federal and Texas PSD review requirements, all major new or modified sources of air pollutants regulated under the Clean Air Act ("CAA") must be reviewed and a pre-construction permit issued. The EPA has approved Texas' SIP, which contains PSD regulations, but has not yet approved GHG PSD regulations for Texas. The applicable PSD rules in Texas are found at 30 TAC 116.60-116.63.

After the addition of the four LFG-fired engines in 2007, Skyline Landfill became a major carbon monoxide ("CO") source for PSD applicability as the engines are permitted to emit 248.2 tons per year ("TPY") of CO, and the enclosed flare is permitted to emit 131.4 TPY of CO, which in combination exceeds the major source threshold for CO of 250 TPY of emissions. Also, because the addition of the engines left Skyline Landfill as a major source of at least one criteria pollutant, fugitive emissions typically are included in the PSD applicability analysis of the next project at the facility requiring an air permit, and the currently proposed Skyline Landfill Expansion Project is that next project.

Skyline Landfill, an MSW landfill facility and an existing major stationary source under the NSR program, is proposing a modification of an existing facility via the Skyline Landfill Expansion Project. The Skyline Landfill Expansion Project will not result in an increase in non-GHG emissions above the significance thresholds, so NSR will not be triggered for non-GHG emissions associated with the Skyline Landfill Expansion Project. As such, a minor source air permit to construct in the form of a TCEQ Standard Permit for MSW Landfills and Transfer Stations is the appropriate form of air emission approval for these pollutants, and on November 22, 2013 TCEQ approved Standard Permit authorization for the Skyline Landfill Expansion Project.

MSW landfills are not included among the list of 28 named source categories that are regulated under a 100 TPY threshold for "regulated NSR pollutants" to determine "major stationary source" status. MSW Landfills, the source category to which Skyline Landfill belongs, is not a listed source category[10]. Only a facility falling within these source categories must include fugitive emissions when determining whether it should be considered a "major stationary source" for purposes of the NSR program.[11] Because Skyline Landfill does not fall within the 28 listed categories, it is subject to the 250 TPY threshold for "regulated

[10] See 40 CFR 52.21(b)(1)(i)(a).
[11] See 40 CFR 52.21(b)(1)(iii).

NSR pollutants," excluding fugitive emissions, to determine NSR major stationary source status.[12] As stated above, Skyline Landfill currently emits or has the potential to emit 250 TPY of at least one of these criteria pollutants (CO), and it is therefore an existing major source.

"Regulated NSR pollutants" for Skyline Landfill currently include the following criteria pollutants: NOx, SOx, particulate matter with mean aerodynamic diameters of 10 microns and 2.5 microns ("PM_{10} and $PM_{2.5}$"), VOCs, and non-methane organic compounds ("NMOCs").[13]

A physical change in or change in the method of operation at an existing major stationary source triggers NSR review if the change results in an increase and a net increase in regulated NSR pollutant emissions above established thresholds. The Skyline Landfill Expansion Project does not cause an increase or a net increase in criteria pollutant emissions above the established "significance" thresholds[14], and therefore, NSR is not triggered for any criteria pollutants.[15]

Skyline Landfill's GHG emissions are not "subject to regulation" or a "regulated NSR pollutant." A facility's GHG emissions are considered to be a "regulated NSR pollutant" only when the GHGs are "subject to regulation" for the facility.[16] At an existing stationary source, such as Skyline Landfill, GHGs may be "subject to regulation" for NSR program purposes only when the facility proposes to undertake a physical change or change in the method of operation.[17] At the time an existing facility proposes a physical change or a change in the method of operation, the facility's GHG emissions will be subject to evaluation to determine whether the GHGs would be "subject to regulation".

When a physical change or change in the method of operation at an existing stationary source that does not otherwise trigger NSR is proposed, which is the Skyline Landfill's current situation, the GHGs are "subject to regulation" if the following criteria are met:

1. The physical change or the change in the method of operation would result in an increase and a net increase of at least 75,000 TPY of carbon dioxide equivalent ("CO_2e") emissions (sum of all GHG emissions, taking into account the Global Warming Potential ("GWP") of each pollutant). Because this is an existing major stationary source, fugitive emissions are included as part of this emissions calculation; and

2. The current facility emits or has the potential to emit at least 100,000 TPY CO_2e or the project itself has the potential to emit at least 100,000 TPY CO_2e, both including fugitives.[18]

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[12] See 40 CFR 52.21(b)(1)(i)(b).
[13] See 40 CFR 52.21(b)(50) for definition of "regulated NSR pollutant".
[14] See 40 CFR 52.21(b)(23)(i).
[15] See the TCEQ MSW Landfill Standard Permit Application for the Skyline Landfill Expansion Project for a detailed discussion of non-GHG air pollutant increases.
[16] See 40 CFR 52.21 (b) (49).
[17] See 40 CFR 52.21(b)(49)(v)(b) i.e., "At an existing stationary source…when such stationary source undertakes a physical change or change in the method of operation...".; see also 75 Fed. Reg. 31514 (June 3, 2010).
[18] See 40 CFR 52.21 (b)(49)(v), (b)(1)(c).

Based on the worst case calculations, assuming the most conservative values, the Skyline Landfill Expansion Project will result in an increase in CO_2e of 117,091 TPY[19] (all of which will be fugitive emissions) and a net emissions increase in CO_2e of 117,091 TPY (all of which will be fugitive emissions), which are each greater than the 75,000 TPY CO_2e threshold. In addition, Skyline Landfill currently has a PTE of 354,783 TPY[20] of CO_2e (including fugitive emissions), which is greater than the 100,000 TPY CO_2e threshold. Because both of these criteria are met, Skyline Landfill's GHGs are "subject to regulation" and GHGs are therefore a "regulated NSR pollutant."

Because GHGs are a regulated NSR pollutant, the next step in the analysis is whether the Skyline Landfill Expansion Project would result in an increase and a net emissions increase in mass GHGs (total of all GHGs without regard to GWP) greater than the significance threshold for GHGs, which is zero TPY (including fugitives). The Skyline Landfill Expansion Project would result in an increase of 17,982 TPY[21] in mass GHGs and a net increase of 17,982 TPY in mass GHGs. Because these increases are both above zero TPY, the Skyline Landfill Expansion Project triggers NSR for GHGs.

Therefore, the Skyline Landfill Expansion Project potentially would be subject to NSR for only GHG emissions, so a major source air permit to construct in the form of an EPA-VI PSD air construction permit is the appropriate form of air emission approval for GHG emissions. The purpose of this Application is to secure such a permit, if required.

While fugitive emissions typically are included in a PSD applicability analysis following a source becoming subject to the PSD program, because all of the GHG emissions for which authorization is requested in this Application are fugitive emissions there is a potentially applicable exemption embedded in the PSD rule at 40 CFR 52.21(i)(vii). This exemption from PSD applicability states that a source or modification that is made a PSD major source or modification "only if fugitive emissions, to the extent quantifiable, are considered in calculating the potential to emit of the stationary source or modification and the source does not belong to any of the following categories: [following by list of 27 categories of source types]." Of the listed 27 categories of source types, 26 are specifically named source types, and MSW landfills is not one of them. The 27th source category is: "(aa) Any other stationary source category which, as of August 7, 1980, is being regulated under section 111 or 112 of the [Clean Air] Act." MSW landfills are now regulated under section 111(d) of the CAA through the NSPS, Subpart WWW, for MSW landfills. However, Subpart WWW of the NSPS was not proposed until May 30, 1991 and was not finalized into law until March 12, 1996, well after August 7, 1980. Therefore, MSW landfills were not regulated under

[19] Includes 13,852 tpy CO_2e biogenic fugitive emissions and 103,240 tpy CO_2e anthropogenic fugitive methane emissions.
[20] Includes 41,969 tpy CO_2e biogenic fugitive carbon dioxide emissions and 312,814 tpy CO_2e anthropogenic methane emissions. In addition the site currently has the PTE 542,442 tpy CO_2e biogenic point source carbon dioxide emissions from LFG control (combustion) activities. These emissions were not included in pre-project actuals for PSD applicability determination because the post-project PTE for Skyline Landfill Expansion Project LFG control emissions are not addressed in the Skyline Landfill Expansion Project because the method of control has not yet been defined and will not be defined until years in the future.
[21] Includes 13,852 tpy biogenic fugitive carbon dioxide emissions and 4,130 tpy anthropogenic fugitive methane emissions.

section 111 or 112 of the CAA as of August 7, 1980, and they are not a listed source that is not eligible for the PSD exemption found at 40 CFR 52.21(i)(vii). As such, the Skyline Landfill, which is an MSW landfill, should be eligible for the exemption from PSD applicability found at 40 CFR 52.21(i)(vii) for modifications that are PSD major only because of the inclusion of their fugitive emissions. And, because the Skyline Landfill Expansion Project is PSD major only because of the inclusion of its fugitive GHG emissions, the Skyline Landfill Expansion Project should be exempt from PSD applicability.

The clarity with which this exemption applies to the Skyline Landfill Expansion Project should provide an incontrovertible basis for WMTX to self-determine the Skyline Landfill Expansion Project exempt from PSD and not in need of a PSD permit for its GHG emissions. However, research conducted on behalf of WMTX indicates no prior precedent for the application of the exemption from PSD applicability found at 40 CFR 52.21(i)(vii). Also, because the PSD program is potentially applicable to the Skyline Landfill Expansion Project only because of fugitive emissions of GHG, the provisions of the GHG PSD permitting regulations are applicable to the Project, and the GHG PSD permitting regulations diverge from the remainder of PSD rules on many points. While research conducted on behalf of WMTX has not revealed any influences of the GHG PSD permitting regulations that would interfere with the application of the exemption from PSD applicability found at 40 CFR 52.21(i)(vii), this research has not yet been subjected to EPA review and confirmation.

Therefore, with the submittal of this Application, WMTX respectfully requests that EPA-VI, on its behalf and on behalf of EPA, confirm that the exemption from PSD applicability found at 40 CFR 52.21(i)(vii) applies to the Skyline Landfill Expansion Project, and that this Application is moot and may be withdrawn by WMTX without need of further action because the Skyline Landfill Expansion Project is not a PSD major source of GHG emissions. In the alternative, WMTX respectfully requests that EPA-VI, on its behalf and on behalf of EPA, deny that the exemption from PSD applicability found at 40 CFR 52.21(i)(vii) applies to the Skyline Landfill Exemption Project and continue the processing of this Application in due course, citing in its comments to this Application the legal justification of its denial of the applicability of the exemption from PSD applicability found at 40 CFR 52.21(i)(vii) to the Skyline Landfill Expansion Project.

As described in greater detail below by topic, WMTX believes it is obligated by applicable regulations and related EPA-VI policy practices to: 1) include biogenic emissions of GHGs from the Skyline Landfill Expansion Project in the calculation of its PTE; 2) calculate the Skyline Landfill Expansion Project's GHG PTE on a "life of site" basis; and 3) base this calculation on conservative default values established by EPA's AP-42 standards for MSW landfills and EPA's LandGEM LFG emissions model. Although the application of these regulations and policies result in an absurdly high GHG PTE that cannot be attained (or, therefore, verified) until 2044 or later, depending again on the accuracy of the current model, no other fully defensible options are available. As such, WMTX is submitting this Application to obtain a major source PSD permit, even though it is potentially exempt from PSD applicability pursuant to 40 CFR 52.21(i)(vii) and is based on a GHG PTE that is a modeled estimate based on debatable model methods and default values that, if it occurs at all, will not occur for 31 years, and part of which may be subject to a later deferral by EPA rulemaking.

7.1.1 Inclusion of Biogenic Emissions in PTE Calculation

The carbon dioxide ("CO_2") component of LFG is classified as "biogenic" because it results from the decay of discarded organic matter regardless of human intervention in the management of the discarded organic matter. The methane ("CH_4") component of LFG is classified as "anthropogenic" because it results primarily from the anaerobic decay conditions created by human intervention in the management of the discarded organic material by placing it in engineered landfill cells. The "biogenic deferral" provisions of the GHG PSD permitting regulations were adopted by EPA on July 20, 2011[22], well after the publication of the GHG PSD permitting regulations. The biogenic deferral allows for the deferral of biogenic CO_2 emissions from inclusion in PTE for NSR/PSD applicability determinations in jurisdictions subject to Federal law with no state limitations on Federal jurisdiction and in states opting into the "biogenic deferral" for a period of three years. During this three-year period, EPA committed to assembling a Science Advisory Board ("SAB") to study the topic of biogenic GHG emissions and their appropriate role in a GHG regulatory system and then to using the SAB's work product and guidance to permanently refine the scope of the GHG PSD permitting regulation's applicability to biogenic emissions. Should EPA not take such action, the biogenic deferral would expire at the end of its three-year term.

The "biogenic deferral" in the GHG PSD permitting regulations was vacated by the U.S. Court of Appeals for the District of Columbia Circuit on July 12, 2013, nearly one year before it was due to expire. However, on November 14, 2013, the U.S. Court of Appeals granted a request from the biomass industry to delay the vacatur at least until the U.S. Supreme Court rules on an upcoming challenge to EPA's regulation of GHGs. On October 15, 2013, the U.S. Supreme Court granted certiorari for six of nine petitions challenging EPA's regulation of GHGs. Briefs for the petitioners are due by December 9, 2013, briefs for EPA are due by January 21, 2014 and oral arguments before the Court are scheduled for February 24, 2014. This schedule ensures that U.S. Court of Appeals for the District of Columbia will not mandate the enactment of the vacatur before spring of 2014, which is close in time to its expiry in summer of 2014. I In the meantime, the biogenic deferral is still in effect as federal law. Therefore, technically, under the operation of the biogenic deferral, only the CH_4 fraction of fugitively emitted LFG, which is anthropogenic, must be included in the PSD applicability analysis for the Skyline Landfill Expansion Project.

[22] See 76 Fed. Reg. 139, p. 43,490 (July 20, 2011).

WMTX is aware that, during the period of EPA-VI review of this Application, EPA may establish by rulemaking within the GHG PSD permitting regulations a biogenic GHG deferral for biogenic CO_2 originating from LFG from inclusion in NSR/PSD applicability determinations. However, WMTX is also aware that this may not occur, and the biogenic deferral will either be vacated or will expire. To avoid potential confusion and delay associated with the changing status of biogenic deferral during the review of this Application in the coming months, WMTX has elected to go forward with this GHG PSD major source air permit application featuring a PTE including fugitive biogenic emissions of CO_2 from the Skyline Landfill Expansion Project in the interest of obtaining authorization to construct the Skyline Landfill Expansion Project in a timely manner. As such, WMTX reserves the right to amend this Application and/or modify any resulting permit to reflect the benefit of a deferral for biogenic CO_2 originating from LFG from inclusion in NSR/PSD applicability determinations should one be enacted by EPA in the future.

7.1.2 Calculation of PTE on "Life of Site" Basis

MSW landfills do not follow a traditional industrial source life cycle which begins with construction, continues with operations and ends with closure. MSW landfills are under construction throughout their operating life. After an area is permitted for filling with MSW, discrete areas or "cells" are prepared for waste receipt and filled or partially filled with MSW and cover material. When all available cells are constructed, construction finally stops, and available cells are filled to capacity. Then the landfill must stop receiving waste and engage in the construction activities associated with the installation of an impermeable cap, as defined by individual state solid waste management rules, over the entire landfill to "close" the landfill. However, after "closure", LFG will continue to be generated and must be managed for approximately 15 to 30 years[23], requiring operations support for the active LFG collection and control system ("GCCS"), in addition to care of the landfill cap, a phase known as "post-closure." During post-closure, LFG generation will gradually decline. During this decline, the GCCS will require periodic modification, such as reduction in the number of active LFG collection wells, to maintain optimum operating conditions, i.e., to ensure sufficient LFG is collected to prevent excess surface (fugitive) emissions, but also to ensure LFG collection is not so aggressive that oxygen is drawn into the waste matrix, which can create a risk of sub-surface fire, result in low-methane LFG that cannot be utilized as a fuel and potentially result in damage to the colony of methanogenic bacteria that accomplish MSW decay. Only when LFG ceases to be generated in safely collectable and combustible amounts can a landfill be said to be past all construction and operations stages and literally at the end of its life.

During this very lengthy construction and operations phase, but for deciding when to start construction, start receiving MSW, and stop receiving MSW, the landfill operator cannot control the timing of any of

23 NSPS Subpart WWW requires a minimum of 15 years of continuing GCCS and cap maintenance and provides operational standards for both activities. After 15 years, the GCCS may be removed if the NMOC generation capacity of the landfill has dropped below 50 megagrams ("Mg") per year. GCCS removal requires prior agency approval. It is not unusual for larger landfills like the Skyline Landfill to continue to generate sufficient LFG to require GCCS operation for as long as another 15 years.

these activities. The landfill owner/operator is driven by regulatory requirements, by the demands of its clients delivering MSW and by the processes of nature (e.g., temperature and precipitation) acting on the landfill.

