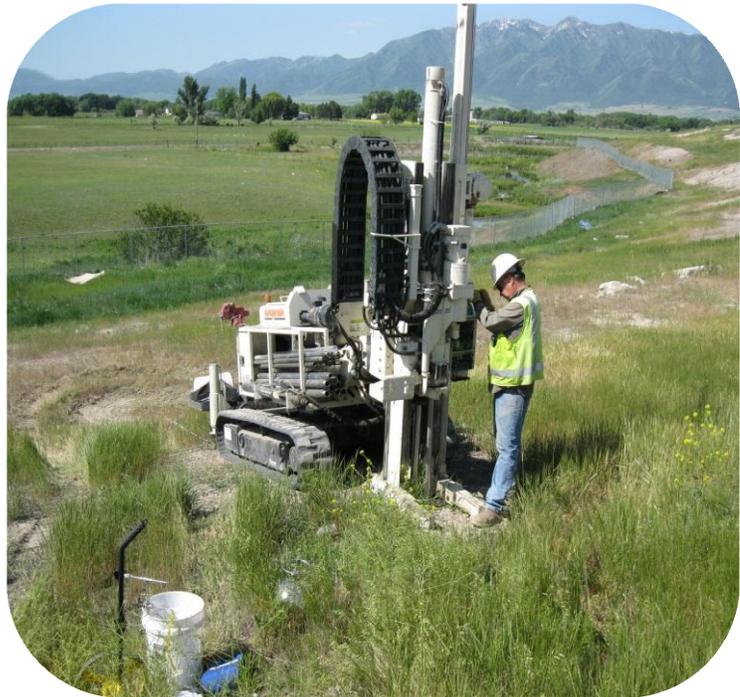


Tier 2 Non-Methane Organic Compound (NMOC) Report

Logan City Sanitary Class I Landfill
1400 West 200 North
Logan, Utah 84321

August 1, 2013
Terracon Project No. AL137277



Prepared for:
City of Logan
Logan, Utah

Prepared by:
Terracon Consultants, Inc.
Salt Lake City, Utah

Offices Nationwide
Employee-Owned

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Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

August 1, 2013

Utah Department of Environmental Quality
Division of Air Quality
P.O. Box 144820
195 N 1950 W
Salt Lake City, Utah 84114-4820



Attn: Mr. Harold Burge
P: (801) 536 4129
E-mail: hburge@utah.gov

**RE: Tier 2 Non-Methane Organic Compound (NMOC)
Logan City Sanitary Class I Landfill
Title V Air Permit No. 500103002
Terracon Project No. AL137277**

Dear Mr. Burge:

Please find enclosed the *Tier 2 NMOC Report* for the above-referenced facility. The Logan City Sanitary Class I Landfill Tier 2 testing was conducted from June 12 to June 13, 2013.

This report and enclosures will be kept in the Landfill's Permanent Operating Record to document compliance with the New Source Performance Standard (NSPS), 40 CFR Part 60 Subpart WWW – Standards of Performance for Municipal Solid Waste Landfills.

If you have any questions regarding this information, please feel free to contact me at (801) 746-5446 / cdeaton@terracon.com or David Hopkins at (501) 847-9292 / dvhopkins@terracon.com.

Sincerely,
Terracon Consultants, Inc.

A handwritten signature in blue ink, appearing to read "Craig D. Eaton".

Craig D. Eaton, P.G.
Department Manager | Environmental Services

A handwritten signature in blue ink, appearing to read "David V. Hopkins".

David V. Hopkins, P.G.
Authorized Project Reviewer



Terracon Consultants, Inc. 640 Wilmington Avenue Salt Lake City, Utah 84106
P (801) 466 2223 F (801) 466 9616 terracon.com

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**Tier 2 NMOC Report
Logan City Sanitary Class I Landfill
1400 West 200 North
Logan, Utah 84321**

**Terracon Project No. AL137277
August 1, 2013**

1.0 INTRODUCTION

The Logan City Sanitary Class I Landfill (Landfill) is located at approximately 1400 West 200 North, Logan, Cache County, Utah (Township 12 N, Range 1 E, Section 31, Salt Lake Base and Meridian) (**Figure 1** in **Appendix A**). The Landfill facility is approximately 85 acres and has a design capacity of approximately 8,397,716 cubic yards (void space not including soil), or 6,011,732 tons, as permitted under Solid Waste Permit #9432R2. Approximately 30 acres of the facility has been landfilled for two or more years.

With the issuance of Solid Waste Permit #9432R2, the Landfill is subject to the New Source Performance Standards (NSPS) (40 CFR 60, Subpart WWW - *Standards for Air Emissions from Municipal Solid Waste Landfills*) rule due to the fact that the design capacity has exceeded 2.5 million Mg (3.27 million CY). The facility's air emissions are permitted under Title V Air Permit No. 500103002 (**Appendix B**). The Tier 2 sampling to cover the next five-year period was performed on June 12 to June 13, 2013.

2.0 FIELD SAMPLING ACTIVITIES

Mr. Jeff Kolmel, Terracon Consultants, Inc. (Terracon), mobilized personnel to the site on June 12-13, 2013 to complete Tier 2 gas sampling activities in accordance with the requirements of 40 CFR 60.754(a)(3) and in accordance with the Tier 2 Testing Plan 2013 (Terracon, May 15, 2013) that was approved by the Utah Division of Air Quality. A copy of the Tier 2 Testing Plan 2013 and the associated acceptance letter from the Utah Division of Air Quality are included in **Appendix C**. The direct-push drill rig for the landfill gas sampling was operated by EarthProbe Environmental Field Services.

The NSPS Rule requires that "at least two sample probes per hectare of landfill surface that has retained waste for at least two years" be sampled. Based upon the current size of the landfill (i.e. approximately 30 acres has been landfilled for two or more years) and in accordance with NSPS requirements, a total of twenty-five (25) sample locations were selected (**Figure 2** in **Appendix A**).

The gas samples were collected utilizing a Geoprobe® direct-push drill rig equipped with a Post Run Tubing (PRT) System. The borings were advanced six (6) to eight (8) feet into the waste mass, with the exception of nine locations (LF-01, LF-11, LF-12, LF-13, LF-17, LF-18, LF-19,

LF-21 and LF-25), where water was encountered at shallow depths. In boreholes where shallow water was encountered, the boreholes were advanced one (1) to three (3) feet into the waste mass, depending on the depth to water encountered at each location. The occurrence of shallow water over such a wide area is likely due to the presence of a wet load dumping area located in the northwest portion of the site.

Once maximum depth was reached, the drill rods were withdrawn approximately six inches, exposing the PRT sampling point to the waste mass. Polyethylene tubing was then inserted through the rods and threaded onto the sampling head for collection of the gas sample. The polyethylene tubing extended out of the top of the probe rod several feet and was connected to the purge and sampling train. The purge and sampling train included a three-way purge/sample valve, a Landtec GEM2000 portable landfill gas analyzer (CH₄, N₂, O₂, and CO₂), and a vacuum gauge.

Terracon waited until the O₂ levels were below 5% and N₂ levels were below 20% at each sampling location prior to collecting a summa canister composite sample. Due to shallow groundwater, the O₂ and N₂ levels at two of the sample locations (LF-01 and LF-12) were not below the sampling thresholds prior to sampling. Several attempts were made to relocate the boreholes in these sample areas, but the presence of shallow groundwater and elevated O₂ and N₂ levels were encountered in each location. Following purging, a laboratory-supplied, batch-certified clean Summa canister was connected to the sample train and a volume equivalent to approximately one-third of a Summa canister was extracted at each sampling point. Nine (9) Summa canisters were filled, containing a composite of a maximum of three (3) samples each.

At each sample location, a Summa canister was connected to the sample train for approximately 1.5 to 3 minutes. Landfill gas samples were collected at a flow rate of approximately 400-500 milliliters per minute (mL/min) in each location. The sample volume for each borehole location was based on the initial pressure reading of the Summa canister. Samples were collected at each location until approximately one-third of the remaining pressure in the canister was depleted. The field data sheets are provided in **Appendix D**.

The summa canisters were shipped to Air Technology Laboratories, Inc. (ATL), located in City of Industry, California. The samples were analyzed for total NMOC, using EPA Method 25C, and for fixed gases (nitrogen and oxygen), using EPA Method 3C. ATL also provided the summa canisters that were used during the sampling process. Each canister was leak-checked and volume-verified prior to use. All shipping was conducted under strict Chain-of-Custody protocol.

3.0 ANALYTICAL RESULTS SUMMARY

ATL performed the required analyses and reported the results of the Tier 2 gas samples collected on June 12 and June 13, 2013. A copy of the analytical report from ATL is included in **Appendix E**.

The nine (9) Summa canisters were analyzed for nitrogen (N₂) and oxygen (O₂), using EPA Method 3C, to determine if significant air intrusion occurred during sampling. With the exception of sample AL137277-1, which had a N₂ concentration of 29%, all samples were reported to contain N₂ and O₂ concentrations less than the 5% and/or 20% criteria, respectively, indicating that ambient air intrusion had not occurred.

The nine (9) Summa canisters were also analyzed for total NMOC, using EPA Method 25C to determine the C_{NMOC} in each composite sample. The C_{NMOC} results were reported in ppmv-carbon (ppmv-c). These results were converted from C_{NMOC} ppmv-c to C_{NMOC} ppmv-h (ppmv as hexane), as required by the modeling software. To convert to the proper units, the result for C_{NMOC} ppmv-c was divided by six.

TABLE 1. C_{NMOC} Concentrations

Sample ID	Sample Locations ^a	C _{NMOC} (ppmv-c)	C _{NMOC} (ppmv-h)
AL137277-1	LF-01, LF-02 and LF-06	1,400	233
AL137277-2	LF-03, LF-04 and LF-05	1,500	250
AL137277-3	LF-08, LF-09 and LF-10	1,100	183
AL137277-4	LF-07, LF-11 and LF-12	1,700	283
AL137277-5	LF-13, LF-14 and LF-15	1,500	250
AL137277-6	LF-16	720	120
AL137277-7	LF-20, LF-24 and LF-25	540	90
AL137277-8	LF-21, LF-22 and LF-23	1,300	217
AL137277-9	LF-17, LF-18 and LF-19	1,600	267
Average		1,262	210

a – Sample locations included in the composite Summa canister.

As presented in Table 1, the site-specific C_{NMOC} results obtained during field activities were averaged for use in the NMOC mass emission rate calculation. The average C_{NMOC} was 210 ppmv-h.

4.0 NMOC MASS EMISSION RATE RESULTS

The Landfill tracks incoming waste by weight (tonnage) and provided annual waste acceptance totals to Terracon from 1960 through 2012. On the basis of these reports, it was determined that the Landfill accepted approximately 73,217 tons of waste for the 2012 reporting period.

Tier 2 NMOC Report

Logan City Sanitary Class I Landfill ■ Logan, Utah

August 1, 2013 ■ Terracon Project No. AL137277



LandGEM Version 3.02 was used to calculate the NMOC emissions from the Landfill utilizing the Class 1 municipal solid waste tonnage. The calculation was performed using the site-specific C_{NMOC} value of 210 ppmv-h obtained from the Tier 2 field activities discussed above, the default values, as provided in 40 CFR 60.754(a)(1) (methane generation potential (Lo = 170 cubic meters), and the methane generation rate constant ($k = 0.02$ for Arid Areas). The LandGEM output files for NMOC emission rates are presented in **Appendix F**.

The NMOC mass emission rate was calculated to be **8.669 Mg/yr** for the 2012 calendar year.

Based on the result of the LandGEM model, using site-specific emission information, the Landfill emission rate for NMOCs is below 50 Mg/yr. The maximum NMOC emission rate over the next five years (2013 to 2017) is estimated to be 10.08 Mg/yr.

5.0 CONCLUSIONS AND RECOMMENDATIONS

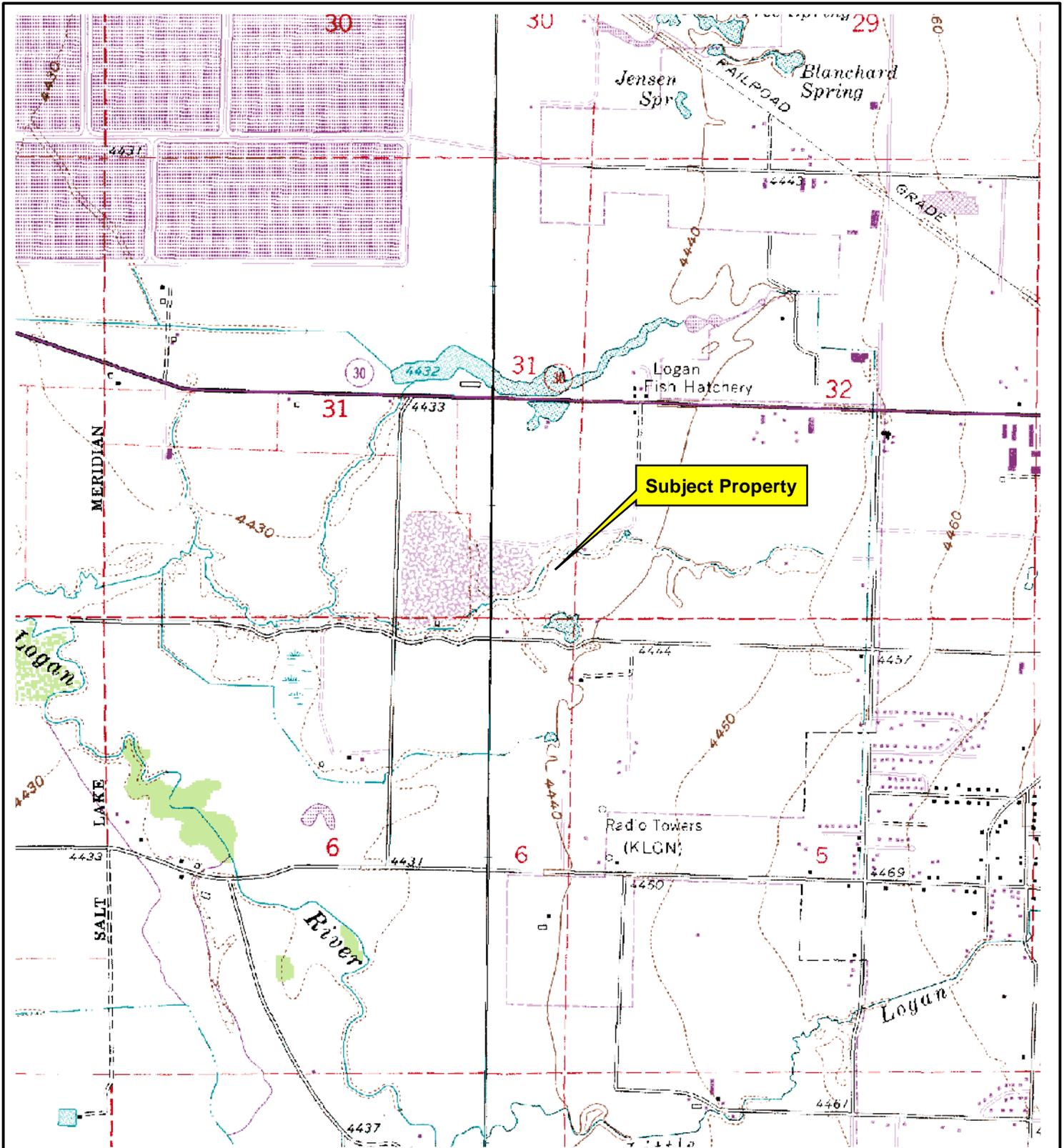
Based on the result of the EPA LandGEM emission model, the NMOC mass emission rate is less than 50 Mg/yr. Therefore, the Landfill is currently exempt from the additional landfill gas collection and control requirements as outlined in the final NSPS Rule. The facility will retest the site-specific NMOC in the year 2018.