In regard to an MSW landfill's life cycle for generating GHG emissions, the following steps will occur:

3. Emissions of fugitive CO_2, CH_4 and NMOCs (which includes VOC and hazardous air pollutant ("HAP") fractions), i.e., LFG, begin within months of first waste receipt, continue through the active life of the landfill, and after landfill closure. Even after an active LFG collection system is installed and operated, there will be some fugitive emissions because these systems are not 100% efficient. In fact, section 2.4 of AP-42 only typically gives credit for 75% collection efficiency for LFG collection systems.
4. An active GCCS will be installed when a cell produces LFG in volumes sufficient to necessitate LFG collection to avoid odor nuisance, and/or within two years if the cell is closed to final grade or within five years after waste is first placed in the cell, whichever comes first, pursuant to the requirements of 40 CFR 60, Subpart WWW. LFG control activities may or may not result in GHG emissions from combustion of LFG on site, depending upon the technology selected for LFG control at the time. Should combustion be accomplished on-site, biogenic GHG emissions, i.e. CO_2 from combustion of collected LFG CH_4, will be emitted, along with the CO_2 component of collected LFG that will pass through the combustion device. However, combustion may be accomplished off-site by a third party, or the LFG may be processed by WMTX or a third party at an on- or off-site location to create a marketable alternative fuel product. Note that:
   a. Premature installation and operation of an active GCCS (i.e., before sufficient LFG volume and CH_4 concentrations will support collection and combustion) creates a risk of subsurface fire due to oxygen being drawn into the waste matrix by the collection system vacuum, which pulls air into the waste matrix when there is insufficient LFG volume and/or CH_4 to respond to the vacuum.
   b. Emissions resulting from LFG collection, processing, and/or combustion will continue until that point in time after landfill closure at which LFG generation drops in volume and the CH_4 concentration decreases to the point at which it is so low that the GCCS can no longer be effectively operated, i.e., to the point that operation of the GCCS would result in subsurface fire risk and/or produce a LFG product so low in methane it cannot support combustion, at which time the active GCCS is decommissioned.
5. Peak emissions (i.e., maximum PTE) of both fugitive and point source air pollutant emissions associated with the generation, collection, and control of LFG is typically predicted to occur in the year after the last year in which a landfill receives MSW for disposal. This point represents the apex of the LFG generation curve that continues to increase as the landfill receives more and more waste, but then begins to decrease when it stops receiving waste. This point is difficult to predict because future business, community waste generation and management patterns, landfill management technology, and climactic influences are unknown and become more difficult to predict with the passage of time.
6. Typically, a closed MSW landfill will generate a sufficient LFG volume and CH_4 concentration to support an active LFG GCCS for approximately 15 to 30 years. When LFG generation has dropped in volume and the CH_4 concentration decreases to the point that active LFG collection and control is no longer feasible, the active GCCS system may be decommissioned, after receiving necessary environmental agency approval to do so.

The long, multi-phased life cycle of landfills, with corresponding air pollutant emission profiles for each phase, and the fact that landfill air pollutant emissions are not produced by controllable processes or by a controllable material content or volume (i.e., as is the case for other industries), presents a challenge in air pollutant emission permitting for landfills.

A landfill's emissions are the result of biological processes, with natural degradation of waste organic materials via anaerobic microbes that use the waste essentially as food and release gas as part of the biological process. The organic degradation itself is highly influenced by climactic factors such as temperature and precipitation. Therefore, the amount, degradable organic content, and rate of decay of organic content of the waste received by the landfill are all outside of the control of the landfill owner/operator. In addition, the volume and content of MSW received is dictated by the waste disposers, i.e., the community at large, not the landfill owner/operator. These factors make accurate estimation of current LFG generation and fugitive emissions difficult, and make accurate projection of far future LFG generation and fugitive emissions even more difficult, with difficulty and error range increasing with the passage of time.

To further complicate landfill emissions estimation, the PTE emissions pattern associated with landfill expansion is unique. Specifically, an MSW landfill's air pollutant emissions behave more like those of an agricultural source than those of an industrial source. A typical industrial source can achieve its PTE rates immediately upon start-up. The only requirement to generate maximum emissions is completion of construction and a supply of sufficient feedstock/fuel to achieve PTE conditions, which is typically easily available to the source owner, at a cost. An MSW landfill, however, cannot achieve PTE conditions upon start-up because its construction process is continuous, achieved via annual additions of waste materials in variable volumes and with variable degradable organic content as controlled by the waste generators and natural weather conditions, not the landfill.

Given the variability of MSW landfill LFG generation patterns over its very long life and given the inability to impose human control over so many aspects of LFG generation, and given that LFG generation is the sole driver of MSW landfill GHG emissions, at this time, WMTX cannot justify establishing PTE on any basis other than the entire "life of site." Any other basis would require guarantees of human behavior, weather conditions and economic conditions that are not possible to meet within the realm of human control technology.

7.1.3 Calculation of PTE Using LandGEM and EPA/AP-42 Default Values

An element of conservatism is added to this "life of site" time assumption by the use of the EPA LandGEM mathematical model to estimate future LFG generation. This model, which was devised in the 1990s using 1990s landfill management technology and waste disposal assumptions for the purpose of designing and sizing LFG collection systems, not for emission inventory use, significantly overestimates

LFG generation, particularly over long periods of time. The factors contributing to LandGEM's tendency to overestimate LFG generation are: 1) an assumption that waste receipts will increase each year in the future, even though landfill receipts are now dropping due to recycling, waste reduction and alternative use options; and 2) an assumption that the degradable organic content of MSW has been constant since the 1990s, even though organic content is now dropping due to increased composting and other forms of organic material landfill diversion.

In addition to the impact of the use of the LandGEM model in overestimation of LFG generation, two additional factors contribute to overestimation of the CH_4 fraction predicted to be emitted in the future as fugitive emissions. First, EPA assumes that only 10 percent (of the fugitive 25%) of the CH_4 passing through the landfill surface is oxidized before release, when recent research, as acknowledged by EPA itself in revisions recently proposed to its Mandatory GHG Reporting Rule[24] which, if approved, will allow for a CH_4 oxidation factor of up to 35 percent. Second, EPA imposes by means of reference to internal memoranda, the Seitz memo published in 1994 and the Leatherwood memo published in 2002 respectively[25], an assumption that only 75 percent of LFG generated in the future will be collectable, even though the AP-42 accepted range is 60 to 85 percent and many landfills can demonstrate LFG collection efficiencies as high as 98 percent. Skyline Landfill itself, in its 2012 GHG Mandatory Reporting Rule report, demonstrated a collection efficiency of 83 percent.

The Skyline Landfill Expansion Project would not trigger PSD applicability for GHG emissions if a LFG collection efficiency of 83% or more were applied, regardless of the other variables applied. If a LFG collection efficiency of 75% is applied, all but one other potential mix of variables results in major source PSD applicability. However, applying all potential combinations of collection efficiency, surface oxidation percentage and inclusion/exclusion of biogenic emissions, the difference between the highest possible emissions scenario, that was conservatively used as the basis for this permit application, and the lowest possible scenario is 64,253.45 TPY, which itself is almost the PSD threshold. And, of the eight potential combinations, five result in major source status for GHG emissions and three result in minor source status. This degree of variability in the emissions estimates used to determine major source status for NSR permitting is a source of difficulty for that analysis, but it is the case for GHG emissions from MSW landfills. See Table 1 below for all of the possible PTE scenarios that could have been applied to the Skyline Landfill Expansion Project.

[24] See 78 Fed. Reg. 63, pp. 19802, et.seq., May 17, 2013.
[25] EPA Memorandum from John S. Seitz, Director, Office of Air Quality Planning and Standards, dated October 21, 1994, re: Classification of Emissions from Landfills for NSR Applicability Purposes, and Memorandum to Brian Guzzone, EPA, from Chad 1 Leatherwood, Eastern Research Group, Inc., dated November 18, 2002, re: Review of Available Data and Industry Contacts Regarding Landfill Gas Collection Efficiency (Leatherwood Memo).

Table 1:
Possible Variations for Peak Fugitive GHG Emissions from Skyline Landfill After Expansion

Percent Methane Oxidized in Cover	Percent Collection Efficiency for LFG	Total TPY GHG without Biogenic Emissions	Major PSD Source? 75,000	Total TPY GHG without Biogenic Emissions	Major PSD Source? 75,000
10	75	103,281.58	yes	117,138.60	yes
25	75	86,067.98	yes	101,818.50	yes
10	83	63,462.18	no	71,976.73	no
25	83	52,885.15	no	65,563.17	yes

Difference (TPY) between highest and lowest variation:	**64,253.45**
Number of variations combinations:	**8**
Variation combinations resulting in GHG major source status:	**5**
Variation combinations resulting in GHG minor source status:	**3**

7.2 Title V Applicability

Skyline Landfill is currently subject to the Title V federal operating permit program and holds a Title V Operating Permit in the form of a TCEQ General Operating Permit. Title V program applicability was triggered by Skyline Landfill for two reasons: 1) the Skyline Landfill has the potential to emit more than 100 TPY of at least one criteria air pollutant and 2) it is subject to NSPS Subpart WWW.

TCEQ has not yet incorporated GHGs into its Title V federal operating permit program[26]. But, EPA-VI does not have in place a mechanism or regulations allowing it to issue a Title V federal operating permit, including a Title V federal operating permit for GHG emissions only although it is currently the sole entity issuing GHG permits in Texas. Typically, WMTX would amend the existing Title V federal operating permit held by Skyline Landfill simultaneously with its submittal of an application for an NSR permit to construct a new project. However, in this case, the Skyline Landfill holds a Title V federal operating permit in the form of a TCEQ General Operating Permit ("GOP"). The GOP already covers the fugitive emissions associated with the Skyline Landfill Expansion Project authorized by the recently approved Standard Permit for MSW Landfills. The GOP does not, however, cover the fugitive GHG emissions associated with the Skyline Landfill Expansion Project. In light of the fact that neither EPA-VI nor TCEQ now has authority to issue a Title V federal operating permit, TCEQ is actively pursuing that authority, and the possibility that the Skyline Expansion Project fugitive GHG emissions are exempt from PSD permitting as described in Section 7.1 of this Application, WMTX at this time plans to wait to amend its Title V federal operating permit application to account for the Skyline Landfill Expansion Project until a

[26] See Section 1 Introduction and Executive Summary of this Application for a description of the current status of GHG permitting authority in Texas.

determination on this Application is made by EPA-VI. At that time, WMTX will consult with TCEQ as to the proper form for such an application, if such an application is necessary.

For purposes of literal applicability, the GHG emissions increase in PTE in CO_2e associated with the Skyline Landfill Expansion Project is greater than 100,000 TPY, and the mass GHG emissions increase is greater than 100 TPY. Therefore, these GHG emissions are "subject to regulation" for purposes of Title V major source applicability under the GHG PSD permitting regulations. See Section 7.1 PSD and Tailoring Rule Applicability for a full analysis of the Skyline Landfill Expansion Project's GHG emissions in light of the GHG PSD permitting regulations.

7.3 EPA GHG Mandatory Reporting Rule

The EPA Mandatory Reporting Rule, found at 40 CFR 98, was enacted under Chapter 114 of the CAA of 1990, which gives the EPA Administrator broad discretion to require that information associated with air emissions be collected and reported, but has no connection to the chapters of the CAA that manage and limit air emissions. As such, the EPA Mandatory Reporting Rule is so remote from other CAA compliance activities that the requirement to file the reports is not even included in Title V federal operating permits. Nevertheless, there is a connection between the EPA GHG Mandatory Reporting Rule and air permit applications filed under the GHG PSD permitting regulations: it is one of the few available EPA-sanctioned sources of emission factors, emission calculations and emission default values for GHG emission estimation activities. In the case of this Application, WMTX has conservatively based the GWP used to convert CH_4 to CO_2e for the GHG calculations used in this Application, i.e., 25, on that finalized for use in the GHG Mandatory Reporting Rule as of January 1, 2014.[27] In addition, WMTX has conservatively used the current EPA Mandatory Reporting Rule default value for MSW landfill cover oxidation of CH_4, i.e., 10%, for the GHG calculations used in the Application because, while higher values have been proposed, the method for applying them to MSW landfill fugitive emissions calculations requires a value, landfill surface area with waste, that cannot be predicted for a point in the future of an MSW landfill's life.

7.4 New Source Performance Standards and MACT for MSW Landfills

7.4.1 40 CFR 60, Subpart WWW

Provisions of the CCA, §111 (concerning Standards of Performance for New Stationary Sources) as listed under 40 Code of Federal Regulations (CFR) Part 60, promulgated by EPA, including Subpart WWW, are applicable to Skyline Landfill and will be applicable to the Skyline Landfill Expansion Project.

[27] See 78 Fed. Reg. 63, p. 19802, April 2, 2013, and pre-release of the respective final rule signed by Gina McCarthy on November 15, 2013, but not yet published in the Federal Register.

Landfills that commenced construction, modification, reconstruction on or after May 30, 1991 and have a total design capacity of greater than 2.5 million Mg and 2.5 million cubic meters (“m^3”) of MSW are subject to the NSPS for MSW landfills in 40 CFR 60, Subpart WWW.

The NSPS outlines criteria for determining landfill control requirements and compliance schedules. The timeline of GCCS installation is determined by calculating the NMOC emission rate for a landfill. If the calculated NMOC emission rate is greater than 50 Mg per year, the landfill is required to install a GCCS to reduce NMOC emissions. If the calculated NMOC is less than 50 Mg per year, then the landfill is only required to report the NMOC emission rate periodically until the recalculated NMOC emission rate is equal to or greater than 50 Mg per year.

The NSPS also includes the procedures for performing NMOC emission calculations for landfills. This procedure is a tiered approach with Tier 1 being simplest. Tier 1 calculations use default values of the NMOC concentration and CH_4 generation rate that are constant. Tier 2 calculations are based on a site-specific NMOC concentration, and Tier 3 calculations are based on site-specific NMOC concentration and CH_4 generation rate constant, which require field measurements. Once a landfill is required to install a GCCS based on a calculated NMOC emission rate value, a series of monitoring, recordkeeping, and reporting requirements outlined in the NSPS rule become applicable.

Skyline Landfill has been modified since May 30, 1991 and has a current design capacity of more than 2.5 million Mg. Therefore, the Skyline Landfill is subject to provisions of the NSPS for MSW landfills described in 40 CFR 60, Subpart WWW. Skyline Landfill has installed and is operating a GCCS in accordance with 40 CFR 60.752(b)(2)(ii)(A) which provides that the existing or proposed GCCS must operate and collect LFG from each area or cells in a landfill where the initial solid waste has been placed for more than five years if active or more than two years if closed or at final grade. Therefore, the proposed expansion of Skyline Landfill will not become subject to NSPS GCCS requirements until the initial solid waste in the expansion area has been in place for five years, or two years if the area is at final grade.

WMTX has determined that compliance with the GCCS operation, monitoring, recordkeeping, and reporting requirements for active LFG GCCS outlined in the NSPS rule constitutes BACT for control of fugitive GHGs from MSW landfills. A detailed discussion of these provisions and their application is provided in this Application in Section 9, BACT Analysis.

7.4.2 40 CFR 63, Subpart AAAA

The National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills in 40 CFR Part 63, Subpart AAAA are applicable to Skyline Landfill and to the Skyline Landfill Expansion Project.

In accordance with 40 CFR Part 63, Subpart AAAA, a written startup, shutdown, and malfunction ("SSM") plan that describes the procedures for operating and maintaining a GCCS during periods of SSM is required for MSW landfills that are subject to NSPS and have installed a GCCS. A related semiannual compliance report must be submitted to the Texas Commission on Environmental Quality's Office of Compliance and Enforcement, in accordance with 40 CFR §63.1980.

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8.0 EMISSION RATE CALCULATIONS

Sources of air emissions associated with the Skyline Landfill Expansion Project originally will consist of landfill cell construction activities, which produce fugitive dust emissions from surface soil disturbance, and waste placement in the newly constructed landfill cells, which produce fugitive dust from truck transportation of waste to the cells.