This report and enclosures will be kept in the Landfill's Permanent Operating Record to document compliance with the current air permit (Title V Air Permit No. 500103002) and the New Source Performance Standard (NSPS), 40 CFR Part 60 Subpart WWW – Standards of Performance for Municipal Solid Waste Landfills.

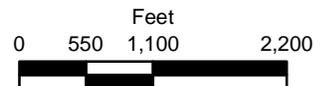
APPENDIX A – Figures

Figure 1 – Topographic Map

Figure 2 – Site Map with Sample Locations



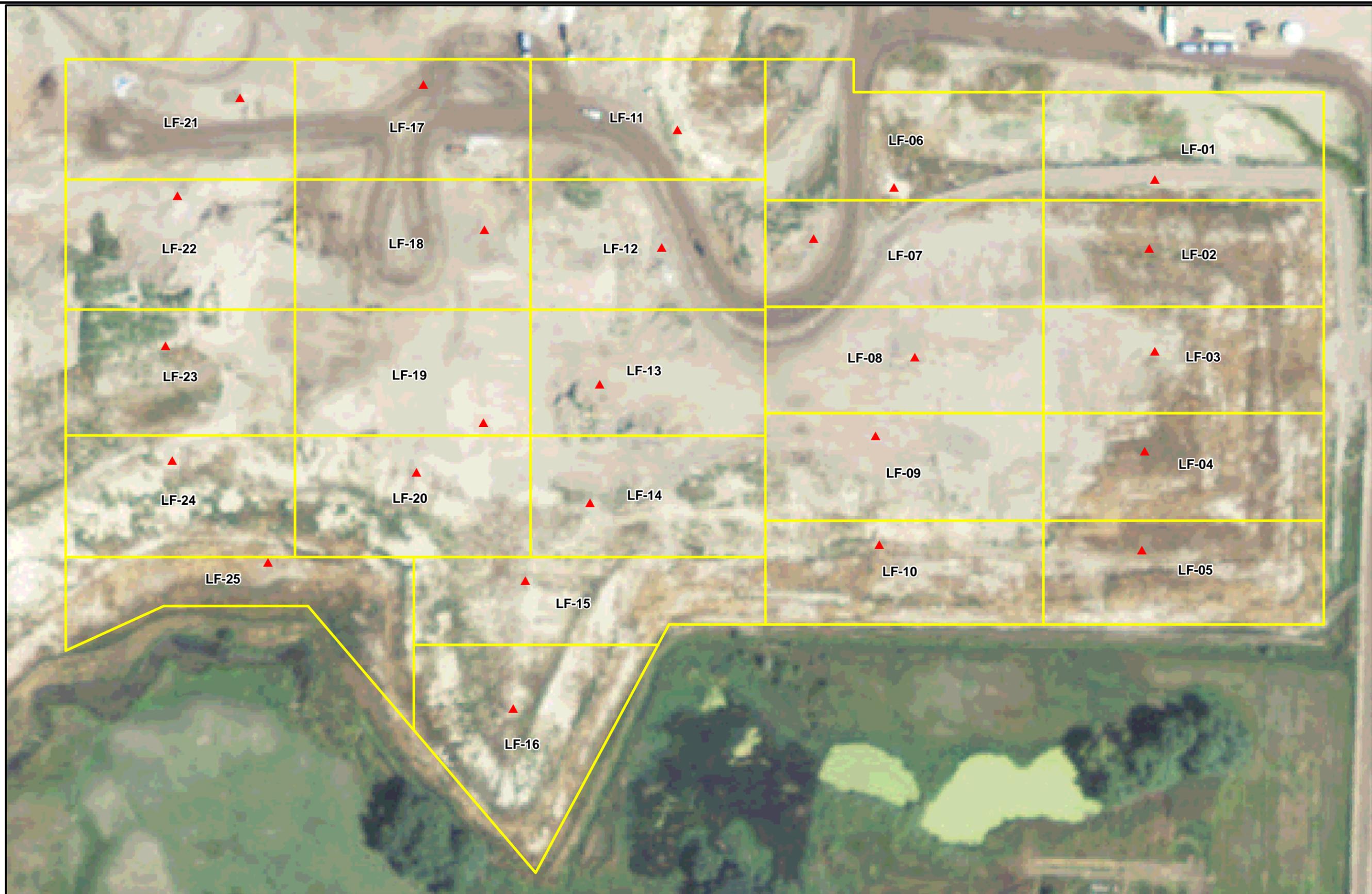
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Logan City Class I Landfill
 Title V Permit #500103002
 Tier 2 Testing Plan 2013
 Logan, Utah

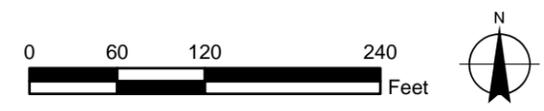
Figure 1: USGS Topographic Map

PROJECT NO:	AL137277
SHEET No:	1
DRAWN BY:	JTK
DATE:	07-22-13
REVISED BY:	
DATE:	



Logan City Class I Landfill
 Title V Permit #500103002
 Tier 2 Testing Plan 2013
 Logan, Utah
 Figure 2 - Site Map with Sample Locations

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PROJECT NO:	AL137277
SHEET NO:	2
DRAWN BY:	JTK
DATE:	07-15-13
REVISED BY:	
DATE:	

APPENDIX B – Title V Air Permit
Permit No. 500103002



State of Utah

GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF AIR QUALITY
Cheryl Heying
Director

12902

Title V Operating Permit

PERMIT NUMBER: 500103002
DATE OF PERMIT: January 14, 2010
Date of Last Revision: January 14, 2010

This Operating Permit is issued to, and applies to the following:

Name of Permittee:

City of Logan
950 W 600 N
Logan City Environmental Dept
Logan UT 843210

Permitted Location:

Logan City Landfill
450 N 1000 W
Logan UT 84321

UTM coordinates: 427,705 m Easting, 4,620,797 m Northing
SIC code: 4953 (Refuse Systems)

UTAH AIR QUALITY BOARD

By:

Prepared By:

M. Cheryl Heying, Executive Secretary

Jennifer He

ENFORCEABLE DATES AND TIMELINES

The following dates or timeframes are referenced in
Section I: General Provisions of this permit.

Annual Certification Due: April 15 of every calendar year that this permit is in force.

Renewal application due: July 14, 2014

Permit expiration date: January 14, 2015

Definition of “prompt”: written notification within 14 days.

ABSTRACT

The City of Logan operates the Logan City Landfill, a municipal solid waste (MSW) landfill source located in Cache County, Utah. The facility accepts municipal and commercial waste. Logan City Landfill is a Title V source because 40 CFR 60 Subpart WWW and the Utah State Plan for MSW landfills (Subpart Cc) have required all landfills over 2.5 million megagrams to submit a Title V application. Logan City Landfill is subject to 40 CFR 60, Subpart A - General Provisions and to Subpart Cc - Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills. Logan City Landfill is also subject to Subpart M of the National Emission Standards for Hazardous Air Pollutants (NESHAP) -National Emission Standards for Asbestos: Standards for Active Waste Disposal Sites (40 CFR 61.154) as well as to Subpart A - General Provisions of the National Emission Standards for Hazardous Air Pollutants (NESHAP).