Following is a timeline of landfill air emissions production, by type of emission:

- Emissions of fugitive dust begins with cell construction, before first waste receipt, and continue until waste is no longer received into the landfill, and dirt moving activity associated with landfill closure is complete.
- Emissions of fugitive GHGs, and NMOCs, which include a VOC fraction and a HAP fraction from LFG that is not collected and controlled begin within weeks of first waste receipt and continue through the active life of the landfill and up to approximately 15 to 30 years after landfill closure.
- Emissions of criteria pollutants from collection and control, i.e., combustion, of LFG (NO_x, CO, VOC, SO_2, PM_{10}, and $PM_{2.5}$) will not occur until the landfill installs an active GCCS. Typically, installation occurs when triggered by applicable regulation or to respond to emerging odor issues, whichever comes first. If a control option that involves LFG processing to produce an alternative fuel is used, additional pollutants may be associated with the processing phase as well.

Pursuant to this unusual “schedule” of emissions, WMTX proposes to include specific emissions data in this air permit application for only those sources of air emissions which have the potential to be emitted within the reasonable time range of the air permit being sought, expected to be the next five to ten years, or more, depending on the amount of landfill gas actually generated. This limits the air emissions subject to permitting to fugitive particulates from landfill construction, operation and on-site transportation, and fugitive NMOCs (including the VOC and HAP fraction) and GHGs associated with LFG from waste decomposition occurring prior to installation of LFG collection and control equipment. This time assumption is based on the fact that Skyline Landfill currently has permitted and constructed more than sufficient LFG collection and combustion capacity to serve the PTE of the expanded landfill for the next five to ten years, or more, because the LFG to energy project with excess capacity was added after a large flare was already in place.

Information provided above and in Section 10.3 of this Application addressing additional impacts regarding non-GHG emissions associated with MSW landfills in general and the Skyline Landfill Expansion Project, specifically, is for information only. Detailed emission calculations are provided in this Application for GHG emissions only, pursuant to EPA-VI’s permitting authority for GHG emissions only.

GHG emission calculations[28] assume a very conservative "worst case" PTE value for the life of the landfill. Note that for fugitive emissions as predicted by the EPA LandGEM mathematical model with AP-42 recommended default values[29], this PTE, if ever achieved, will not be achieved until 2044, the currently model-predicted last year of MSW receipt.

8.1 GHG Emission Calculations

For purposes of the GHG emission calculations presented in this section of the Application, LFG are fugitive emissions assumed to consist of 50 percent CO_2 and 50 percent CH_4. This distribution is cited in the AP-42 Standards for MSW Landfills, the NSPS for MSW Landfills (Subpart WWW) and the EPA GHG Mandatory Reporting Rule. Because composition may be demonstrated by sampling and analysis, it is not necessary to rely on a default value for emissions inventory purposes. But, for future PTE purposes, it is necessary to apply a default value, because the exact composition of future LFG cannot be predicted.

The increase in PTE of fugitive landfill GHG emissions associated with the Skyline Landfill Expansion Project represents the portion of LFG that is generated by the expansion area, but not captured by an active LFG GCCS, and are therefore emitted through the landfill cover material as fugitives. For purposes of the GHG emission calculations presented in this section, LFG collection efficiency is assumed to be 75 percent (based on Section 2.5 of AP-42), leaving remaining 25 percent of the LFG as fugitive emissions even though the most recent site specific information indicates that only 17 percent of the LFG is emitted as fugitive emissions at the Skyline Landfill.

Use of a default value of 75 percent for LFG collection efficiency has a long and controversial history, beginning with the "Seitz Memo"[30] which first established the concept that it is not reasonable to assume that all generated LFG is fugitive. Based on the definition of fugitive emissions as "those emissions which could not reasonably pass through a stack…"[31], the memo determined that the common use of LFG collection systems by MSW landfills creates a presumption that LFG collection is reasonable, so a portion of LFG generation is collected and will pass through a stack and will not be fugitive. What this memo did not address is the proportion of LFG generation that may be reasonably collected.

Establishing this proportion is controversial because it is not possible to measure, and is only arguably possible to estimate, the amount and composition of LFG generated by a landfill, or emitted fugitively by a landfill in a given time. It is possible to accurately measure only the amount and composition of the LFG that is collected. With two variables remaining, both subject to many different natural forces and therefore

[28] See Section 7.1 PSD and "Tailoring Rule" Applicability for a full discussion of GHG and non-GHG permitting authority in the State of Texas.
[29] See Section 1.0 Introduction above for a full discussion of the impacts of using the LandGEM and AP-42 default values to model future LFG generation and fugitive methane emissions.
[30] Memorandum from John S. Seitz, Director, OAQPS to EPA Regional Air Directors, "Classification of Emissions from Landfills for NSR Applicability Purposes," October 21, 1994.
[31] Ibid.

difficult to model, neither can be solved to full resolution. Based upon studies and observations conducted to date, the default LFG collection efficiency of 75 percent was first suggested in the "Leatherwood Memo" in 2002[32], and has survived to this day, primarily because it has not conclusively been proven wrong and no alternative has conclusively been proven right. This collection efficiency has been institutionalized by its adoption into the AP-42, Section 2.4, Standards for MSW Landfills (1997) and subsequent inclusion in the EPA GHG Mandatory Reporting Rule as an overall default value[33] and as the value to be applied for areas with LFG collection and an application of intermediate cover for those landfills maintaining more precise LFG collection system and cover operational data.[34]

A collection efficiency of 75 percent is being used in this Application because of its preponderance of legal support, not because it is known to be specifically applicable to Skyline Landfill. In fact, the results of EPA GHG Mandatory Reporting Rule data collected and submitted to the EPA in past years for Skyline Landfill indicate a range of collection efficiencies between the AP-42 specified ranges of 60 to 85 percent. Nevertheless, to serve as the basis thisa major source PSD air permit Application, the conservative, well documented value is being used.

This Application's fugitive GHG emission calculations also use the EPA assumption that 10 percent of the uncontrolled CH_4 is oxidized into CO_2 by microbial activity in the landfill cover material before being released as fugitive emissions. The concept of CH_4 oxidation in landfill cover was primarily an academic concern until the emergence of voluntary and mandatory GHG emissions reporting. When the conservative estimate of a 10 percent oxidation factor was established in the initial EPA GHG Mandatory Reporting Rule in 2009, the academic community was already publishing research indicating that this was unrealistically conservative. Since 2009, significant research on the topic has been conducted and published, virtually all debunking a default value as low as 10 percent. While some studies have indicated very high percentage of oxidation, most arrive at a defensible range of 35 percent to 42 percent.[35] In fact, currently proposed revisions to the EPA GHG Mandatory Reporting Rule allow for the use of a range of cover oxidation capacities from 10 to 35 percent if certain operating condition standards are met. However, the calculations necessary to demonstrate ability to use a higher-than-10-percent cover oxidation factor are applicable only to static operating scenarios for annual GHG inventory purposes, not to future changeable operating scenarios for PTE determination purposes when parameters such as the area of the landfill covered by waste cannot be predicted. As such, a cover CH_4

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[32] Memorandum from Chad Leatherwood of Eastern Research Group, Inc., to Brian Guzzone of U.S. EPA, "Review of Available Data and Gas Collection Efficiency", November 8, 2002.

[33] See 40 CFR 98.343(c)(3)(ii).

[34] See 40 CFR 98, Table HH-3 (proposed).

[35] See Methane Oxidation in Landfill Cover Soils, is a 10% Default Value Reasonable?, Jeffery Chanton, David Powelson and Roger Green, Journal of Environmental Quality, vol. 38, 2009, and Landfill Methane Oxidation Across Climate Types in the U.S., Jeffery Chanton, Tarek Abichou, Claire Langford, Gary Hater, Roger Green, Doug Goldsmith and Nathan Swan, Environmental Science and Technology Journal, November 14, 2010.

oxidation factor of 10 percent is being used in this Application because of its preponderance of legal support, not because it is known to be specifically applicable to Skyline Landfill.

For each of the assumptions made in the process of estimating future fugitive GHG emissions from the Skyline Landfill Expansion Project, the key variable is LFG generation. Default values must be devised to fill in for the absence of a definitive value because of the uncertainty surrounding the LFG generation pattern(s) that will emerge over time as Skyline Landfill progresses through its active life, closure and post-closure periods. LFG generation is variable because the factors contributing to it are not subject to the control of the landfill operator. Following is a list of the factors influencing the volume and composition of LFG generated by an MSW landfill[36]:

- **Volume of waste received and consistency of volumes over time**: Absent a very unusual MSW composition, more volume of waste will eventually result in more LFG. Landfill operators are subject to the terms of contracts that require them to accept the waste generated by a community or business without respect to volume. The landfill operator is not in control of the growth of communities or businesses or their disposal patterns over time. In general, MSW disposal per capita is dropping as a result of recycling and packaging control efforts. But, a severe storm (tornado, far reaching flood, hurricane, etc., requiring immediate and large-scale clean-up and disposal efforts can cause a spike in volume that influences a landfill for years to come.

- **Composition of waste received**: LFG is produced by bacteria consuming organic material in disposed waste. If waste is poor in organic content, less LFG will be generated; if waste is rich in organic content, more LFG will be generated. Factors influencing organic content vary. In general, MSW is dropping in organic content as a result of recycling and composting activities. But, a severe storm (tornado, far reaching flood, hurricane, etc.) requiring immediate and large-scale clean-up and disposal efforts can cause a spike in organic content because there is not sufficient time to sort out recyclables prior to disposal.

- **Moisture in waste matrix**: Water is necessary for the bacteria to thrive in the waste matrix. But, saturated conditions discourage bacterial growth. MSW landfills are open-air facilities, the moisture content of which are determined primarily by local weather. While moisture can be controlled somewhat in a lined landfill, the size and depth of the fill area can make moisture control problematic and costly. Flood and drought conditions generally will interfere with LFG production, even in the presence of ample organic material.

- **Ambient temperature**: Heat is necessary for bacteria to thrive in the waste matrix. So, cold conditions discourage bacterial growth and LFG generation. But, saturated conditions discourage bacterial growth. MSW landfills are open-air facilities, the temperatures of which are determined exclusively by local weather. Unlike moisture, there is no available technology to control landfill temperature.

These influences, most of which cannot be controlled to any extent by the landfill operator, are not fully taken into account in the mathematical model used to predict LFG generation. That model is the EPA-

[36] See State of Garbage in America, Rob van Haaren, Nickolas Themelis and Nora Goldstein, October 2010, for a discussion of MSW disposal and composition trends.

authored LandGEM model. More refined models that take into account more environmental and operational parameters, such as the SWICS[37] model, are available, but they are not fully endorsed by EPA. LandGEM was developed in the 1990s as a tool for sizing LFG collection systems, not as tool for GHG emissions estimation. As a result, it was designed to be conservative, i.e., to overestimate LFG generation, to ensure that costly LFG collection systems would not be undersized. There was no downside to overestimation at that time, because the results were not used for setting permit conditions or for reporting, as they are now.

LandGEM predicts future LFG generation based on first-order-of-decay calculations and data entered on past known waste receipts, estimates of future waste receipts, estimates of waste composition (which are targeted to high organic content) and assumptions of waste composition characteristics. AP-42 for MSW landfills recommends high (1990s era) default values for organic content that increase the conservatism of the model. Moreover, the influence of temperature and moisture, while accounted for, are not highly impactful. The result is a model that typically overestimates LFG generation when applied to the current year, and overestimates even more for each successive year, as time goes on. For a scenario like the Skyline Landfill Expansion Project, which is anticipated to accept waste until 2044, the accuracy of the LandGEM model in estimating future peak LFG generation, and the year in which it will occur, is highly questionable. Nevertheless, it has been used to provide a basis for emissions calculations for this Application, in the absence of an EPA-acceptable alternative.

For purposes of emissions estimation, total fugitive landfill GHG emissions are comprised of the following three components:

- 100 percent of the uncontrolled CO_2 emissions;
- 90 percent of the uncontrolled CH_4 emissions; and
- The CO_2 formed and released when the remaining 10 percent of the uncontrolled CH_4 emissions are oxidized in the landfill cover material.

This Application assumes a GWP of 25, as provided in the newly revised Table A-1 to Subpart A of 40 CFR Part 98 – GWPs proposed for consideration at Federal Register, Volume 78, Issue 63, on April 2, 2013 and signed in final form by Gina McCarthy on November 15, 2013, for effect on January 1, 2014.

These factors may be applied to any amount of LFG produced by a landfill at any point in its lifecycle with varying accuracy as noted in the preceding Section 3.0. In preparing this Application these factors have been applied to the “life of site” peak LFG generation by the Skyline expansion area to conservatively represent the lifetime PTE, as estimated using data generated by the EPA LandGEM model. The “life of site” peak LFG generation for the Skyline expansion of 3,305 standard cubic feet per minute (“scfm”) is

[37] Solid Waste Industry for Climate Solutions model, 2007, developed by SCS Engineers.

derived by subtracting the maximum LFG generation value from a LandGEM model run conducted for the full post-expansion Skyline Landfill size (year 2026) by the maximum LFG generation value from a LandGEM model run conducted for the pre-expansion landfill size (year 2044). This peak-to-peak comparison is more conservative than a year-to-year comparison due to the effects of adding years of waste receipt to the model. The pre- and post-landfill expansion LandGEM output data are provided in Table 2.

Based on the assumptions previously discussed, and using a maximum LFG generation rate of 3,305 scfm, fugitive GHG emissions from the Skyline Landfill Expansion Project are estimated to be 117,139 TPY of CO2e. Results of fugitive landfill GHG emission calculations based on each potentially applicable combination of variables are provided in Table 1 in Section 7.0 of this Application. Detailed fugitive landfill GHG emission calculations for the Skyline Landfill Expansion Project are provided in Table 2. The calculations in Table 2 illustrate the most conservative combination of variables, and the remaining combinations may be achieved by changing the key variables in the same formulae.

The results of the LandGEM models used to estimate the LFG generation volumes used in these calculations are provided in Appendix 1 of this Application. Both the pre-expansion project model and post-expansion project model results are provided. The LFG generation represented by the delta between these two values serves as the increase in LFG generation attributed directly and exclusively to the Skyline Landfill Expansion Project and the basis for the calculations in Table 2.

Table 2: Detailed GHG Emissions Calculations for Skyline Landfill Expansion Project

GHG Emission Calculations to Support GHG PSD Permit Application
For Skyline Landfill Expansion Project

Uncollected Methane Emissions

Amount of LFG Generated in Peak Year Post Project	13316 scfm		LFG Generated in Peak Year Pre Project	10011 scfm
Increase in LFG Generated in Peak Year Due to Project	3305 scfm		Concentration of CH_4 in LFG	50%
Increase in CH_4 Generated in Peak Year Due to Project	16525 scfm		Volume of CH_4 Generated Due to Project	868.554 mmscf
Amount of CH_4 collected during Peak Year Due to Project	651.48 mmscf		Global Warming Potential of CH_4	25
LFG System Collection Efficiency	75.00%			
Amount of Uncollected CH_4	217.1604 mmscf			
Amount of Uncollected CH_4	4,164.29 metric tons/year	4,590.29 US tons per year		
CH_4 Oxidation Factor	10.00%			
Uncollected CH_4 Emitted through cover	195.44436 mmscf			
Uncollected CH_4 Emitted through cover	3,747.86 metric tons/year	4,131.26 US tons per year		

Uncollected Carbon Dioxide Emissions

Amount of CO_2 Collected in Peak Year Due to Project	651.48 mmscf	
LFG System Collection Efficiency	75.00%	
Uncollected CO_2 Emitted through Cover	217.1604 mmscf	
Uncollected CO_2 Emitted through Cover	11,425.82 metric tons/year	12,594.69 US tons per year
CH_4 oxidized in cover	416.43 metric tons/year	459.03 US tons per year
CO_2 emitted through cover from oxidixed methane	1,145.18 metric tons/year	1,262.33 US tons per year

Methane Emissions

Uncollected Emissions of CH_4	3,747.86 metric ton/yr		4,131.26 US tons per year	
Total Uncollected Methane Emissions from Landfill in CO_2e	93,696.44	**Metric tons CO_2e/year**	103,281.58	**Short tons per year**

Carbon Dioxide Emissions

Uncollected CO_2 Emissions emitted through landfill cover	11,425.82 metric ton/yr		12,594.69 US tons per year	
CO_2 emitted through landfill cover from oxidized methane	1,145.18 metric ton/yr		1,262.33 US tons per year	
Total Uncollected Carbon Dioxide Emissions	12,571.00	**Metric tons CO_2/year**	13,857.02	**Short tons per year**
CO_2e from Methane and Carbon Dioxide for total fugitive GHG	**Total Fugitive in CO_2e**		117,138.60	**short tons per year**

9.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

The 1977 CAA Amendments established requirements for the approval of pre-construction permit applications under the PSD program. One of these requirements is that Best Available Control Technology ("BACT") be installed for applicable pollutants (i.e., those pollutants for which the project has a PTE rate above major source or significance thresholds, as applicable). The Skyline Landfill Expansion Project has a total GHG PTE rate (in CO_2e) in amounts exceeding the PSD significance threshold of 75,000 TPY. Other air pollutants associated with the Skyline Landfill Expansion Project have PTE rates below their respective significance thresholds, and have been authorized via a Standard Air Permit issued by the TCEQ on November 22, 2013.

Per EPA Guidance[38], a determination of BACT for GHGs should be conducted in the same manner as it is done for any other PSD regulated pollutant. The BACT requirement is set forth in section 165(a)(4) of the CAA, in federal regulations at 40 CFR 52.21(j), and in various federal and state rules concerning State and Federal Implementation Plans. This Application section presents the proposed top-down BACT analysis and BACT selection for GHG emissions associated with the Skyline Landfill Expansion Project. The approach to the BACT analysis is based on the regulatory definitions of BACT, as well as consideration of EPA's current policy guidelines requiring a "top-down" approach. A BACT determination requires a site-specific analysis of the technical, economic, environmental, energy, and other impacts of the proposed and alternative control technologies (see Rule 62-212.400, F.A.C.).

The "top-down" approach consists of the following five steps, as described in the *New Source Review Workshop Manual-Draft* (EPA, 1990):

1. Identification of all available control technologies;
2. Elimination of technically infeasible control options;
3. Ranking the remaining technically feasible control technologies based on their control effectiveness;
4. Evaluation of the economic, environmental, and energy impacts of the feasible control options; and
5. Selection of BACT based on consideration of the above factors.

The PSD regulations require that new major stationary sources and major modifications to existing major sources undergo a control technology review for each pollutant that may potentially be emitted above significance thresholds. Because the proposed Skyline Landfill Expansion Project is seeking a PSD permit for GHG only, only GHG emissions require a BACT analysis in this Application. BACT is an emission limitation that meets the maximum degree of emission reduction after taking into account the proposed project's specific economic, environmental, energy, and other impacts, as well as consideration

[38] See PSD & Title V Permitting Guidance, USEPA OAQPS, November 2010, p. 17.

of the application of the technologies proposed. If it is infeasible to impose an emission limit, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT.

9.1 Identification of Skyline Landfill GHG Emission Sources and Applicable Rules

The Skyline Landfill Expansion Project will result in fugitive emissions of GHG due to the generation of LFG, which is composed of approximately 50 percent CO_2 and 50 percent CH_4, both of which are GHGs. LFG is generated from the decomposition of organic matter in disposed MSW. EPA has recognized since the mid-1990s[39] the fact that it is not technically feasible to collect and control all of the LFG that is generated. Because the Skyline Landfill Expansion Project is subject to Title 40 Code of Federal Regulations Part 60, Subpart WWW (the NSPS for MSW landfills), an LFG collection system must be installed and operated in the area added by the Skyline Landfill Expansion, as prescribed by NSPS, no later than five years after first placement of MSW in the respective cells constructed in the area added by the Skyline Landfill Expansion, or no later than two years if the cell is closed to final grade.

9.2 "Top Down" BACT Analysis Introduction

BACT technology options for reduction of fugitive GHG emissions from the Skyline Landfill Expansion Project can generally be addressed in three categories: (1) carbon storage, (2) improved efficiency of cover oxidation of CH_4 to CO_2, and (3) installation and operation of an NSPS-compliant LFG collection and control system (including consideration of specific enhancements over current NSPS requirements)[40]. Only two fugitive GHG control technologies applicable to MSW landfills [(1) use of a biocover to improve efficiency of cover oxidation of CH_4 to CO_2 and (2) installation of an NSPS-compliant LFG collection and control system] were highlighted in, "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from MSW Landfills," EPA Office of Air and Radiation, June 2011, as featured below in Table 3. Even recent MSW landfill publications do not cite attempts at carbon storage at MSW landfills as GHG emission control technology due to its limited feasibility to implement and limited ability to measure or monitor its emission reductions, or lack thereof. Nevertheless, to address current EPA policy in requiring the full consideration of carbon storage as BACT, the following sections provide the required top-down BACT analysis for each of: (1) carbon storage, (2) improved efficiency of cover oxidation of CH_4 to CO_2, and (3) installation and operation of an NSPS-compliant LFG collection and control system (including consideration of specific enhancements over current NSPS requirements).

[39] See Memorandum from John S. Seitz, Director, OAQPS to EPA Regional Air Directors, "Classification of Emissions from Landfills for NSR Applicability Purposes", October 21, 1994, and Memorandum from Chad Leatherwood of Eastern Research Group, Inc., to Brian Guzzone of U.S. EPA, "Review of Available Data and Gas Collection Efficiency", November 8, 2002.

[40] The results of actions taken to improve LFG collection efficiency will not be reflected in fugitive emissions calculations performed according to AP-42 standards, because these standards set a default collection efficiency of 75 percent.

Table 3

Fugitive GHG Control Measures for MSW Landfills

Measure	Applicability	CH_4 Reduction	Typical Capital Costs	Typical Annual O&M Costs	Cost Effectiveness ($/metric ton of CO_2e reduced)	Notes / Issues
LFG Collection Efficiency Improvement	All landfills with gas collection systems	Varies	$24,000 /acre	$4,100/ acre	N/A	Cost and performance varies depending on the type of cover material.
Biocover[41]	All landfills	Up to 32%	$48,000 /acre	N/A	$745	No extensive retrofit.

9.3 Previous MSW Landfill BACT Determinations and Control Technology Selections

Following is a summary of the results of a review performed of previous BACT determinations for GHG emissions from MSW landfills listed in the RACT/BACT/LAER Clearinghouse ("RBLC") database located on the EPA website. From this information, applicable BACT determinations issued within the last 10 years (i.e., since 2003) were identified. These BACT determinations are presented in Table 4. None of the BACT determinations identified a technology or practice to increase efficiency in cover oxidation of CH_4, or carbon storage as BACT. All of the BACT determinations identified installation and operation of all or part of an active LFG collection and control system as BACT. While this creates a strong indicator of BACT for MSW landfill GHG emissions in general and fugitive GHG emissions from the Skyline Landfill Expansion Project specifically, these determinations were performed for the same company (not a WM company), in the same state (not Texas), and in the same EPA Region (not Region VI). In addition, they supported a permit application that sought approval of landfill GHG emissions from both fugitive and point (combustion) sources, unlike this Application, which seeks approval of solely of fugitive landfill GHG emissions. Therefore, a comprehensive top down BACT analysis taking into consideration a broader field of technologies is appropriate to address the company, project, location and regulatory agency associated with this Application.

[41] Increasing the biologic activity in landfill cover is the means by which oxidation of CH_4 passing through the cover is increased.

Table 4
RACT/BACT/LAER Clearinghouse Search Results
for Greenhouse Gas Controls for Municipal Solid Waste Facilities
(Permits Dated 2003 - 2013)

RBLC ID	Facility Name	State	Permit Type	Basis	Source	Throughput	Control Type
OH-0281	RUMPKE SANITARY LANDFILL	OH	A	BACT-PSD	New solid waste disposal with LFG generation	42,760,000 (tons of waste)	active gas collection and control system: flare; LFG recovery for sale/use; or control by a thermal oxidizer
OH-0281	RUMPKE SANITARY LANDFILL	OH	A	BACT-PSD	Existing solid waste disposal with LFG generation	32,272,000 (tons of waste)	active gas collection and control system: flare; LFG recovery for sale/use; or control by a thermal oxidizer
OH-0281	RUMPKE SANITARY LANDFILL	OH	A	BACT-PSD	Fugitive emissions from landfill and gas collection system	ND	ND
OH-0330	RUMPKE SANITARY LANDFILL	OH	C	N/A	MSW landfill modification to increase capacity	ND	4 enclosed combustors and 5 candlestick flares; and main open flare for existing landfill
OH-0330	RUMPKE SANITARY LANDFILL	OH	C	N/A	Enclosed combustors (4)	ND	combustors are the control
OH-0330	RUMPKE SANITARY LANDFILL	OH	C	N/A	Candlestick flare (5)	ND	flare is control
OH-0330	RUMPKE SANITARY LANDFILL	OH	C	N/A	Open flare	ND	flare is control

Permit Types
A New/Greenfield
C Modifying Existing Process at Existing Facility

ND = No Data

9.4 BACT Analysis for Skyline Landfill Expansion Project

As stated in the introduction to this section, the BACT analysis for the Skyline Landfill Expansion Project evaluates one technology as BACT because of U.S. EPA policy requiring its consideration (carbon storage), another technology because of reference as a means of reducing MSW landfill fugitive emissions in EPA publications (use of a biocover to increase efficiency in cover oxidation of CH_4) and a third technology because of demonstrated precedent as final BACT for MSW landfills listed in the RACT/BACT/LAER database (installation and use of a LFG collection and control system). Consideration of these three technologies allow for evaluation of their potential overall operational efficiency and potential for GHG emissions reductions to be integrated into BACT.

The discussion below regarding each of the three major technology categories identifies the potentially applicable control alternatives available within it, identifies the history of the potentially applicable control technologies as BACT, discusses and determines the feasibility of the technology overall as well as each potentially applicable control alterative associated with it, and eliminates those technologies and alternatives that are infeasible for consideration as BACT.

9.4.1 Category One: Carbon Storage

Carbon storage is a key technology for accomplishing climate change impact reductions for processes that are inherently linked to carbon compounds. For fossil fuel combustion processes, active carbon capture, separation and injection is a potential “add-on” technology that allows fossil fuels to be combusted for energy while still achieving significant reduction in the amount of carbon released for each unit of energy produced. Presumably, this process could be applied to point source GHG emissions from an MSW landfill under the appropriate operating and locational conditions, because most MSW landfills are capable of capturing and combusting a significant amount of the LFG they produce, and the GHGs from combusting this LFG (CO_2 and CH_4) are the same GHGs that are produced by fossil fuel combustion for energy. However, carbon storage is impossible to apply to fugitive GHG emissions from MSW landfills because fugitive emissions, by definition, are those emissions that cannot reasonably be captured[42]. A full discussion of the determination of the portion of LFG that is generated that is and is not reasonably collectable is provided in this Application in Section 8.1. Nevertheless, in the interest of fulfilling the requirements of a GHG PSD permit application in EPA-VI, a discussion of carbon storage is provided.

Another form of carbon storage, typically known as “subsurface carbon sequestration”, is a key part of the engineered landfill process and is unique to natural (biogenic) carbon decay scenarios. Carbon sequestration is a phenomenon by which organic polymers, which are technically degradable but are

[42] The EPA's NSR regulations define "fugitive emissions" to mean "those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening" (40 CFR 51.165(a)(1)(x)).

resistant to degradation, are isolated deep in a matrix so that they are denied access to the oxygen, moisture and heat needed to facilitate their bacterial decay, resulting in long term storage of their carbon content. Sequestration of carbon in MSW landfills results in a reduction of fugitive emissions compared to their potential to emit carbon if all the organic material introduced to them did, in fact, decay, as is assumed by current LFG generation models.

9.4.2 Previous BACT Determinations for Carbon Storage

As part of the BACT analysis, a review was performed of previous BACT determinations for GHG emissions from MSW landfills listed in the RACT/BACT/LAER Clearinghouse ("RBLC") database located on the EPA website. From this information, applicable BACT determinations issued within the last 10 years (i.e., since 2003) were identified. A summary of these BACT determinations is presented in Table 4. None of the BACT determinations identified carbon storage as a technology to reduce landfill GHG emissions, whether by active carbon capture and injection or by carbon sequestration in the landfill matrix.

9.4.3 Identification of Potentially Applicable Control Alternatives for Carbon Storage

This section identifies and describes in detail the two potential GHG control alternatives associated with carbon storage as BACT: 1) active carbon collection, separation and injection and 2) carbon sequestration, based upon the RBLC review conducted above, review of the published literature regarding fugitive LFG emissions, and previous experience with MSW landfills. The descriptions of the control alternatives are followed by an assessment of the feasibility of each of the control alternatives.

9.4.3.1 Active Carbon Collection, Separation and Injection (CCS)

Carbon collection and storage typically involves the collection of air pollutant emissions, physical separation of CO_2 from the other pollutants, compression of the CO_2, and injection of the compressed CO_2 into subsurface strata, where the subsurface injection can occur in locations on-site or far from the site, potentially requiring long-distance transportation of the CO_2 via pipeline (e.g., oil production fields where the compressed CO_2 is used for enhanced oil recovery). More specifically, carbon collection and storage is recognized as a potentially applicable anthropogenic CO_2 emissions reduction method for certain fossil fuel production and use projects, particularly fossil fuel-fired power plants and large industrial users of fossil fuel. These operations typically have the potential to emit CO_2 at much higher volumes than MSW landfills.

9.4.3.2 Landfill Carbon Sequestration

MSW landfills offer another form of carbon storage that is typically not addressed in BACT analyses because it concerns biogenic carbon exclusively, and biogenic carbon has, to date, not been addressed in the PSD air permitting area: subsurface carbon sequestration. Subsurface carbon sequestration occurs when some of the organic polymers (e.g., lignin, cellulose and hemicellulose as contained in wood and paper products) which are naturally resistant to decay are disposed deep in an MSW landfill where conditions are not conducive to bacterial decay (e.g., oxygen-poor, moisture-poor and heat-poor) and do not decay to form LFG, but rather are permanently stored or "sequestered" in the landfill matrix. Subsurface carbon sequestration, like carbon capture and injection, is a form of carbon storage which removes carbon from the carbon cycle indefinitely, reducing net emissions of GHG to atmosphere.

The effect of this process on overall U.S. GHG emissions is significant as it offsets as much as 50 percent of landfill CH_4 emissions, as modeled. Both the Intergovernmental Panel on Climate Change ("IPCC") guidelines for landfill emissions estimation and EPA's annual U.S. GHG Inventory recognize and account for carbon sequestration of un-decomposed wood products as well as food scraps and yard trimmings disposed in landfills. In 2011, the U.S. GHG Inventory estimated that 13.5 percent of total U.S. GHG emissions were offset by carbon sequestration in forests, trees in urban areas, agricultural soils, and landfills. The IPCC guidelines and reporting tools include a spreadsheet for calculating carbon storage, which spreadsheet recognizes that the organic matter that does not decompose as expressed in the default decomposition factor is permanently stored in the landfill.

However, even though both the IPCC guidelines and the U.S. GHG Inventory recognize landfill carbon sequestration, EPA elected to not allow landfill owners and operators to calculate and report carbon storage pursuant to the EPA GHG Mandatory Reporting Rule because that rule focuses on data reporting of emissions exclusively. As a result, there is no EPA-approved mathematical algorithm for estimating subsurface carbon sequestration in an MSW landfill based on landfill operating parameters. Therefore, MSW landfill GHG emissions are over-reported in the EPA GHG Mandatory Reporting Rule and over-estimated in this Application.

9.4.4 Identification of Technically Feasible Control Alternatives for Carbon Storage

In this section, the technical feasibility of each of the two potentially applicable control technologies for this BACT technology: carbon collection, separation and injection and subsurface carbon sequestration, is assessed. Those technologies that are found to be technically infeasible will not be considered further in the BACT analysis.

9.4.4.1 Feasibility and Cost Estimate of Active Carbon Collection, Separation and Injection (CCS)

Landfill gas is composed of approximately 50 percent biogenic CO_2 and 50 percent anthropogenic CH_4. When collected LFG is combusted, the resulting CO_2 is also biogenic. This is a significantly different GHG emission profile than that associated with the production and/or use of fossil fuel, which results in all anthropogenic GHG emissions. There is no precedent of application of carbon collection, separation and injection to biogenic CO_2 emissions associated with the operation of a pollution control device, such as an

LFG combustion device. Biogenic emissions of CO_2 have historically and internationally been considered part of the natural carbon cycle and not subject to collection and control technologies.

Moreover, the purpose of this particular Application is to permit the GHG emissions of LFG from the Skyline Landfill Expansion Project, all of which are fugitive emissions. By definition, fugitive LFG emissions are those emissions that are not or cannot reasonably be collected. As such, they are not available for application of CO_2 collection, separation and injection technologies, making these technologies de facto infeasible as BACT for the fugitive GHG emissions associated with the Skyline Landfill Expansion Project. Nevertheless, in order to be fully responsive to the requirements of EPA-VI for GHG PSD permit applications, a brief analysis of the cost of applying carbon capture and storage to an amount of CO_2 equivalent to the Skyline Landfill Expansion Project's calculated PTE for fugitive emissions in CO_2e is provided below.