OPERATING PERMIT HISTORY

Permit/Activity	Date Issued	Recorded Changes
Title V renewal application (Project #OPP0129020003)	1/14/2010	Changes: There are some changes made to update regulatory citations. There are no other changes in this renewal permit.
Title V initial application (Project #OPP0129020001)	2/23/2005	

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Issued under authority of Utah Code Ann. Section 19-2-104 and 19-2-109.1, and in accordance with Utah Administrative Code R307-415 Operating Permit Requirements.

All definitions, terms and abbreviations used in this permit conform to those used in Utah Administrative Code R307-101 and R307-415 (Rules), and 40 Code of Federal Regulations (CFR), except as otherwise defined in this permit. Unless noted otherwise, references cited in the permit conditions refer to the Rules.

Where a permit condition in Section I, General Provisions, partially recites or summarizes an applicable rule, the full text of the applicable portion of the rule shall govern interpretations of the requirements of the rule. In the case of a conflict between the Rules and the permit terms and conditions of Section II, Special Provisions, the permit terms and conditions of Section II shall govern except as noted in Provision I.M, Permit Shield.

SECTION I: GENERAL PROVISIONS

I.A Federal Enforcement.

All terms and conditions in this permit, including those provisions designed to limit the potential to emit, are enforceable by the EPA and citizens under the Clean Air Act of 1990 (CAA) except those terms and conditions that are specifically designated as "State Requirements". (R307-415-6b)

I.B Permitted Activity(ies).

Except as provided in R307-415-7b(1), the permittee may not operate except in compliance with this permit. (See also Provision I.E, Application Shield)

I.C Duty to Comply.

I.C.1 The permittee must comply with all conditions of the operating permit. Any permit noncompliance constitutes a violation of the Air Conservation Act and is grounds for any of the following: enforcement action; permit termination; revocation and reissuance; modification; or denial of a permit renewal application. (R307-415-6a(6)(a))

I.C.2 It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (R307-415-6a(6)(b))

I.C.3 The permittee shall furnish to the Executive Secretary, within a reasonable time, any information that the Executive Secretary may request in writing to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. Upon request, the permittee shall also furnish to the Executive Secretary copies of records required to be kept by this permit or, for information claimed to be confidential, the permittee may furnish such records directly to the EPA along with a claim of confidentiality. (R307-415-6a(6)(e))

I.C.4 This permit may be modified, revoked, reopened, and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or of a notification of planned changes or anticipated noncompliance shall not stay any permit condition, except as provided under R307-415-7f(1) for minor permit modifications. (R307-415-6a(6)(c))

I.D Permit Expiration and Renewal.

I.D.1 This permit is issued for a fixed term of five years and expires on the date shown under "Enforceable Dates and Timelines" at the front of this permit. (R307-415-6a(2))

I.D.2 Application for renewal of this permit is due on or before the date shown under "Enforceable Dates and Timelines" at the front of this permit. An application may be submitted early for any reason. (R307-415-5a(1)(c))

I.D.3 An application for renewal submitted after the due date listed in I.D.2 above shall be accepted for processing, but shall not be considered a timely application and shall not relieve the permittee of any enforcement actions resulting from submitting a late application. (R307-415-5a(5))

I.D.4 Permit expiration terminates the permittee's right to operate unless a timely and complete renewal application is submitted consistent with R307-415-7b (see also Provision I.E, Application Shield) and R307-415-5a(1)(c) (see also Provision I.D.2). (R307-415-7c(2))

I.E Application Shield.

If the permittee submits a timely and complete application for renewal, the permittee's failure to have an operating permit will not be a violation of R307-415, until the Executive Secretary takes final action on the permit renewal application. In such case, the terms and conditions of this permit shall remain in force until permit renewal or denial. This protection shall cease to apply if, subsequent to the completeness determination required pursuant to R307-415-7a(3), and as required by R307-415-5a(2), the applicant fails to submit by the deadline specified in writing by the Executive Secretary any additional information identified as being needed to process the application. (R307-415-7b(2))

I.F Severability.

In the event of a challenge to any portion of this permit, or if any portion of this permit is held invalid, the remaining permit conditions remain valid and in force. (R307-415-6a(5))

I.G Permit Fee.

I.G.1 The permittee shall pay an annual emission fee to the Executive Secretary consistent with R307-415-9. (R307-415-6a(7))

I.G.2 The emission fee shall be due on October 1 of each calendar year or 45 days after the source receives notice of the amount of the fee, whichever is later. (R307-415-9(4)(a))

I.H No Property Rights.

This permit does not convey any property rights of any sort, or any exclusive privilege. (R307-415-6a(6)(d))

I.I Revision Exception.

No permit revision shall be required, under any approved economic incentives, marketable permits, emissions trading and other similar programs or processes for changes that are provided for in this permit. (R307-415-6a(8))

I.J Inspection and Entry.

I.J.1 Upon presentation of credentials and other documents as may be required by law, the

permittee shall allow the Executive Secretary or an authorized representative to perform any of the following:

- I.J.1.a Enter upon the permittee's premises where the source is located or emissions related activity is conducted, or where records are kept under the conditions of this permit. (R307-415-6c(2)(a))
- I.J.1.b Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit. (R307-415-6c(2)(b))
- I.J.1.c Inspect at reasonable times any facilities, equipment (including monitoring and air pollution control equipment), practice, or operation regulated or required under this permit. (R307-415-6c(2)(c))
- I.J.1.d Sample or monitor at reasonable times substances or parameters for the purpose of assuring compliance with this permit or applicable requirements. (R307-415-6c(2)(d))
- I.J.2 Any claims of confidentiality made on the information obtained during an inspection shall be made pursuant to Utah Code Ann. Section 19-1-306. (R307-415-6c(2)(e))

I.K **Certification.**

Any application form, report, or compliance certification submitted pursuant to this permit shall contain certification as to its truth, accuracy, and completeness, by a responsible official as defined in R307-415-3. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete. (R307-415-5d)

I.L **Compliance Certification.**

- I.L.1 Permittee shall submit to the Executive Secretary an annual compliance certification, certifying compliance with the terms and conditions contained in this permit, including emission limitations, standards, or work practices. This certification shall be submitted no later than the date shown under "Enforceable Dates and Timelines" at the front of this permit, and that date each year following until this permit expires. The certification shall include all the following (permittee may cross-reference this permit or previous reports): (R307-415-6c(5))
 - I.L.1.a The identification of each term or condition of this permit that is the basis of the certification;
 - I.L.1.b The identification of the methods or other means used by the permittee for determining the compliance status with each term and condition during the certification period. Such methods and other means shall include, at a minimum, the monitoring and related recordkeeping and reporting requirements in this permit. If necessary, the permittee also shall identify any other material information that must be included in the certification to comply with section 113(c)(2) of the Act, which prohibits knowingly making a false certification or omitting material information;
 - I.L.1.c The status of compliance with the terms and conditions of the permit for the period covered by the certification, including whether compliance during the period was continuous or intermittent. The certification shall be based on the method or means designated in Provision I.L.1.b. The certification shall identify each deviation and take it into account in the compliance certification. The certification shall also identify as possible exceptions to

compliance any periods during which compliance is required and in which an excursion or exceedance as defined under 40 CFR Part 64 occurred; and

I.L.1.d Such other facts as the Executive Secretary may require to determine the compliance status.

I.L.2 The permittee shall also submit all compliance certifications to the EPA, Region VIII, at the following address or to such other address as may be required by the Executive Secretary: (R307-415-6c(5)(d))

Environmental Protection Agency, Region VIII
Office of Enforcement, Compliance and Environmental Justice
(mail code 8ENF)
1595 Wynkoop Street
Denver, CO 80202-1129

I.M Permit Shield.