In an assessment of realistic costs of first-of-its-kind carbon capture technology published in July of 2009, the capital cost of carbon capture and control, excluding the cost of transport and storage for a ton of CO_2 from a utility-scale power plant was estimated at $100 to $150.[43] Adjusted for inflation to October 2013 dollars, this range is $104 to $157.[44] Application of this factor to a hypothetical carbon capture and control project at an MSW landfill is conservative, as application to an MSW landfill would not entail the detailed engineering required to prevent the carbon capture and control technology from interfering with the operation of combustion turbines and other pollution control equipment. The only engineering associated with application of carbon capture and control technology to an MSW landfill would be that needed to route emissions from a simple flare without added pollution control equipment to the control device. Applying this cost range to the Skyline Landfill Expansion Project's calculated PTE for fugitive emissions in CO_2e of 117,138.60 tons, the capital cost range for applying carbon capture and control to the Skyline Landfill Expansion would range from $11,713,860 to $17,570,790, excluding the cost of transport and storage.

The cost of carbon transport and storage is outlined by the U.S Department of Energy, National Energy Technology Laboratory in its guide to transfer and storage costs published in March 2013. This document estimated CO_2 transport capital costs for a facility located in Texas at $3.65 per metric tonne and storage capital costs at $6.06 per metric tonne, for a total of $9.71 per metric tonne, all in 2011 dollars[45]. Adjusting these costs for application to short tons and October 2013 dollars, the estimated capital cost for carbon transport and storage is $9.91 per ton of CO_2. Applying this cost to the Skyline Landfill Expansion Project's projected PTE for fugitive emissions in CO_2e of 117,138.60 tons, the capital cost of applying

[43] See Al-Juaied, Mohammed A and Whitmore, Adam, "Realistic Costs of Carbon Capture" Discussion Paper 2009-08, Cambridge, Mass.: Belfer Center for Science and International Affairs, July 2009

[44] Range adjusted for inflation using factors published at www.usinflationcalculator.com.

[45] See U.S. Department of Energy, National Energy Technology Laboratory, "Quality Guidelines for Energy System Studies, Carbon Dioxide Transfer and Storage Costs in NETL Studies, March 2013.

carbon transport and storage to the Skyline Landfill Expansion would add $1,136,236. Adding this to the capital cost estimate range for carbon capture results in a total capital cost estimate range of $12,850,096 to $18,707,026. In terms of project impact, assuming the investment in carbon capture, control, transport and storage is made in 2014, the cost to WMTX would be $13.43 to $19.56 for every ton of waste received in 2014, based on assumed 2014 waste receipts from the Skyline Landfill Gas Model.

9.4.4.2 Feasibility of Landfill Carbon Sequestration

Landfill carbon sequestration has conservatively not been calculated and applied to the fugitive GHG emissions estimates provided in this Application, because the landfill sequestration concept is not fully recognized by EPA, and EPA has not approved an applicable estimation algorithm for it. However, as an illustration, the proportion of CH_4 emissions from the landfill as calculated for the Skyline Landfill 2012 EPA GHG Mandatory Reporting Rule to the amount of carbon sequestered by the landfill as calculated in 2012 using the Solid Waste Industry for Climate Solutions ("SWICS") estimation protocol, which does include a subsurface carbon sequestration algorithm and does account for subsurface carbon sequestration, was 63 percent. This means that 63 percent of the CH_4 emitted by Skyline Landfill in 2012 was offset by carbon sequestered in Skyline Landfill in 2012. Had that proportion been applied to the far future GHG PTE of Skyline Landfill after the addition of the proposed expansion area, emissions of GHG would have been reduced below the threshold for PSD applicability, even with the inclusion of fugitive CO_2 emissions, making this PSD permit application unnecessary.[46] Nevertheless, specific carbon sequestration requirements as BACT for the Skyline Landfill Expansion Project are infeasible due to the lack of an EPA-approved, or even fully recognized, landfill carbon sequestration accounting system.

9.4.5 Summary of Feasibility of Carbon Storage as BACT

Neither of the available control alternatives for carbon storage are technically feasible for application as BACT to control fugitive GHG emissions of the Skyline Landfill Expansion Project, as discussed in the previous sections. The remaining steps of the BACT analysis are no longer applicable to carbon storage as BACT. As such, it may be eliminated at this "Step 2" of the five-step top-down BACT analysis

9.5 Category Two: Increase in Efficiency of Cover Oxidation of CH_4 to CO_2

In the guidance document entitled, "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from MSW Landfills," EPA Office of Air and Radiation, June 2011, EPA cites the use of a biocover as a potentially viable fugitive GHG emissions control measure. Biocovers are specially managed and designed landfill covers that manipulate conditions to encourage biologic activity. Typically, landfill covers are constructed of inert materials that discourage biologic activity. However, unlike the biologically active waste matrix, the goal of the biologically active cover is not the decomposition of cover

[46] Skyline Landfill 2012 methane emissions were 321,952 metric tons CO_2e and its 2012 carbon dioxide sequestration was 201,390 metric tons CO_2e. Skyline Landfill fugitive emission PTE in 2044, according to the current LandGEM model run and allowing an equivalent 62 percent reduction in methane emissions, would be 52,071 TPY.CO_2e.

materials into LFG, but rather the decomposition of CH_4 passing through the cap into CO_2, thereby reducing the GHG emission's Global Warming Potential ("GWP"). This necessitates the application of two control alternatives simultaneously: a shift in the cover materials from primarily inert materials to active organic materials and the maintenance of strictly controlled operating conditions for the cover, which is typically subject only to management for crack-free consistency of coverage.

9.5.1 Previous BACT Determinations for Increase in Efficiency of Cover Oxidation of CH_4 to CO_2

As part of the BACT analysis, a review was performed of previous BACT determinations for GHG emissions from landfills listed in the RBLC database located on the EPA website. From this information, applicable BACT determinations issued within the last 10 years (i.e., since 2003) were identified. A summary of these BACT determinations is presented in Table 4. None of the BACT determinations identified increasing the efficiency of cover oxidation of CH_4 to CO_2 as BACT.

9.5.2 Identification of Potentially Applicable Control Alternatives to Increase Efficiency of Cover Oxidation of CH_4 to CO_2

This section identifies and describes a potential GHG control alternative based on review of the published literature regarding fugitive LFG emissions, and previous experience with MSW landfills. Strategies used to increase CH_4 oxidation to CO_2 in landfill covers can be split into two categories that are, nevertheless, dependent upon each other to accomplish GHG control: (1) increasing the rate at which organic matter decomposes in the cover and (2) maximizing the addition of organic matter to the landfill's cover that will have the opportunity to decompose into LFG.

9.5.2.1 Strict Control of Cover Organic Content and Operating Conditions

Organic decomposition is enhanced by optimizing the moisture level, temperature, and oxygen content of the cover material to create an optimally hospitable environment for bacteria to thrive. Organic decomposition is also enhanced by increasing the organic content of the cover, to maximize the food available to bacteria. Achievement of both of these goals requires strict control of both the composition of the landfill cover and the conditions to which it is subjected. Cover composition can be controlled to enhance organic content by preferentially diverting high organic fill to cover use. However, that enhancement may lead to ambient odor issues, as the decomposition process is brought up to the surface of the landfill, rather than being obscured by an inert cover layer.

Control of landfill cover operating conditions is a more complex prospect. The landfill cover is fully exposed in the outdoors, subject to the typical climate in its specific area and to anomalies in that climate (i.e., weather), which can occasionally be extreme in nature. Outdoor operating conditions can be controlled only within certain parameters, and even those parameters are subject to variability and unpredictability. For example, if cover moisture is less than ideal, a water spray can be applied. But, if cover moisture is more than ideal, there is no short-term solution to enhance a drainage system to overcome an extreme rain event. Oxygen content in cover can be enhanced by turning it over. Cover temperature cannot be controlled at all.

9.5.3 Identification of Technically Feasible Control Alternatives to Increase Efficiency of Cover Oxidation of CH_4 to CO_2

This section addresses the technical feasibility of the potentially applicable control technology and its various attributes described above. Those technologies that are found to be technically infeasible will not be considered further in the BACT analysis.

9.5.3.1 Strict Control of Cover Organic Content and Operating Conditions

In its; guidance document entitled, "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from MSW Landfills," EPA Office of Air and Radiation, June 2011, the EPA states that the use of biocovers reduces overall CH_4 emissions, but it also recognizes that, "The biocover itself is not known to affect the functionality of an existing or new gas collection and control system."[47] The parameters used to determine the fugitive GHG emissions of MSW landfills are limited to measurements and calculations associated with landfill waste receipts and LFG collection and control systems. None of the parameters used in the LandGEM LFG generation model take into account efforts to strictly control landfill cover composition or operating conditions. Therefore, in addition to a general inability to directly and reliably control these parameters, there is no recognized means to measure their impact, positive or negative. Given this inability to generate empirical evidence of biocover GHG emission reduction, use of a biocover specifically for the purpose of the measurable GHG fugitive emission reduction is not feasible.

Although biocovers may offer overall GHG benefit in the long-term, they do not fit within a rigid permit compliance system requiring the achievement of immediate, consistent, measurable emissions reductions. In light of this information, mandatory biocover installation and maintenance as BACT for the Skyline Landfill Expansion Project is infeasible based upon its inability to produce a documentable reduction in emissions if implemented.

9.5.4 Summary of Feasibility to Increase Efficiency of Cover Oxidation of CH_4 to CO_2

The option to reduce landfill GHG emissions by increasing the efficiency of cover oxidation of CH_4 to CO_2 is not technically feasible, as discussed in the previous sections. The remaining steps of the BACT analysis are no longer applicable to this option. As such, it may be eliminated at this "Step 2" of the top-down BACT analysis.

[47] "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills", U.S. EPA, Office of Air and Radiation, June 2011, p. 17.

9.6 Category Three: Application of LFG Collection Technologies

Landfill gas collection at MSW landfills is required by regulation, specifically NSPS, and/or a state equivalent to NSPS, at most larger landfills like Skyline Landfill. Use of a landfill gas collection and control system is the remaining available strategy by which fugitive GHG LFG emissions can be reduced at MSW landfills and the remaining available BACT technology candidate for the Skyline Landfill Expansion Project. For purposes of this BACT analysis, in addition to considering general use of a LFG collection and control system as a potentially applicable control alterative for GHG emissions, three potentially applicable control enhancements to an already NSPS-compliant LFG collection and control system to increase efficiency of LFG collection and maximize GHG reduction are also considered on an individual basis. LFG collection and efficiency enhancements, i.e., operating practices going beyond that required to comply with NSPS, were considered because the more robust the LFG collection and control effort, the less high GWP CH_4 is allowed to escape as fugitive GHG emissions through the surface of the landfill, and the more CH_4 is combusted into low GWP CO_2. If still recognizing the biogenic nature of landfill CO_2 and the exclusion of biogenic CO_2 from GHG accounting and permitting, this minimization of anthropogenic landfill CH_4 fugitive emissions is considerably more effective at reducing overall GHG emissions.

9.6.1 Previous BACT Determinations for Application of LFG Collection Technologies

As part of the BACT analysis, a review was performed of previous BACT determinations for GHG emissions from landfills listed in the RBLC database. From this information, applicable BACT determinations issued within the last 10 years (i.e., since 2003) were identified. A summary of these BACT determinations is presented in Table 4. In general, these options listed the use of an active Gas Collection and Control System ("GCCS") as the only BACT for MSW landfills. However, application of the specific potentially applicable control alternatives for improving efficiency of LFG collection beyond that required for NSPS compliance that are addressed below in this BACT analysis were not identified as BACT for MSW landfills in the examples from the RBLC database.

9.6.2 Identification of Potentially Applicable Control Alternatives for Application of LFG Collection Technologies

This section identifies potential GHG control alternatives based on review of the published literature regarding fugitive LFG emissions, and previous experience with MSW landfills. Strategies used to apply LFG collection technology to an MSW landfill include application of NSPS guidelines to the GCCS absent enhancements and application of NSPS guidelines to the GCCS with each of the following enhancements to maximize LFG collection efficiency: 1) increase the percentage of generated LFG that is collected by the GCCS; 2) increase cover monitoring and maintenance; and 3) install the GCCS earlier in the landfill's (or individual cell's) operating life.

9.6.2.1 NSPS-Compliant GCCS

Collection of LFG is achieved by installing an “active” GCCS, i.e., a GCCS that is supported by application of negative pressure to the landfill matrix to extract LFG rather than allowing LFG to migrate unassisted to LFG collection devices. This negative pressure can be adjusted to fit the LFG generation of a particular landfill or area within a landfill. An active LFG GCCS can use a combination of horizontal and vertical wells (with vertical wells being the most commonly used for maintaining compliance with NSPS requirements) with perforated casings attached to a blower system. The blower system supplies negative pressure to gently extract LFG from those portions of a landfill that are generating LFG of a sufficient CH_4 concentration to allow the LFG to be combusted, either as a fuel or as a waste gas in a flare.[48] The system is designed to allow a sufficient degree of control over the negative pressure applied to avoid causing the intrusion of oxygen through the landfill cover and into the landfill matrix, which can cause a subsurface fire.

A “passive” GCCS uses vertical wells without application of negative pressure and/or horizontal collectors to vent LFG to the atmosphere, which prevents subsurface migration in cases where an active GCCS is not feasible for use. In some cases, “solar flares” that will ignite upon exposure to combustible gas, and carbon or biogenic filters are used on passive LFG collectors to reduce the amount of CH_4 introduced to atmosphere. An active GCCS is required by the NSPS for MSW landfills when they achieve a certain LFG generation threshold, as indicated by their generation of Non-Methane Organic Compounds (“NMOCs”). NMOCs typically constitute less than one percent of the total LFG volume. Applicability of NSPS is triggered by NMOC rather than by CO_2, CH_4, or total LFG volume because CO_2 and CH_4, which comprise approximately 99 percent of LFG, were not regulated pollutants under the CAA when NSPS was enacted. NSPS requires installation of an active GCCS soon after the NMOC threshold is reached. Then NSPS requires that the GCCS be expanded to new landfill cells within five years (two years if the cell is at final grade) of when waste is first placed into a cell.

Dramatic reductions in MSW landfill GHG emissions since the implementation of NSPS are documented in the Inventory of United States Greenhouse Gas Emissions and Sinks, most recently published on April 12, 2013, by EPA in its 1990 to 2011 version. This inventory reports that GHG emissions from MSW landfills in the U.S.[49] have declined by 30 percent from 1990 to 2011, while the amount of waste disposed in MSW landfills has increased by 26 percent over the same time period. The primary reason for this reduction in GHG emissions per unit processed (disposed) by the MSW landfill industry is the expansion of the practice of LFG collection and control over this time period, both in terms of percentage of landfills

[48] Flares are capable of combusting lower heating value gases than are the engines and turbines typically used to convert LFG to energy, so methane-poor LFG may have to be flared. Also, while some industrial uses may be tolerant of a lower-Btu fuel, third-party purchasers of LFG as a fossil fuel substitute typically impose strict fuel specifications that the LFG must meet to avoid rejection.
[49] The inventory counts only methane emissions, as it recognizes that carbon dioxide emissions from landfills are part of the carbon cycle of decomposition.

pursuing active LFG collection and control, and in terms of advances in LFG collection and control technology, much of which is now dictated for use by the NSPS regulations.

Skyline Landfill is already subject to NSPS, and has already installed and is operating a compliant active GCCS in appropriate, active areas of the landfill. As such, Skyline Landfill will be obligated to comply with NSPS requirements in the area added by the expansion project. BACT may be as stringent or more stringent than NSPS requirements, but it may not be less stringent. Thus, the NSPS requirements would constitute a BACT "floor" for this particular GHG emissions reduction activity. The following discussions address control alternatives in which potential enhancements are made to this BACT floor that may, if feasible, constitute BACT for control of fugitive GHG emissions for the Skyline Landfill Expansion Project.

9.6.2.2 NSPS-Compliant GCCS with Increase in Percentage of Generated LFG Collected by the GCCS

NSPS not only requires the installation and operation of an active GCCS over qualifying areas of a subject MSW landfill, it also requires that certain operating parameters be maintained within set thresholds. These operating parameters are imposed to ensure efficient LFG collection, as well as safe operation of the landfill by minimizing risk of subsurface fire and excess fugitive emissions. Pursuant to NSPS, the GCCS must operate under negative pressure at each wellhead, except in the case of a fire or increased well temperature. Each interior wellhead in the collection system must operate with LFG temperature less than 55°C and either a nitrogen level below 20 percent, or an oxygen level below 5 percent. The GCCS must also operate so that the CH_4 concentration above the surface of the landfill is less than 500 ppmv. The GCCS must vent to a control system, and the control system must be operated at all times when collected LFG is routed to the system. Compromise of these operating parameters in order to increase the percentage of generated LFG collected by the GCCS is not allowed by the NSPS.

While these parameters are subject to a strict monitoring, maintenance, recordkeeping, and reporting regimen outlined in the NSPS rule itself, there is no required minimum value assigned to the percentage of LFG collection achieved by the GCCS. Instead, pursuant to conservative EPA AP-42 standards, installation and operation of an NSPS-compliant LFG GCCS is recognized to result in an average reduction in fugitive CH_4 emissions from the landfill surface by 75 percent, representing the fraction of CH_4 collected and controlled and thus being prevented from release to atmosphere. This 75 percent reduction in fugitive emissions is accomplished absent negative implications such as increased emissions from other sources (e.g., subsurface fires). This 75 percent reduction is also a static number, applied by AP-42 as a default value which may or may not reflect actual site conditions at a particular landfill. While an increase in the percentage of generated LFG that is collected and controlled would presumably reduce GHG fugitive emissions from the landfill, there is no mechanism by which to demonstrate this reduction in field practice.

The AP-42 standards for MSW Landfills predate direct regulation of GHGs by the GHG PSD permitting regulations, including the concept of deferral or inclusion of biogenic emissions in GHG inventories or permits. This cited 75 percent reduction in fugitive emissions would not apply to CO_2 included in total landfill GHG emissions absent a deferral as biogenic and part of the natural carbon cycle. Landfill CO_2 (approximately 50 percent of total LFG) is not affected by collection and combustion, but merely passes through the combustion unit and would have to be returned to the inventory in its original volume. The CO_2 resulting from combustion of collected CH_4 would also have to be returned to the total inventory. As such, LFG collection and control would prove to be less effective in reducing overall GHG emissions absent the application of the biogenic deferral of landfill CO_2, because its only effect would then be the reduction of the GWP of the collected CH_4 by combustion into CO_2.

9.6.2.3 NSPS-Compliant GCCS with Increase in Cover Monitoring and Maintenance Activities

NSPS prescribes regular monitoring of the landfill cover for surface-level fugitive CH_4 emissions and regular monitoring of the landfill cover for surface integrity (i.e., presence of cracks, which can provide a means of egress for LFG). Corrective action must be taken to correct confirmed excess surface CH_4, defined as a reading of 500 ppm or more, and/or visible surface cracks. Surface monitoring must be conducted each calendar quarter, using a portable organic vapor monitor or detector meeting specifications provided in the rule and maintained and calibrated as provided in the rule. Surface monitoring must be conducted along the entire perimeter of the filled area, then along a pattern within the fill area traversing it every 100 feet (approximately), with the meter being held two to four inches above the surface. Surface integrity monitoring and repair must be conducted monthly according to a plan developed by the individual landfill to meet the particular landfill's configuration and operations pattern.

While surface concentrations of methane are measured to indicate the need for cover maintenance, there is no compliance mechanism to measure the actual amount of CH_4 released over time by a compromised cover condition. Therefore, while increasing the frequency and/or decreasing the spacing of the monitoring runs for cover monitoring would be expected to reduce fugitive emissions of GHG, this reduction cannot be quantified. By the same token there is no compliance mechanism to measure the emission reduction impact of faster cover repair or more aggressive cover maintenance.

9.6.2.4 NSPS-Compliance GCCS with Installation of a GCCS Earlier in a Landfill's Operating Life

NSPS dictates not only GCCS design and operation, but also its installation. After an MSW landfill has triggered NSPS applicability and installed the first phase of its GCCS, installation of an active GCCS is required on a cell-by-cell basis, no later than five years after MSW is first placed into a cell, or two years if the cell is closed to final grade. Presumably, installation of a GCCS before the prescribed time would not reduce the total amount of LFG produced by the landfill, because total LFG produced is determined by the amount of waste in the landfill and its organic content. However, it could result in more of the LFG that is generated being collected and controlled, meaning more of the CH_4 ultimately produced would be converted into CO_2[50]. It could also impact the annual GHG emissions inventory, specifically in those years before NSPS requires installation of a GCCS.

9.6.3 Identification of Technically Feasible Control Alternatives

In this section, the technical feasibility of each potentially applicable control technology is assessed. Those technologies that are found to be technically infeasible will not be considered further in the BACT analysis.

9.6.3.1 Feasibility of NSPS-Compliant GCCS

The Skyline Landfill currently has a permitted, NSPS-compliant GCCS installed. Continued expansion of the GCCS into new cells built in the existing Skyline Landfill footprint as well as into the Skyline Landfill Expansion Project footprint per NSPS requirements is fully feasible, is required by regulation and is planned to occur.

The existing GCCS, which features a four-IC-engine LFG-to-energy plant as well as a large back-up flare that served as the main source of LFG combustion prior to the installation of the LFG-to-energy plant, has substantial excess combustion capacity to handle LFG produced by the proposed expansion. Because this Application is for an expansion of the landfill fill area only, and does not include any additions or changes to LFG combustion capacity, methodology, or units, options regarding the control of LFG and their feasibility are not explored further. Any change made to LFG combustion capacity, methodology, or units imposed by EPA via the mechanism of this Application and the resulting permit would constitute a fundamental change to the project, and such changes are therefore not under the scope of this BACT analysis.

Note that, while the NSPS does not treat LFG-to-energy technology with preference over LFG flare technology for purposes of LFG control, the "PSD and Title V Permitting Guidance for Greenhouse Gases[51]" (GHG White Paper), includes a BACT sample for MSW landfills that does. This BACT sample requires the use of IC engines to combust LFG as GHG BACT for LFG combustion. This BACT sample features a new landfill for which both fugitive and point source (combustion) emissions are being permitted, not a landfill expansion for which only fugitive emissions are being permitted. Because this Application does not address point source (combustion) GHG emissions, this BACT analysis will not discuss or designate BACT for point source (combustion) GHG emissions nor comment upon the appropriateness of the BACT sample in the GHG White Paper for LFG combustion. While the feasibility of specific LFG control technologies is not at issue in this Application, it is nevertheless relevant that

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50 This option is limited by the AP-42 default assumption of 75% LFG collection efficiency across the board.
[51] Published by U.S. EPA, Office of Air and Radiation, November 2010.

Skyline Landfill already has a LFG-to-energy plant. It is also relevant that the continued use of the available GCCS combustion capacity at Skyline Landfill, including the LFG-to-energy plant and enclosed flare, is also fully feasible and is also planned to occur.

9.6.3.2 Feasibility of NSPS-Compliant GCCS with Increase in Percentage of Generated LFG Collected by the GCCS

Increasing the proportion of total generated LFG collected by the GCCS versus that left uncollected and subject to surface CH_4 oxidation and emission as fugitives beyond that achieved by an NSPS-compliant GCCS would simply and directly reduce the GHG emissions from the landfill surface to the atmosphere. However, more is required to increase LFG collection efficiency than simply installing more wells and turning up the vacuum applied to them. Also, as stated in the identification of this potential control method, it is impossible to increase the percentage of generated LFG collected by a GCCS for compliance purposes because AP-42 sets a hard default value of 75 percent for LFG collection efficiency, absent pursuing a change in the AP-42 value itself. Even if, literally, an action increased LFG collection efficiency, this increase would not be reflected in GHG emissions calculations performed in strict accordance with AP-42.

LFG is produced slowly and gradually throughout the waste and cover material matrix of an MSW landfill as bacteria consume the available organic matter throughout. The distribution of organic matter in the landfill matrix is neither consistent nor predictable, so bacterial activity is similarly inconsistent and unpredictable. Waste is placed in the landfill as it is received, and most of it is received under the generic category of “MSW”. However, the organic content of MSW can vary dramatically: a load from a grocery store could be very rich in organic material in the form of discarded meat and produce, but a load from an industrial park could have virtually no organic material. In addition, all organic material is not equal in decomposition rates. Some organic compounds, such as carbohydrates, proteins, and lipids, are easily consumed by bacteria and decompose quickly. Others, particularly organic polymers such as lignin and cellulose, are very difficult for bacteria to consume and decompose slowly, if at all[52]. Finally, activity of the bacteria executing decomposition is affected by many conditions, including temperature, moisture and oxygen concentration. Taken together, these factors, none of which are under the control of the landfill operator, influence LFG generation resulting in a finite, but variable, amount of LFG produced at any given time, which is distributed inconsistently through the landfill matrix.

Landfill gas collection efforts are limited by the variability in LFG volume and the inconsistency of its location within the landfill matrix. Turning up the vacuum on a LFG collection system will not capture more LFG if there is no more LFG to capture. Increasing the vacuum will instead pull air from the surface into the landfill matrix and potentially spark a subsurface fire. Therefore, if the same degree of vacuum must be applied across a large area, it must be low enough to not cause oxygen intrusion in the most

[52] See section 3.1.2.2. for a full discussion of carbon sequestration in an MSW landfill.

LFG-poor portion of the area. Installing wells very close together also will not capture more LFG if there is no more LFG to capture. In fact, even selective installation of wells in very LFG rich areas is not effective, because these "hotspots" are quickly consumed and, if the well remains in place, the additional vacuum provided by it could necessitate turning down the vacuum on the entire system. Although AP-42 sets a default value for LFG collection efficiency, the GCCS design and operation requirements found in NSPS were enacted with the goal of optimizing GCCS's to collect as much LFG as practicable without creating and increased risk of subsurface fire. In light of this information, operating a GCCS outside these ranges as BACT for the Skyline Landfill Expansion project is infeasible based upon that fact that such operation would be either ineffective, or damaging, or both.

Although efforts to optimize landfill gas collection may offer overall GHG benefit in specific circumstances, they do not fit within a rigid permit compliance system requiring the achievement of immediate, consistent, measurable emissions reductions on a long term basis. In light of this information, mandatory increase of LFG collection percentage over the 75 percent established as the AP-42 default value as BACT for the Skyline Landfill Expansion Project is infeasible based upon the inability to devise a single, static set of operating parameters that would ensure a simultaneous consistent increase in LFG collection percentage and continuation of safe operating practices (i.e., without risk of subsurface fire), in spite of changing landfill conditions.

9.6.3.3 Feasibility of NSPS-Compliant GCCS with Increase in Cover Monitoring and Maintenance Activities

Cover monitoring and maintenance parameters available for enhancement beyond NSPS compliance requirements to constitute BACT include: frequency of monitoring, surface CH_4 action level, and pattern of the monitoring path. However, all of these parameters were fully vetted, taking into account a wide range of variation, during the proposal and comment process for NSPS in 1996. EPA determined at the end of this process that the current status quo was optimal to reduce surface emissions without unnecessarily burdening landfill operations. The NSPS re-proposals in 2002 and 2006 (neither of which was finalized) allowed an opportunity to again reassess these parameters. The only change proposed was to add to the surface monitoring process the specific monitoring of the area around penetrations of the cover. However, the preponderance of comments indicated that this no more effective than existing surface monitoring practice. The latest opportunity to revisit these parameters was limited to the State of California in 2010 when the California Air Resources Board adopted an alternative surface monitoring method that combined the existing method, which considers only instantaneous readings, with another "integrated" method at a lower concentration which is implemented either quarterly or annually, depending upon results. The "integrated" measurements do indicate surface emissions patterns, but not necessarily their intensity, thereby significantly limiting their value in evaluating actual mass emissions reductions. In addition, they add considerably to the time and effort associated with landfill surface monitoring, and, depending on the size and location of the landfill, this additional time and effort is directly associated with carbon emissions from transportation to, from and around a site to perform the monitoring.

Although an increase in cover monitoring and maintenance activities may offer overall GHG benefit in the long-term, it does not fit within a rigid permit compliance system requiring the achievement of immediate, consistent, measurable emissions reductions. In light of this information, mandatory increases in cover monitoring and maintenance practices as BACT for the Skyline Landfill Expansion Project are infeasible based upon its inability to produce a verifiable, documentable reduction in GHG emissions if implemented.

9.6.3.4 Feasibility of NSPS-Compliant GCCS with Installation of a GCCS Earlier in a Landfill's Operating Life

Like other landfill operations management methods, installation of a GCCS at an NSPS-subject MSW landfill earlier than five years after first placement of MSW in a cell is subject to limitations that cannot be predicted. First, in order to install wells in the landfill matrix, there must be sufficient depth of landfill matrix in which to install a well. Depending on the rate of waste acceptance by a landfill, developing sufficient depth could take months or even years. Second, in addition to landfill matrix depth impacting the ability to install wells, it also impacts the ability of bacteria to produce CH_4. Specifically, methanogenic bacteria thrive only in an anaerobic environment. An anaerobic environment will not form in the landfill matrix until sufficient depth is attained to preclude intrusion of oxygen from the surface. Collecting LFG before CH_4 generation becomes prevalent, in addition to creating a subsurface fire risk, results in a CH_4-poor collected LFG product. Even moderately CH_4-poor LFG (25 to 40 percent) is not suitable for combustion in IC engines and most turbines for energy recovery, which is problematic for landfills like Skyline Landfill that depend on this technology for LFG control. Very CH_4-poor LFG (15 percent and less) is not even suitable for combustion in a flare absent supplementation with natural gas (which would increase GHG emissions and waste fossil fuel) and, if collected, would have to be released to atmosphere, with or without carbon filtration.

An additional concern regarding early installation of an active GCCS is its impact on waste disposal activities. If waste is still being located to a cell when a GCCS is being installed, having both construction activities underway at the same time creates a safety concern because of the additional equipment and activity. After installation, the wells are vulnerable to damage during waste disposal activities. If wells are installed too early in the cell's life, they may become covered and require raising and/or reinstallation, a process that involves invasive activity in the GCCS with potential to release significant amounts of LFG to atmosphere. When NSPS was first proposed, it called for the installation of an active GCCS two years after first placement of MSW in a cell. In response to comments, EPA changed this requirement to five years for active (still receiving waste) cells and retained the two years for cells that are not still receiving waste.[53]

The NSPS timeline for active GCCS installation potentially applies to any NSPS-subject landfill and must allow for a wide range of operating scenarios. However, each individual landfill is subject to changes in the volume and organic content of the waste it receives and to the climactic conditions that impact LFG generation. An individual landfill cannot predict exactly when an active GCCS will be supported in a cell because its past history is not a valid indicator of its future operations; as such, the point at which all cells at all NSPS-subject landfills must install an active GCCS must be set conservatively.

However, some landfills do install active an GCCS before the applicable regulatory deadline. The basis for this early installation is odor control. An active GCCS is not only an air emissions management device, it is also an aesthetic measure. When odor becomes an issue for employees and neighbors, and especially when formal odor complaints are received, many landfills elect to voluntarily install an active GCCS. However, potential odors are dependent on the volumes and composition of MSW received which cannot be accurately predicted. Because odor is frequently a subjective parameter that cannot be continuously and accurately measured, it is virtually impossible to use as a formal metric to trigger an activity.

EPA's GHG White Paper includes a BACT sample for MSW landfills. This BACT sample requires installation of an active GCCS prior to the NSPS deadline as GHG BACT for LFG collection. However, this BACT sample is extremely brief, with the entire discussion covering slightly over two pages, and it does not address any of the technical issues discussed above. The BACT sample assumes that an MSW landfill is as predictable in operation as a power plant or manufacturing unit, which it is not. As such, WMTX refutes the conclusion in the GHG White Paper that far future MSW landfill behavior can be predicted with sufficient specificity in terms of GHG emission volume and timing that installation of an active GCCS prior to the NSPS deadline can be established as BACT for a new landfill (or a landfill expansion area) prior to its construction.

Although early installation of an active GCCS may offer overall GHG benefit in certain scenarios, it does not fit within a rigid permit compliance system requiring the achievement of immediate, consistent, measurable emissions reductions. In light of this information, installation of an active GCCS in the Skyline Landfill expansion area at a time certain occurring before current NSPS regulatory deadlines as BACT for the Skyline Landfill Expansion Project is infeasible based upon the inability to either predict or control when LFG generation in the expansion will safely support such a system. The one parameter that could be utilized as an alternative trigger for installation, presence of the odor associated with LFG, is too subjective to be applied as an enforceable BACT technology.

[53] See 61 Fed. Reg. 9919, March 12,1996, preamble.

9.6.4 Summary of Feasibility of Use of an NSPS-Compliant GCCS, With and Without Potential Enhancements

The option to reduce landfill fugitive GHG emissions by use of an NSPS-compliant GCCS without mandatory enhancements is feasible as BACT for the Skyline Landfill Expansion Project.

Available potential enhancements, including the option to reduce landfill GHG emissions by increasing the percentage of generated LFG that is collected; reduce landfill GHG emissions by increasing landfill cover monitoring and maintenance and reduce landfill GHG emissions by installation of a GCCS earlier in landfill and/or individual cell operating life are not technically feasible as BACT, as discussed in the previous sections. The remaining steps of the BACT analysis are no longer applicable to the three enhancement options. As such, they may be eliminated at this "Step 2" of the top-down BACT analysis.