I.M.1 Compliance with the provisions of this permit shall be deemed compliance with any applicable requirements as of the date of this permit, provided that:

I.M.1.a Such applicable requirements are included and are specifically identified in this permit, or (R307-415-6f(1)(a))

I.M.1.b Those requirements not applicable to the source are specifically identified and listed in this permit. (R307-415-6f(1)(b))

I.M.2 Nothing in this permit shall alter or affect any of the following:

I.M.2.a The emergency provisions of Utah Code Ann. Section 19-1-202 and Section 19-2-112, and the provisions of the CAA Section 303. (R307-415-6f(3)(a))

I.M.2.b The liability of the owner or operator of the source for any violation of applicable requirements under Utah Code Ann. Section 19-2-107(2)(g) and Section 19-2-110 prior to or at the time of issuance of this permit. (R307-415-6f(3)(b))

I.M.2.c The applicable requirements of the Acid Rain Program, consistent with the CAA Section 408(a). (R307-415-6f(3)(c))

I.M.2.d The ability of the Executive Secretary to obtain information from the source under Utah Code Ann. Section 19-2-120, and the ability of the EPA to obtain information from the source under the CAA Section 114. (R307-415-6f(3)(d))

I.N Emergency Provision.

I.N.1 An "emergency" is any situation arising from sudden and reasonably unforeseeable events beyond the control of the source, including acts of God, which situation requires immediate corrective action to restore normal operation, and that causes the source to exceed a technology-based emission limitation under this permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by improperly designed equipment, lack of preventive maintenance, careless or improper operation, or operator error. (R307-415-6g(1))

I.N.2 An emergency constitutes an affirmative defense to an action brought for noncompliance with such technology-based emission limitations if the affirmative defense is demonstrated

through properly signed, contemporaneous operating logs, or other relevant evidence that:

- I.N.2.a An emergency occurred and the permittee can identify the causes of the emergency. (R307-415-6g(3)(a))
- I.N.2.b The permitted facility was at the time being properly operated. (R307-415-6g(3)(b))
- I.N.2.c During the period of the emergency the permittee took all reasonable steps to minimize levels of emissions that exceeded the emission standards, or other requirements in this permit. (R307-415-6g(3)(c))
- I.N.2.d The permittee submitted notice of the emergency to the Executive Secretary within two working days of the time when emission limitations were exceeded due to the emergency. This notice must contain a description of the emergency, any steps taken to mitigate emissions, and corrective actions taken. This notice fulfills the requirement of Provision I.S.2.c below. (R307-415-6g(3)(d))
- I.N.3 In any enforcement proceeding, the permittee seeking to establish the occurrence of an emergency has the burden of proof. (R307-415-6g(4))
- I.N.4 This emergency provision is in addition to any emergency or upset provision contained in any other section of this permit. (R307-415-6g(5))

I.O Operational Flexibility.

Operational flexibility is governed by R307-415-7d(1).

I.P Off-permit Changes.

Off-permit changes are governed by R307-415-7d(2).

I.Q Administrative Permit Amendments.

Administrative permit amendments are governed by R307-415-7e.

I.R Permit Modifications.

Permit modifications are governed by R307-415-7f.

I.S Records and Reporting.

I.S.1 Records.

I.S.1.a The records of all required monitoring data and support information shall be retained by the permittee for a period of at least five years from the date of the monitoring sample, measurement, report, or application. Support information includes all calibration and maintenance records, all original strip-charts or appropriate recordings for continuous monitoring instrumentation, and copies of all reports required by this permit. (R307-415-6a(3)(b)(ii))

I.S.1.b For all monitoring requirements described in Section II, Special Provisions, the source shall record the following information, where applicable: (R307-415-6a(3)(b)(i))

I.S.1.b.1 The date, place as defined in this permit, and time of sampling or measurement.

- I.S.1.b.2 The date analyses were performed.
- I.S.1.b.3 The company or entity that performed the analyses.
- I.S.1.b.4 The analytical techniques or methods used.
- I.S.1.b.5 The results of such analyses.
- I.S.1.b.6 The operating conditions as existing at the time of sampling or measurement.
- I.S.1.c Additional record keeping requirements, if any, are described in Section II, Special Provisions.
- I.S.2 Reports.
 - I.S.2.a Monitoring reports shall be submitted to the Executive Secretary every six months, or more frequently if specified in Section II. All instances of deviation from permit requirements shall be clearly identified in the reports. (R307-415-6a(3)(c)(i))
 - I.S.2.b All reports submitted pursuant to Provision I.S.2.a shall be certified by a responsible official in accordance with Provision I.K of this permit. (R307-415-6a(3)(c)(i))
 - I.S.2.c The Executive Secretary shall be notified promptly of any deviations from permit requirements including those attributable to upset conditions as defined in this permit, the probable cause of such deviations, and any corrective actions or preventative measures taken. Prompt, as used in this condition, shall be defined as written notification within the number of days shown under "Enforceable Dates and Timelines" at the front of this permit. Deviations from permit requirements due to unavoidable breakdowns shall be reported in accordance with the provisions of R307-107. (R307-415-6a(3)(c)(ii))
- I.S.3 Notification Addresses.
 - I.S.3.a All reports, notifications, or other submissions required by this permit to be submitted to the Executive Secretary are to be sent to the following address or to such other address as may be required by the Executive Secretary:

Utah Division of Air Quality
P.O. Box 144820
Salt Lake City, UT 84114-4820
Phone: 801-536-4000
 - I.S.3.b All reports, notifications or other submissions required by this permit to be submitted to the EPA should be sent to one of the following addresses or to such other address as may be required by the Executive Secretary:

For annual compliance certifications:

Environmental Protection Agency, Region VIII
Office of Enforcement, Compliance and Environmental Justice
(mail code 8ENF)
1595 Wynkoop Street
Denver, CO 80202-1129

For reports, notifications, or other correspondence related to permit modifications, applications, etc.:

Environmental Protection Agency, Region VIII
Office of Partnerships & Regulatory Assistance Air & Radiation Program (mail code 8P-AR)
1595 Wynkoop Street
Denver, CO 80202-1129
Phone: 303-312-6440

I.T Reopening for Cause.

I.T.1 A permit shall be reopened and revised under any of the following circumstances:

I.T.1.a New applicable requirements become applicable to the permittee and there is a remaining permit term of three or more years. No such reopening is required if the effective date of the requirement is later than the date on which this permit is due to expire, unless the terms and conditions of this permit have been extended pursuant to R307-415-7c(3), application shield. (R307-415-7g(1)(a))

I.T.1.b The Executive Secretary or EPA determines that this permit contains a material mistake or that inaccurate statements were made in establishing the emissions standards or other terms or conditions of this permit. (R307-415-7g(1)(c))

I.T.1.c EPA or the Executive Secretary determines that this permit must be revised or revoked to assure compliance with applicable requirements. (R307-415-7g(1)(d))

I.T.1.d Additional applicable requirements are to become effective before the renewal date of this permit and are in conflict with existing permit conditions. (R307-415-7g(1)(e))

I.T.2 Additional requirements, including excess emissions requirements, become applicable to a Title IV affected source under the Acid Rain Program. Upon approval by EPA, excess emissions offset plans shall be deemed to be incorporated into this permit. (R307-415-7g(1)(b))

I.T.3 Proceedings to reopen and issue a permit shall follow the same procedures as apply to initial permit issuance and shall affect only those parts of this permit for which cause to reopen exists. (R307-415-7g(2))

I.U Inventory Requirements.