9.7 Ranking of Technically Feasible Control Alternatives

A formal ranking of technically feasible control alternatives is not necessary, because only one control alternative is technically feasible. Design, installation and operation of an NSPS-compliant active GCCS is the only technically feasible control alternative for BACT for controlling fugitive GHG emissions from the Skyline Landfill Expansion Project.

9.7.1 Evaluation of Economic, Environmental, and Energy Impacts of Feasible Technologies

An NSPS-compliant LFG GCCS is currently installed and operating in the existing areas of Skyline Landfill, and will be required to be expanded eventually to include the proposed expansion area by the terms of NSPS itself. An analysis of the economic, environmental, and energy impacts of feasible BACT control alternatives is neither relevant, nor required because only one control alternative is feasible, eliminating the need or ability to compare and contrast options. The installation and use of the NSPS-compliant LFG GCCS is required by law regardless of effectiveness or impacts, including cost. Nevertheless, the fact that mandatory, specific, static improvements to the various LFG control methods embodied by NSPS proved infeasible for establishment as BACT, particularly for far-future applicability, the analysis of technically feasible control alternatives provided above demonstrates the robustness of the NSPS control requirements for GHG control of MSW landfills. As stated earlier in this document, BACT may be equally stringent as an NSPS standard, or more stringent, but it may not be less stringent. In this case, compliance with the NSPS requirements for active LFG collection and control, not more stringent than NSPS, and not less stringent than NSPS, has been identified as feasible for implementation as BACT for the Skyline Landfill Expansion Project. Because this proposed BACT is at least equally stringent to the NSPS requirements, it is acceptable as BACT.

9.8 Selected BACT and Rationale

Installation of an NSPS-compliant GCCS will serve as BACT for the Skyline Landfill Expansion Project. It is the only technically feasible alternative for controlling fugitive GHG emissions from the Skyline Landfill Expansion Project, it is a regulatory requirement for the operation of the proposed landfill expansion, and it is not less stringent than the applicable federal, state and local regulatory requirements. There is no specific emission rate or control efficiency associated with this option, although there are assigned default values for control efficiency used for purposes of emission estimations, specifically, the AP-42 value for LFG collection efficiency of 75 percent. The provisions of NSPS Subpart WWW for the most part constitute a series of best management practices for construction and operation of an MSW landfill that are enforceable at the federal and state levels already, absent their designation as BACT.

10.0 OTHER PSD REQUIREMENTS

10.1 Impacts Analysis

An impacts analysis is not being provided with the application in accordance with EPA's recommendations in its PSD permitting guidance document for GHGs:

> "Since there are not NAAQS or PSD increments for GHGs, the requirements in sections 52.21(k) and 51.166(k) of EPA's regulations to demonstrate that a source does not cause or contribute to a violation of the NAAQS are not applicable to GHGs. Therefore, there is no requirement to conduct dispersion modeling or ambient monitoring for CO_2 or GHGs."[54]

An impacts analysis for non-GHG emissions also was not required for the TCEQ Standard Permit Application, by its terms and application instructions.

10.2 GHG Preconstruction Monitoring

A preconstruction monitoring analysis for GHG is not being provided with this Application in accordance with EPA's recommendations in its PSD permitting guidance document for GHGs:

> "EPA does not consider it necessary for applications to gather monitoring data to assess ambient air quality for GHGs under section 52.21(m)(1)(ii), section 51.166(m)(1)(iii), or similar provisions that may be contained in state rules based on EPA's rules. GHGs do not affect "ambient air quality" in the sense that EPA intended when these parts of the EPA's rules were initially drafted. Considering the nature of GHG emissions and their global impacts, EPA does not believe it is practical or appropriate to expect permitting authorities to collect monitoring data for purposes of assessing ambient air impacts of GHGs."[55]

A preconstruction monitoring analysis for non-GHG emissions also was not required for the TCEQ Standard Permit Application, by its terms and application instructions.

10.3 Additional Impacts Analysis

EPA makes the following recommendations regarding additional impacts analyses in its PSD permitting guidance document for GHGs:

> "Furthermore, consistent with EPA's statement in the Tailoring Rule, EPA believes it is not necessary for applicants or permitting authorities to assess impacts from GHGs in the context of the additional impacts analysis or Class I area provisions of the PSD regulations for the following policy reasons. Although it is clear that GHG emissions contribute to global warming and other

[54] See PSD and Title V Permitting Guidance for Greenhouse Gases, EPA, pp. 48-49.
[55] Id. at p. 49.

climate changes that result in impacts on the environment, including impacts on Class I areas and soils and vegetation due to the global scope of the problem, climate change modeling and evaluations of risks and impacts of GHG emissions is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible with current climate change modeling. Given these considerations, GHG emissions would serve as the more appropriate and credible proxy for assessing the impact of a given facility. Thus, EPA believes that the most practical way to address the considerations reflected in the Class I area and additional impacts analysis is to focus on reducing GHG emissions to the maximum extent. In light of these analytical challenges, compliance with the BACT analysis is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules related to GHGs."[56]

A PSD additional impacts analysis for non-GHG emissions also was not required for the TCEQ Standard Permit Application, by its terms and application instructions.

Nevertheless, PSD regulations require an Additional Impacts Analysis for projects that are subject to PSD review. In 40 CFR 52.21(o), it states that:

1. The owner or operator shall provide an analysis of the impairment to visibility, soils and vegetation that would occur as a result of the source or modification and general commercial, residential, industrial and other growth associated with the source or modification. The owner or operator need not provide an analysis of the impact on vegetation having no significant commercial or recreational value.
2. The owner or operator shall provide an analysis of the air quality impact projected for the area as a result of general commercial, residential, industrial and other growth associated with the source or modification.
3. The Administrator may require monitoring of visibility in any Federal Class I area near the proposed new stationary source for major modification for such purposes and by such means as the Administrator deems necessary and appropriate.

Therefore, the following sections address additional impacts requirements.

10.3.1 Visibility, Soils and Vegetation

The Skyline Landfill Expansion Project will not result in a significant increase in any air contaminant other than GHGs; therefore, it is not subject to PSD review for any other pollutant. Sources of air pollutant emissions in the Skyline Landfill Expansion area will initially consist of landfill cell construction activities, which will produce fugitive dust emissions (in the form of particulate matter with a diameter of less than 10 microns ("PM_{10}") and particulate matter with a diameter of less than 2.5 microns ("$PM_{2.5}$") from surface soil

[56] Id. at p. 48.

disturbance, fugitive dust emissions from waste transportation and fugitive emissions of LFG, the components of which are primarily CO_2 and CH_4, with trace (less than one percent) amounts of non-methane organic compounds or NMOC. NMOC's include a variety of volatile organic compounds and hazardous air pollutants, the majority of which occur in LFG not because they are the product of organic decay, but because they were directly disposed at some point in time in the landfill matrix. Pursuant to a comparison of pre-project actual (baseline) emissions rates to post-project potential to emit rates, post-project PM_{10} and $PM_{2.5}$ emissions were found to be lower than the Skyline Landfill's baseline due to changes in operating practices at the landfill over the ten-year baseline period. The post-project potential to emit VOCs reflected an increase of 14.3 TPY over baseline, occurring in 2044, the Skyline Landfill's projected year of closure. The post-project potential to emit HAPs reflected an increase of 11.97 TPY over baseline (with no individual HAP increasing by more than 10 TPY) over baseline, also occurring in 2044, the Skyline Landfill's projected year of closure.

Depending on future waste receipt organic content and volume, as well as the climate in the landfill's locale, LFG generation at the Skyline Landfill may increase to the point that it is necessary to expand the Skyline Landfill's capacity to control LFG, even though the current system is oversized due to the addition of a LFG-to-energy plant after the installation of a large, enclosed flare. However, LFG generation capacity and the availability of specific LFG control technologies this far in the future is not sufficiently predictable to support the choice of a future control technology and it's permitting at this time. Therefore, the scope of this Application and the now-granted TCEQ Standard Permit authorization is limited to fugitive sources only, exclusive of LFG control technologies, which may produce point source emissions.

As stated above, GHGs themselves are not known to have any direct impact on visibility, soils, and vegetation other than their possible impact associated with global warming, which EPA has ruled does not need to be evaluated for GHG PSD permits. However, emissions of other air pollutants from the project could potentially impact these resources. Because the project increases for all other pollutants are insignificant, it is concluded that their impact on visibility, soils, and vegetation is also insignificant.

10.3.2 Associated Growth

The Skyline Landfill Expansion Project will not significantly affect residential, commercial, or industrial growth in the area. No permanent new jobs are expected to be created, as the primary impact of the expansion is to lengthen the life of current operations, not to significantly expand their scope. However, some increase in the number of waste hauling trucks entering and leaving the facility per day may occur at certain times of heavy activity. As such, the Skyline Landfill Expansion Project will result in a negligible impact on the existing infrastructure. Because these impacts will be negligible, the corresponding impact on air quality will also be negligible.

10.3.3 Visibility Monitoring

The nearest Federal Class I Areas is the Caney Creek Wilderness in Arkansas, which is approximately 290 miles (467 kilometers) from Skyline Landfill. The non-GHG emissions associated with the Skyline Landfill Expansion Project are below the PSD major modification threshold and will not have an impact on this area.

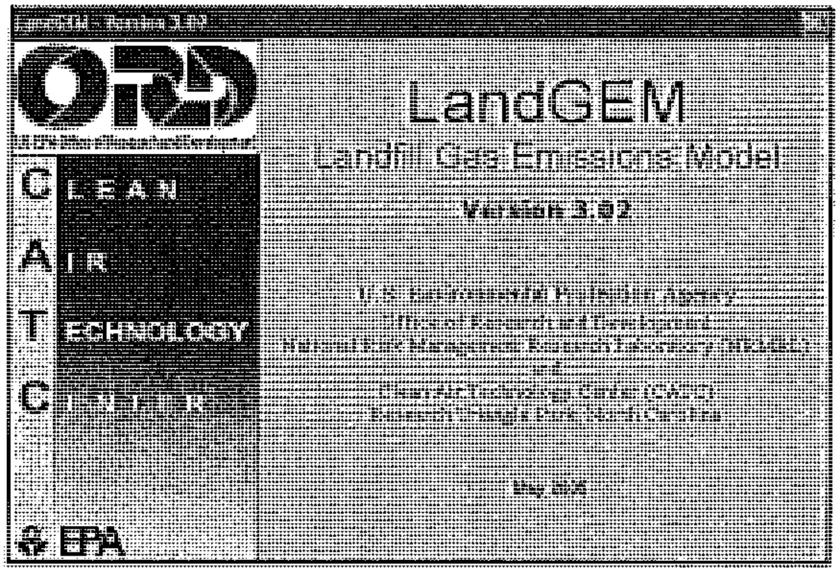
11.0 PROPOSED GHG MONITORING PROVISIONS

As explained in detail in preceding sections of this Application, there is no currently available technology for accurately and comprehensively monitoring fugitive LFG emissions, and thereby fugitive GHG (CO_2 and CH_4) emissions, from MSW landfills. This is why the complex system of modeling potential LFG generation and applying default values for LFG collection and cover oxidation are necessary. This system is the only currently available method for estimating, if not directly monitoring, fugitive LFG emissions from MSW landfills. A specific application of this method as determined by the provisions of NSPS Subpart WWW, and corresponding references to the AP-42 Standards for MSW Landfills is the only currently EPA-sanctioned method for estimating, if not directly measuring, fugitive LFG emissions.

As such, WMTX proposes to monitor fugitive GHG emissions from the Skyline Landfill Expansion Project, and the remainder of Skyline Landfill, by implementing the requirements of NSPS Subpart WWW which include, among other things, surface emissions monitoring, LFG well monitoring, LFG control device monitoring and cover condition monitoring. WMTX realizes that these activities, when properly undertaken, do not result in an actual periodic estimate of fugitive GHG emissions. Therefore, WMTX proposes to supplement this data with the data required to be collected and calculated pursuant to the EPA GHG Mandatory Reporting Rule (40 CFR 98), which applies to MSW landfills. The report submitted to EPA on an annual basis does include an annual estimate of fugitive GHG emissions. WMTX proposes this approach as the best available EPA-sanctioned method available to quantify fugitive GHG emissions from MSW landfills.

APPENDIX 1

PRE-EXPANSION PROJECT AND POST-EXPANSION PROJECT SKYLINE LANDGEM MODELS



Summary Report

Landfill Name or Identifier: Skyline Recycling and Disposal Facility

Date: Tuesday, January 17, 2006

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	**1950**	
Landfill Closure Year (with 80-year limit)	**2027**	
Actual Closure Year (without limit)	***2027***	
Have Model Calculate Closure Year?	**Yes**	
Waste Design Capacity	**32,632,611**	*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**400**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

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

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1950	53,967	59,363	0	0
1951	53,967	59,363	53,967	59,363
1952	53,967	59,363	107,933	118,726
1953	53,967	59,363	161,900	178,089
1954	53,967	59,363	215,866	237,453
1955	53,967	59,363	269,833	296,816
1956	53,967	59,363	323,799	356,179
1957	53,967	59,363	377,766	415,542
1958	53,967	59,363	431,732	474,905
1959	53,967	59,363	485,699	534,268
1960	53,967	59,363	539,665	593,632
1961	53,967	59,363	593,632	652,995
1962	53,967	59,363	647,598	712,358
1963	53,967	59,363	701,565	771,721
1964	53,967	59,363	755,531	831,084
1965	53,967	59,363	809,498	890,447
1966	53,967	59,363	863,464	949,810
1967	53,967	59,363	917,431	1,009,174
1968	53,967	59,363	971,397	1,068,537
1969	53,967	59,363	1,025,364	1,127,900
1970	53,967	59,363	1,079,330	1,187,263
1971	53,967	59,363	1,133,297	1,246,626
1972	53,967	59,363	1,187,263	1,305,989
1973	53,967	59,363	1,241,230	1,365,352
1974	53,967	59,363	1,295,196	1,424,716
1975	53,967	59,363	1,349,163	1,484,079
1976	53,967	59,363	1,403,129	1,543,442
1977	53,967	59,363	1,457,096	1,602,805
1978	53,967	59,363	1,511,062	1,662,168
1979	53,967	59,363	1,565,029	1,721,531
1980	53,967	59,363	1,618,995	1,780,895
1981	53,967	59,363	1,672,962	1,840,258
1982	53,967	59,363	1,726,928	1,899,621
1983	53,967	59,363	1,780,895	1,958,984
1984	53,967	59,363	1,834,861	2,018,347
1985	53,967	59,363	1,888,828	2,077,710
1986	53,967	59,363	1,942,794	2,137,073
1987	53,967	59,363	1,996,761	2,196,437
1988	53,967	59,363	2,050,727	2,255,800
1989	53,967	59,363	2,104,694	2,315,163

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1990	53,967	59,363	2,158,660	2,374,526
1991	53,967	59,363	2,212,627	2,433,889
1992	53,967	59,363	2,266,593	2,493,252
1993	53,967	59,363	2,320,560	2,552,615
1994	181,400	199,540	2,374,526	2,611,979
1995	456,334	501,968	2,555,926	2,811,519
1996	387,289	426,018	3,012,260	3,313,486
1997	601,341	661,475	3,399,549	3,739,504
1998	757,345	833,080	4,000,890	4,400,979
1999	812,425	893,668	4,758,235	5,234,059
2000	698,390	768,229	5,570,661	6,127,727
2001	756,754	832,429	6,269,051	6,895,956
2002	765,171	841,688	7,025,804	7,728,385
2003	921,989	1,014,188	7,790,975	8,570,072
2004	767,261	843,987	8,712,964	9,584,260
2005	876,951	964,646	9,480,225	10,428,248
2006	894,969	984,466	10,357,176	11,392,893
2007	912,535	1,003,789	11,252,145	12,377,360
2008	930,455	1,023,501	12,164,681	13,381,149
2009	948,983	1,043,882	13,095,136	14,404,650
2010	968,375	1,065,212	14,044,119	15,448,531
2011	988,304	1,087,134	15,012,494	16,513,744
2012	1,008,997	1,109,896	16,000,798	17,600,877
2013	1,030,008	1,133,009	17,009,794	18,710,774
2014	1,051,189	1,156,308	18,039,802	19,843,782
2015	1,072,964	1,180,261	19,090,991	21,000,090
2016	1,094,570	1,204,027	20,163,956	22,180,351
2017	1,116,232	1,227,855	21,258,526	23,384,378
2018	1,137,739	1,251,513	22,374,758	24,612,234
2019	1,159,472	1,275,419	23,512,497	25,863,746
2020	1,181,042	1,299,146	24,671,968	27,139,165
2021	1,202,301	1,322,531	25,853,010	28,438,311
2022	1,223,341	1,345,675	27,055,311	29,760,842
2023	1,244,382	1,368,821	28,278,652	31,106,517
2024	1,265,537	1,392,091	29,523,034	32,475,337
2025	1,286,292	1,414,921	30,788,571	33,867,428
2026	557,748	613,523	32,074,863	35,282,349
2027	0	0	32,632,611	35,895,872
2028	0	0	32,632,611	35,895,872
2029	0	0	32,632,611	35,895,872

Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1950	0	0	0	0	0	0
1951	5.296E+02	4.241E+05	2.849E+01	1.415E+02	2.120E+05	1.425E+01
1952	1.038E+03	8.315E+05	5.587E+01	2.774E+02	4.157E+05	2.793E+01
1953	1.527E+03	1.223E+06	8.217E+01	4.079E+02	6.115E+05	4.108E+01
1954	1.997E+03	1.599E+06	1.074E+02	5.334E+02	7.995E+05	5.372E+01
1955	2.448E+03	1.960E+06	1.317E+02	6.539E+02	9.802E+05	6.586E+01
1956	2.882E+03	2.308E+06	1.550E+02	7.698E+02	1.154E+06	7.752E+01
1957	3.298E+03	2.641E+06	1.775E+02	8.810E+02	1.321E+06	8.873E+01
1958	3.699E+03	2.962E+06	1.990E+02	9.879E+02	1.481E+06	9.950E+01
1959	4.083E+03	3.270E+06	2.197E+02	1.091E+03	1.635E+06	1.098E+02
1960	4.453E+03	3.565E+06	2.396E+02	1.189E+03	1.783E+06	1.198E+02
1961	4.808E+03	3.850E+06	2.587E+02	1.284E+03	1.925E+06	1.293E+02
1962	5.149E+03	4.123E+06	2.770E+02	1.375E+03	2.061E+06	1.385E+02
1963	5.476E+03	4.385E+06	2.946E+02	1.463E+03	2.193E+06	1.473E+02
1964	5.791E+03	4.637E+06	3.116E+02	1.547E+03	2.319E+06	1.558E+02
1965	6.094E+03	4.880E+06	3.279E+02	1.628E+03	2.440E+06	1.639E+02
1966	6.384E+03	5.112E+06	3.435E+02	1.705E+03	2.556E+06	1.717E+02
1967	6.664E+03	5.336E+06	3.585E+02	1.780E+03	2.668E+06	1.793E+02
1968	6.932E+03	5.551E+06	3.730E+02	1.852E+03	2.775E+06	1.865E+02
1969	7.190E+03	5.757E+06	3.868E+02	1.920E+03	2.879E+06	1.934E+02
1970	7.437E+03	5.955E+06	4.001E+02	1.987E+03	2.978E+06	2.001E+02
1971	7.675E+03	6.146E+06	4.129E+02	2.050E+03	3.073E+06	2.065E+02
1972	7.904E+03	6.329E+06	4.252E+02	2.111E+03	3.165E+06	2.126E+02
1973	8.124E+03	6.505E+06	4.371E+02	2.170E+03	3.252E+06	2.185E+02
1974	8.335E+03	6.674E+06	4.484E+02	2.226E+03	3.337E+06	2.242E+02
1975	8.537E+03	6.836E+06	4.593E+02	2.280E+03	3.418E+06	2.297E+02
1976	8.732E+03	6.992E+06	4.698E+02	2.332E+03	3.496E+06	2.349E+02
1977	8.919E+03	7.142E+06	4.799E+02	2.382E+03	3.571E+06	2.399E+02
1978	9.099E+03	7.286E+06	4.896E+02	2.430E+03	3.643E+06	2.448E+02
1979	9.272E+03	7.425E+06	4.989E+02	2.477E+03	3.712E+06	2.494E+02
1980	9.438E+03	7.558E+06	5.078E+02	2.521E+03	3.779E+06	2.539E+02
1981	9.598E+03	7.685E+06	5.164E+02	2.564E+03	3.843E+06	2.582E+02
1982	9.751E+03	7.808E+06	5.246E+02	2.605E+03	3.904E+06	2.623E+02
1983	9.898E+03	7.926E+06	5.325E+02	2.644E+03	3.963E+06	2.663E+02
1984	1.004E+04	8.039E+06	5.401E+02	2.682E+03	4.020E+06	2.701E+02
1985	1.018E+04	8.148E+06	5.475E+02	2.718E+03	4.074E+06	2.737E+02
1986	1.031E+04	8.253E+06	5.545E+02	2.753E+03	4.126E+06	2.772E+02
1987	1.043E+04	8.353E+06	5.612E+02	2.786E+03	4.177E+06	2.806E+02
1988	1.055E+04	8.450E+06	5.677E+02	2.819E+03	4.225E+06	2.839E+02
1989	1.067E+04	8.542E+06	5.740E+02	2.849E+03	4.271E+06	2.870E+02
1990	1.078E+04	8.631E+06	5.799E+02	2.879E+03	4.316E+06	2.900E+02
1991	1.089E+04	8.717E+06	5.857E+02	2.908E+03	4.359E+06	2.928E+02
1992	1.099E+04	8.799E+06	5.912E+02	2.935E+03	4.400E+06	2.956E+02
1993	1.109E+04	8.878E+06	5.965E+02	2.962E+03	4.439E+06	2.983E+02
1994	1.118E+04	8.954E+06	6.016E+02	2.987E+03	4.477E+06	3.008E+02
1995	1.252E+04	1.003E+07	6.738E+02	3.345E+03	5.014E+06	3.369E+02
1996	1.651E+04	1.322E+07	8.883E+02	4.410E+03	6.611E+06	4.442E+02
1997	1.966E+04	1.575E+07	1.058E+03	5.252E+03	7.873E+06	5.290E+02
1998	2.479E+04	1.985E+07	1.334E+03	6.623E+03	9.927E+06	6.670E+02
1999	3.125E+04	2.503E+07	1.682E+03	8.348E+03	1.251E+07	8.408E+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)
2000	3.800E+04	3.043E+07	2.045E+03	1.015E+04	1.521E+07	1.022E+03
2001	4.336E+04	3.472E+07	2.333E+03	1.158E+04	1.736E+07	1.167E+03
2002	4.909E+04	3.931E+07	2.641E+03	1.311E+04	1.965E+07	1.321E+03
2003	5.467E+04	4.378E+07	2.942E+03	1.460E+04	2.189E+07	1.471E+03
2004	6.158E+04	4.931E+07	3.313E+03	1.645E+04	2.465E+07	1.656E+03
2005	6.669E+04	5.340E+07	3.588E+03	1.781E+04	2.670E+07	1.794E+03
2006	7.268E+04	5.820E+07	3.910E+03	1.941E+04	2.910E+07	1.955E+03
2007	7.861E+04	6.295E+07	4.230E+03	2.100E+04	3.148E+07	2.115E+03
2008	8.449E+04	6.765E+07	4.546E+03	2.257E+04	3.383E+07	2.273E+03
2009	9.030E+04	7.231E+07	4.859E+03	2.412E+04	3.616E+07	2.429E+03
2010	9.608E+04	7.693E+07	5.169E+03	2.566E+04	3.847E+07	2.585E+03
2011	1.018E+05	8.153E+07	5.478E+03	2.719E+04	4.076E+07	2.739E+03
2012	1.075E+05	8.610E+07	5.785E+03	2.872E+04	4.305E+07	2.892E+03
2013	1.132E+05	9.065E+07	6.091E+03	3.024E+04	4.532E+07	3.045E+03
2014	1.189E+05	9.519E+07	6.396E+03	3.175E+04	4.759E+07	3.198E+03
2015	1.245E+05	9.971E+07	6.700E+03	3.326E+04	4.986E+07	3.350E+03
2016	1.302E+05	1.042E+08	7.004E+03	3.477E+04	5.212E+07	3.502E+03
2017	1.358E+05	1.087E+08	7.307E+03	3.628E+04	5.437E+07	3.653E+03
2018	1.414E+05	1.133E+08	7.610E+03	3.778E+04	5.663E+07	3.805E+03
2019	1.471E+05	1.178E+08	7.912E+03	3.928E+04	5.888E+07	3.956E+03
2020	1.527E+05	1.222E+08	8.214E+03	4.078E+04	6.112E+07	4.107E+03
2021	1.583E+05	1.267E+08	8.515E+03	4.228E+04	6.337E+07	4.258E+03
2022	1.639E+05	1.312E+08	8.816E+03	4.377E+04	6.561E+07	4.408E+03
2023	1.694E+05	1.357E+08	9.116E+03	4.526E+04	6.784E+07	4.558E+03
2024	1.750E+05	1.401E+08	9.416E+03	4.675E+04	7.007E+07	4.708E+03
2025	1.806E+05	1.446E+08	9.715E+03	4.823E+04	7.229E+07	4.857E+03
2026	1.861E+05	1.490E+08	1.001E+04	4.971E+04	7.451E+07	5.007E+03
2027	1.843E+05	1.476E+08	9.915E+03	4.922E+04	7.378E+07	4.958E+03
2028	1.771E+05	1.418E+08	9.526E+03	4.729E+04	7.089E+07	4.763E+03
2029	1.701E+05	1.362E+08	9.153E+03	4.544E+04	6.811E+07	4.576E+03
2030	1.634E+05	1.309E+08	8.794E+03	4.366E+04	6.544E+07	4.397E+03
2031	1.570E+05	1.257E+08	8.449E+03	4.195E+04	6.287E+07	4.225E+03
2032	1.509E+05	1.208E+08	8.118E+03	4.030E+04	6.041E+07	4.059E+03
2033	1.450E+05	1.161E+08	7.799E+03	3.872E+04	5.804E+07	3.900E+03
2034	1.393E+05	1.115E+08	7.494E+03	3.720E+04	5.576E+07	3.747E+03
2035	1.338E+05	1.072E+08	7.200E+03	3.574E+04	5.358E+07	3.600E+03
2036	1.286E+05	1.030E+08	6.917E+03	3.434E+04	5.148E+07	3.459E+03
2037	1.235E+05	9.892E+07	6.646E+03	3.300E+04	4.946E+07	3.323E+03
2038	1.187E+05	9.504E+07	6.386E+03	3.170E+04	4.752E+07	3.193E+03
2039	1.140E+05	9.131E+07	6.135E+03	3.046E+04	4.566E+07	3.068E+03
2040	1.096E+05	8.773E+07	5.895E+03	2.926E+04	4.387E+07	2.947E+03
2041	1.053E+05	8.429E+07	5.664E+03	2.812E+04	4.215E+07	2.832E+03
2042	1.011E+05	8.099E+07	5.441E+03	2.701E+04	4.049E+07	2.721E+03
2043	9.717E+04	7.781E+07	5.228E+03	2.596E+04	3.891E+07	2.614E+03
2044	9.336E+04	7.476E+07	5.023E+03	2.494E+04	3.738E+07	2.512E+03
2045	8.970E+04	7.183E+07	4.826E+03	2.396E+04	3.591E+07	2.413E+03
2046	8.618E+04	6.901E+07	4.637E+03	2.302E+04	3.451E+07	2.318E+03
2047	8.280E+04	6.631E+07	4.455E+03	2.212E+04	3.315E+07	2.228E+03
2048	7.956E+04	6.371E+07	4.280E+03	2.125E+04	3.185E+07	2.140E+03
2049	7.644E+04	6.121E+07	4.113E+03	2.042E+04	3.060E+07	2.056E+03
2050	7.344E+04	5.881E+07	3.951E+03	1.962E+04	2.940E+07	1.976E+03

TABLE G5-B-1
Estimated Landfill Gas Generation Rate
Skyline Landfill

Year	Waste In Place (Mg)	Landfill Gas Generation	
		m^3/yr	scfm
1950	0	0.000E+00	0
1951	42,727	3.357E+05	23
1952	85,240	6.566E+05	44
1953	127,540	9.633E+05	65
1954	169,629	1.256E+06	84
1955	211,508	1.536E+06	103
1956	253,177	1.803E+06	121
1957	294,638	2.058E+06	138
1958	335,891	2.302E+06	155
1959	376,938	2.534E+06	170
1960	417,780	2.756E+06	185
1961	458,418	2.967E+06	199
1962	499,340	3.172E+06	213
1963	540,549	3.372E+06	227
1964	582,046	3.565E+06	240
1965	623,834	3.754E+06	252
1966	665,914	3.937E+06	265
1967	708,289	4.116E+06	277
1968	750,960	4.290E+06	288
1969	793,930	4.459E+06	300
1970	837,201	4.625E+06	311
1971	880,775	4.786E+06	322
1972	925,438	4.949E+06	333
1973	971,217	5.115E+06	344
1974	1,018,142	5.283E+06	355
1975	1,066,239	5.454E+06	366
1976	1,115,539	5.627E+06	378
1977	1,166,071	5.804E+06	390
1978	1,217,866	5.983E+06	402
1979	1,270,956	6.166E+06	414
1980	1,325,374	6.351E+06	427
1981	1,381,152	6.541E+06	439
1982	1,438,938	6.738E+06	453
1983	1,498,805	6.944E+06	467

TABLE G5-B-1
Estimated Landfill Gas Generation Rate
Skyline Landfill
(Continued)

Year	Waste In Place (Mg)	Landfill Gas Generation	
		m^3/yr	scfm
1984	1,560,826	7.160E+06	481
1985	1,625,080	7.384E+06	496
1986	1,691,648	7.617E+06	512
1987	1,760,612	7.860E+06	528
1988	1,832,058	8.114E+06	545
1989	1,906,077	8.377E+06	563
1990	1,982,761	8.651E+06	581
1991	2,062,204	8.936E+06	600
1992	2,225,473	9.869E+06	663
1993	2,403,986	1.088E+07	731
1994	2,546,131	1.157E+07	778
1995	2,737,510	1.262E+07	848
1996	2,863,399	1.312E+07	881
1997	3,196,249	1.522E+07	1,023
1998	3,659,953	1.827E+07	1,227
1999	4,247,433	2.217E+07	1,489
2000	4,886,574	2.632E+07	1,768
2001	5,581,556	3.075E+07	2,066
2002	6,299,465	3.518E+07	2,364
2003	6,971,915	3.909E+07	2,626
2004	7,893,904	4.480E+07	3,010
2005	8,661,166	4.907E+07	3,297
2006	9,460,609	5.343E+07	3,590
2007	10,211,581	5.724E+07	3,846
2008	11,129,418	6.220E+07	4,180
2009	12,174,673	6.798E+07	4,568
2010	13,101,127	7.259E+07	4,878
2011	14,025,299	7.701E+07	5,174
2012	14,947,709	8.124E+07	5,458
2013	15,890,989	8.546E+07	5,742
2014	16,847,474	8.963E+07	6,022
2015	17,817,351	9.374E+07	6,298
2016	18,800,806	9.779E+07	6,570
2017	19,798,030	1.018E+08	6,839

TABLE G5-B-1
Estimated Landfill Gas Generation Rate
Skyline Landfill
(Continued)

Year	Waste In Place (Mg)	Landfill Gas Generation	
		m^3/yr	scfm
2018	20,809,214	1.057E+08	7,105
2019	21,834,555	1.097E+08	7,368
2020	22,874,251	1.135E+08	7,628
2021	23,928,503	1.174E+08	7,885
2022	24,997,514	1.212E+08	8,140
2023	26,081,491	1.249E+08	8,394
2024	27,180,644	1.287E+08	8,645
2025	28,295,185	1.324E+08	8,894
2026	29,425,330	1.361E+08	9,142
2027	30,571,296	1.397E+08	9,389
2028	31,733,307	1.434E+08	9,634
2029	32,911,585	1.470E+08	9,878
2030	34,106,359	1.506E+08	10,122
2031	35,317,860	1.543E+08	10,365
2032	36,546,322	1.579E+08	10,607
2033	37,791,983	1.615E+08	10,849
2034	39,055,083	1.651E+08	11,090
2035	40,335,866	1.686E+08	11,331
2036	41,634,580	1.722E+08	11,573
2037	42,951,477	1.758E+08	11,814
2038	44,286,809	1.794E+08	12,056
2039	45,640,837	1.830E+08	12,298
2040	47,013,820	1.866E+08	12,541
2041	48,406,026	1.903E+08	12,784
2042	49,817,723	1.939E+08	13,028
2043	51,249,183	1.975E+08	13,273
2044	**52,315,065**	**1.982E+08**	**13,315**
2045	52,315,065	1.904E+08	12,793
2046	52,315,065	1.829E+08	12,292
2047	52,315,065	1.758E+08	11,810
2048	52,315,065	1.689E+08	11,347
2049	52,315,065	1.623E+08	10,902
2050	52,315,065	1.559E+08	10,474

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