An emission inventory shall be submitted in accordance with the procedures of R307-150, Emission Inventories. (R307-150)

I.V Title IV and Other, More Stringent Requirements

Where an applicable requirement is more stringent than an applicable requirement of regulations promulgated under Title IV of the Act, Acid Deposition Control, both provisions shall be incorporated into this permit. (R307-415-6a(1)(b))

SECTION II: SPECIAL PROVISIONS

II.A **Emission Unit(s) Permitted to Discharge Air Contaminants.**
(R307-415-4(3)(a) and R307-415-4(4))

II.A.1 **Permitted Source**
Source-wide

II.A.2 **Landfill: Logan City Landfill**
Approximately 85 acre Municipal Solid Waste (MSW) Landfill.

II.A.3 **Misc. Tanks: Fuel Tanks**
Four above ground storage tanks. 3000 gallon or less containing Diesel Fuel and Used Oil. No unit-specific applicable requirements.

II.A.4 **Furnace: Space Heater**
Maintenance shop oil heater. Burns used oil. No unit-specific applicable requirements.

II.B **Requirements and Limitations**

The following emission limitations, standards, and operational limitations apply to the permitted facility as indicated:

II.B.1 **Conditions on permitted source (Source-wide).**

II.B.1.a **Condition:**

Sulfur content of any fuel oil burned shall be no greater than 0.85 lb/MMBtu heat input. [Origin: R307-203]. [R307-203]

II.B.1.a.1 **Monitoring:**

For each delivery of oil, the permittee shall either:

(1) Determine the fuel sulfur content expressed as lb/MMBtu in accordance with the methods of the American Society for Testing Materials (ASTM) and Equation 1;

(2) Inspect the fuel sulfur content expressed as lb/MMBtu determined by the vendor using methods of the ASTM and Equation 1; or

(3) Inspect documentation provided by the vendor that indirectly demonstrates compliance with this provision.

Equation 1:

Fuel Sulfur Content, lb/MMBtu = [(Weight percent sulfur/100) x Density (lb/gal)] / [(gross heating value (Btu/gal)) x (1 MMBtu/1,000,000 Btu)]

II.B.1.a.2 **Recordkeeping:**

Results of monitoring shall be maintained in accordance with Provision I.S.1 of this permit.

II.B.1.a.3

Reporting:

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.1.b

Condition:

Visible emissions shall be no greater than 20 percent opacity. [Origin: R307-201]. [R307-201]

II.B.1.b.1

Monitoring:

A visual opacity survey of each affected emission unit shall be performed on a quarterly basis by an individual trained on the observation procedures of 40 CFR 60, Appendix A, Method 9. If visible emissions other than condensed water vapor are observed from an emission unit, an opacity determination of that emission unit shall be performed by a certified observer within 24 hours of the initial survey. The opacity determination shall be performed in accordance with 40 CFR 60, Appendix A, Method 9 for point sources, and in accordance 58 FR 61640 Method 203A for fugitive sources.

II.B.1.b.2

Recordkeeping:

The permittee shall record the date of each visual opacity survey and keep a list of the emission points checked during the visual opacity survey. The permittee shall also keep a log of the following information for each observed visual emission: date and time visual emissions observed, emission point location and description, time and date of opacity test, and percent opacity. The records required by this provision and all data required by 40 CFR 60, Appendix A, Method 9 shall be maintained in accordance with Provision I.S.1 of this permit.

II.B.1.b.3

Reporting:

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2

Conditions on Logan City Landfill (Landfill).

II.B.2.a

Condition:

(a) The permittee shall calculate a nonmethane organic compounds (NMOC) emission rate for the landfill using the procedures specified in monitoring. The NMOC emission rate shall be recalculated annually, except as provided in paragraph (b)(1)(i) of reporting.

(1) If the calculated NMOC emission rate is less than 50 megagrams per year, the permittee shall:

(i) Submit an annual emission report to the Executive Secretary, except as provided for in paragraph (b)(1)(i) of reporting; and

(ii) Recalculate the NMOC emission rate annually using the procedures specified in (a) of monitoring until such time as the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, or the landfill is closed.

(A) If the NMOC emission rate, upon recalculation required in paragraph (a)(1)(ii), is equal to or greater than 50 megagrams per year, the permittee shall install a collection and control system in compliance with 40 CFR 60.752(b)(2).

(B) If the landfill is permanently closed, a closure notification shall be submitted

to the Executive Secretary as provided for in (d) of reporting.

(2) If the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, the permittee shall:

(i) Submit a collection and control system design plan prepared by a professional engineer to the Executive Secretary within 1 year:

(A) The collection and control system as described in the plan shall meet the design requirements of paragraph 40 CFR 60.752(b)(2)(ii).

(B) The collection and control system design plan shall include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions of 40 CFR 60.753 through 60.758 proposed by the permittee.

(C) The collection and control system design plan shall either conform with specifications for active collection systems in 40 CFR 60.759 or include a demonstration to the Executive Secretary's satisfaction of the sufficiency of the alternative provisions to 40 CFR 60.759.

(ii) The permittee shall install a collection and control system capable of meeting emissions standards in R307-221 within 30 months of the date when the landfill has an emission rate of NMOC of 50 megagrams per year or more.

(b) When the MSW landfill is closed, the permittee is no longer subject to the requirement to maintain an operating permit under 40 CFR 70 for the landfill if the landfill is not otherwise subject to the requirements of either 40 CFR 70 and if either of the following conditions are met:

(1) The landfill was never subject to the requirement for a control system under paragraph (a)(2);
or

(2) The permittee meets the conditions for control system removal specified in 40 CFR 60.752(b)(2)(v). [Origin: 40 CFR 60.752(b) and (d), R307-221]. [R307-221, 40 CFR 60 Subpart Cc]

II.B.2.a.1

Monitoring:

The permittee shall monitor the NMOC emission rate by using the equations in (a) and following the three tier process outlined in (b), (c), and (d).

(a) The permittee shall calculate the NMOC emission rate using either the equation provided in paragraph (a)(1) or the equation provided in paragraph (a)(2). Both equations may be used if the actual year to year solid waste acceptance rate is known, as specified in paragraph (a)(1) for part of the life of the landfill and the actual year to year solid waste acceptance rate is unknown, as specified in paragraph (a)(2), for part of the life of the landfill. The values to be used in both equations are 0.05 per year for k , 170 cubic meters per megagram for L_0 , and 4,000 parts per million by volume as hexane for the C_{NMOC} . For landfills located in geographical areas with a thirty-year annual average precipitation of less than 25 inches, as measured at the nearest representative official meteorological site, the k value to be used is 0.02 per year.

(1) The following equation shall be used if the actual year to year solid waste acceptance rate is known.

$$M_{NMOC} = \text{Sum } (2 k L_0 M_i (e^{-kt_i})(C_{NMOC})(3.6 \times 10^{-9})) \text{ of } i \text{ through } n$$

where,

$$M_{NMOC} = \text{Total NMOC emission rate from the landfill, megagrams per year}$$

k =methane generation rate constant, per year
 L_o =methane generation potential, cubic meters per megagram solid waste
 M_i =mass of solid waste in the i th section, megagrams
 t_i =age of the i th section, years
 C_{NMOC} =concentration of NMOC, parts per million by volume as hexane
 3.6×10^{-9} =conversion factor

The mass of nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value for M_i if documentation of the nature and amount of such wastes is maintained.

(2) The following equation shall be used if the actual year to year solid waste acceptance rate is unknown.

$$M_{\text{NMOC}} = 2L_o R (e^{-kc} - e^{-kt}) (C_{\text{NMOC}}) (3.6 \times 10^{-9})$$

Where:

M_{NMOC} =mass emission rate of NMOC, megagrams per year
 L_o =methane generation potential, cubic meters per megagram solid waste
 R =average annual acceptance rate, megagrams per year
 k =methane generation rate constant, per year
 t = age of landfill, years
 C_{NMOC} =concentration of NMOC, parts per million by volume as hexane
 c =time since closure, years; for active landfill $c=0$ and $e^{-kc} = 1$
 3.6×10^{-9} =conversion factor

The mass of nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value of R , if documentation of the nature and amount of such wastes is maintained.

(b) Tier 1. The permittee shall compare the calculated NMOC mass emission rate to the standard of 50 megagrams per year.

(1) If the NMOC emission rate calculated in (a) is less than 50 megagrams per year, then the permittee shall submit an emission rate report as provided in paragraph (b)(1) of reporting, and shall recalculate the NMOC mass emission rate annually as required under paragraph (a)(1) of this condition.

(2) If the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, then the landfill owner shall either comply with paragraph (a)(2) of this condition or determine a site-specific NMOC concentration and recalculate the NMOC emission rate using the procedures provided in paragraph (c) of this section.

(c) Tier 2. The permittee shall determine the NMOC concentration using the following sampling procedure. The permittee shall install at least two sample probes per hectare of landfill surface that has retained waste for at least 2 years. If the landfill is larger than 25 hectares in area, only 50 samples are required. The sample probes should be located to avoid known areas of nondegradable solid waste. The permittee shall collect and analyze one sample of landfill gas from each probe to determine the NMOC concentration using Method 25 or 25C of Appendix A of 40 CFR 60. Method 18 of Appendix A of 40 CFR 60 may be used to analyze the samples collected by the Method 25 or 25C sampling procedure. Taking composite samples from different probes into a single cylinder is allowed; however, equal sample volumes must be taken from each

probe. For each composite, the sampling rate, collection times, beginning and ending cylinder vacuums, or alternative volume measurements must be recorded to verify that composite volumes are equal. Composite sample volumes should not be less than one liter unless evidence can be provided to substantiate the accuracy of smaller volumes. Terminate compositing before the cylinder approaches ambient pressure where measurement accuracy diminishes. If using Method 18, the permittee must identify all compounds in the sample and, as a minimum, test for those compounds published in the most recent Compilation of Air Pollutant Emission Factors (AP 42), minus carbon monoxide, hydrogen sulfide, and mercury. As a minimum, the instrument must be calibrated for each of the compounds on the list. Convert the concentration of each Method 18 compound to C_{NMOC} as hexane by multiplying by the ratio of its carbon atoms divided by six. If more than the required numbers of samples are taken, all samples must be used in the analysis. The permittee must divide the NMOC concentration from Method 25 or 25C of Appendix A of 40 CFR 60 by six to convert from C_{NMOC} as carbon to C_{NMOC} as hexane. If the landfill has an active or passive gas removal system in place, Method 25 or 25C samples may be collected from these systems instead of surface probes provided the removal system can be shown to provide sampling as representative as the two sampling probe per hectare requirement. For active collection systems, samples may be collected from the common header pipe before the gas moving or condensate removal equipment. For these systems, a minimum of three samples must be collected from the header pipe.

(1) The permittee shall recalculate the NMOC mass emission rate using the equations provided in (a) and using the average NMOC concentration from the collected samples instead of the default value in the equations provided in (a).

(2) If the resulting mass emission rate calculated using the site specific NMOC concentration is equal to or greater than 50 megagrams per year, then the permittee shall either comply with paragraph (a)(2) of this condition, or determine the site specific methane generation rate constant and recalculate the NMOC emission rate using the site specific methane generation rate using the procedure specified in (d).

(3) If the resulting NMOC mass emission rate is less than 50 megagrams per year, the permittee shall submit a periodic estimate of the emission rate report as provided in paragraph (b)(1) of reporting and retest the site specific NMOC concentration every 5 years using the methods specified in monitoring.

(d) Tier 3. The site specific methane generation rate constant shall be determined using the procedures provided in Method 2E of appendix A of 40 CFR 60. The permittee shall estimate the NMOC mass emission rate using equations in (a) and using a site specific methane generation rate constant k , and the site specific NMOC concentration as determined in (c) instead of the default values provided in (a). The permittee shall compare the resulting NMOC mass emission rate to the standard of 50 megagrams per year.

(1) If the NMOC mass emission rate as calculated using the site specific methane generation rate and concentration of NMOC is equal to or greater than 50 megagrams per year, the permittee shall comply with paragraph (a)(2) of this condition.

(2) If the NMOC mass emission rate is less than 50 megagrams per year, then the permittee shall submit a periodic emission rate report as provided in paragraph (b)(1) of reporting and shall recalculate the NMOC mass emission rate annually, as provided in paragraph (a)(1) of reporting using the equations in (a) and using the site specific methane generation rate constant and NMOC concentration obtained in (c). The calculation of the methane generation rate constant is performed only once, and the value obtained from this test shall be used in all subsequent annual NMOC emission rate calculations. [40 CFR 60.754, R307-221].

II.B.2.a.2

Recordkeeping:

(a) Except as provided in paragraph (a)(2)(i)(B) of this condition, the permittee subject to (a) of this condition, shall keep for at least 5 years up to date, readily accessible, on site records of the design capacity report which triggered (a) of this condition, the current amount of solid waste in place, and the year by year waste acceptance rate. Off site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.

(b) Results of monitoring shall also be maintained in accordance with provision I.S.1 of this permit.

II.B.2.a.3

Reporting:

Except as provided in paragraph (a)(2)(i)(B) of this condition,

(a) An amended design capacity report shall be submitted to the Executive Secretary providing notification of any increase in the design capacity of the landfill, whether the increase results from an increase in the permitted area or depth of the landfill, a change in the operating procedures, or any other means which results in an increase in the maximum design capacity of the landfill. The amended design capacity report shall be submitted within 90 days of the earliest of the following events:

- (1) the issuance of an amended operating permit;
- (2) submittal of application for a solid waste permit under R315-310; or
- (3) the change in operating procedures which will result in an increase in design capacity.

(b) The permittee shall submit an NMOC emission rate report to the Executive Secretary initially and annually thereafter, except as provided for in paragraph (b)(1)(i). The Executive Secretary may request such additional information as may be necessary to verify the reported NMOC emission rate.

(1) The NMOC emission rate report shall contain an annual or 5 year estimate of the NMOC emission rate calculated using the formula and procedures provided in monitoring.

(i) If the estimated NMOC emission rate as reported in the annual report to the Executive Secretary is less than 50 megagrams per year in each of the next 5 consecutive years, the permittee may elect to submit an estimate of the NMOC emission rate for the next 5 year period in lieu of the annual report. This estimate shall include the current amount of solid waste in place and the estimated waste acceptance rate for each year of the 5 years for which an NMOC emission rate is estimated. All data and calculations upon which this estimate is based shall be provided to the Executive Secretary. This estimate shall be revised at least once every 5 years. If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5 year estimate, a revised 5 year estimate shall be submitted to the Executive Secretary. The revised estimate shall cover the 5 year period beginning with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate.

(2) The NMOC emission rate report shall include all the data, calculations, sample reports and measurements used to estimate the annual or 5 year emissions.

(c) Each permittee subject to the provisions of paragraph (a)(2)(i) of this condition shall submit a collection and control system design plan to the Executive Secretary within 1 year of the first report required under (b) in which the emission rate equals or exceeds 50 megagrams per year, except as follows:

(1) If the permittee elects to recalculate the NMOC emission rate after Tier 2 NMOC sampling and analysis as provided in (c) of monitoring and the resulting rate is less than 50

megagrams per year, annual periodic reporting shall be resumed, using the Tier 2 determined site specific NMOC concentration, until the calculated emission rate is equal to or greater than 50 megagrams per year or the landfill is closed. The revised NMOC emission rate report, with the recalculated emission rate based on NMOC sampling and analysis, shall be submitted within 180 days of the first calculated exceedance of 50 megagrams per year.

(2) If the permittee elects to recalculate the NMOC emission rate after determining a site specific methane generation rate constant (k), as provided in Tier 3 in (d) of monitoring, and the resulting NMOC emission rate is less than 50 Mg/yr, annual periodic reporting shall be resumed. The resulting site specific methane generation rate constant (k) shall be used in the emission rate calculation until such time as the emissions rate calculation results in an exceedance. The revised NMOC emission rate report based on the provisions of (d) of monitoring and the resulting site specific methane generation rate constant (k) shall be submitted to the Executive Secretary within 1 year of the first calculated emission rate exceeding 50 megagrams per year.

(d) Each permittee of a landfill shall submit a closure report to the Executive Secretary within 30 days of waste acceptance cessation. The Executive Secretary may request additional information as may be necessary to verify that permanent closure has taken place in accordance with the requirements of 40 CFR 258.60. If a closure report has been submitted to the Executive Secretary, no additional wastes may be placed into the landfill without filing a notification of modification as described under 40 CFR 60.7(a)(4).

(e) The permittee shall notify the Executive Secretary of the awarding of contracts for the construction of the collection and control system or the order to purchase components for the system. This notification shall be submitted within 18 months after reporting an NMOC emission equal to or greater than 50 megagrams per year.

(f) The permittee shall also comply with the reporting requirements of Section I of this permit. [40 CFR 60.757, R307-221-3(3)].

II.B.2.b Condition:

The permittee shall meet one of the following requirements for all asbestos disposal operations at the landfill:

(a) there shall be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited,

(b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall:

(1) be covered with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, or

(2) be covered with a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. Such an agent shall be used in the manner and frequency recommended for the particular dust by the dust suppression agent manufacturer to achieve and maintain dust control. Other equally effective dust suppression agents may be used upon prior approval by the Executive Secretary. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(c) use an alternative emissions control method that has received prior written approval by the U.S. Environmental Protection Agency (USEPA) according to the procedures described in 40 CFR 61.149(c)(2). [Origin: 40 CFR 61.154]. [40 CFR 61 Subpart M]

II.B.2.b.1 Monitoring:

If the permittee chooses to comply with the no visible emissions provisions of this condition, a visual opacity observation of each active asbestos disposal site shall be performed on a daily basis in accordance with 58 FR 61640 Method 203C.

If the permittee chooses to comply with the daily cover provisions of this condition, a visual inspection of the site(s) where asbestos containing waste material is deposited shall be conducted daily to verify compliance with this condition.

II.B.2.b.2 Recordkeeping:

If the permittee chooses to comply with the no visible emissions provisions of this condition, a log of the visual opacity observations shall be maintained as described in Provision S.1 in Section I of this permit. All data required by 40 CFR 60, Appendix A, Method 9 or 58 FR 61640, Method 203C shall also be maintained as described in Provision S.1 in Section I of this permit.

If the permittee chooses to comply with the daily cover provisions of this condition, results of daily visual inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.b.3 Reporting:

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2.c Condition:

Upon closure of an asbestos-containing waste disposal site, the permittee shall submit a copy of records of asbestos waste disposal locations and quantities and shall:

(a) Comply with one of the following:

(1) Either discharge no visible emissions to the outside air from an inactive asbestos-containing waste disposal site or

(2) Cover the asbestos-containing waste material with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the asbestos-containing waste material. In desert areas where vegetation would be difficult to maintain, at least 8 additional centimeters (3 inches) of well-graded, nonasbestos crushed rock may be placed on top of the final cover instead of vegetation and maintained to prevent emissions; or

(3) Cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted nonasbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste; or

(4) For inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent that effectively binds dust to control surface air emissions may be used instead of the methods in paragraphs (a) (1), (2), and (3) of this section. Use the agent in the manner and frequency recommended for the particular asbestos tailings by the manufacturer of the dust suppression agent to achieve and maintain dust control. Obtain prior written approval of USEPA to use other equally effective dust suppression agents. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(b) Unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as follows, or comply with paragraph (a)(2) or (a)(3) of this

(1) Display warning signs at all entrances and at intervals of 100 m (328 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements for 51 cm×36 cm (20"×14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation
Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block
Do Not Create Dust	1.9 cm (3/4 inch) Sans Serif, Gothic or Block
Breathing Asbestos is Hazardous to Your Health	14 Point Gothic

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

(2) Fence the perimeter of the site in a manner adequate to deter access by the general public.

(3) When requesting a determination on whether a natural barrier adequately deters public access, supply information enabling the Administrator to determine whether a fence or a natural barrier adequately deters access by the general public.

(c) In lieu of complying with the requirements of paragraph (a) or (b) of this condition, the permittee may use an alternative control method that has received prior approval of the USEPA. [Origin: 40 CFR 61.151]. [40 CFR 61 Subpart M]

II.B.2.c.1

Monitoring:

A visual inspection of each closed site where asbestos containing waste material is deposited shall be conducted quarterly to verify compliance with all the requirements of 40 CFR 61.151.

II.B.2.c.2

Recordkeeping:

Results of all inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.c.3

Reporting:

(a) The permittee shall notify the Executive Secretary in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Executive Secretary at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. The following information shall be included in the notice:

(1) Scheduled starting and completion dates.

(2) Reason for disturbing the waste.

(3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Executive Secretary may require changes in the emission control procedures to be used.

(4) Location of any temporary storage site and the final disposal site.

(b) Within 60 days of a site becoming inactive and after the effective date of this subpart, record, in accordance with State law, a notation on the deed to the facility property and on any other instrument that would normally be examined during a title search; this notation shall in perpetuity notify any potential purchaser of the property that:

(1) The land has been used for the disposal of asbestos-containing waste material;

(2) The survey plot and record of the location and quantity of asbestos-containing waste disposed of within the disposal site required in 40 CFR 61.154(f) have been filed with the USEPA; and

(3) The site is subject to 40 CFR 61, Subpart M.

II.B.2.d Condition:

The permittee shall maintain waste shipment records of all asbestos-containing waste material received. In addition to routine shipment-tracking information, the waste shipment records shall document instances of improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers. [Origin: 40 CFR 61.154]. [40 CFR 61 Subpart M]

II.B.2.d.1 Monitoring:

Records required for this permit condition will serve as monitoring.

II.B.2.d.2 Recordkeeping:

Records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site shall be maintained on a map or diagram of the disposal area as described in Provisions I.S.1 of this permit.

II.B.2.d.3 Reporting:

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2.e Condition:

Unless a natural barrier adequately deters access by the general public, the permittee shall comply with one of the following:

- (a) the fencing and warning sign requirements of 40 CFR 61.154 (b), or
- (b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material. [Origin: 40 CFR 61.154]. [40 CFR 61 Subpart M]

II.B.2.e.1 Monitoring:

If the permittee chooses to comply with the fencing and warning sign provisions of this condition, a visual inspection of the property line including all entrances to the site and/or sections of the site where asbestos containing waste material is deposited shall be conducted quarterly to verify compliance with the fencing and warning sign requirements of 40 CFR 61.154 (b)

If the permittee chooses to comply with the daily cover provisions of this condition, a visual inspection of the site(s) where asbestos containing waste material is deposited shall be conducted daily to verify compliance with this condition.

II.B.2.e.2 Recordkeeping:

Results of all inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.e.3

Reporting:

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2.f

Condition:

The permittee shall maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area. [Originated: 40 CFR 61.154]. [40 CFR 61 Subpart M]

II.B.2.f.1

Monitoring:

Records required for this permit condition will serve as monitoring.

II.B.2.f.2

Recordkeeping:

Records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site shall be maintained on a map or diagram of the disposal area as described in Provisions I.S.1 of this permit. [R307-415-6b]

II.B.2.f.3

Reporting:

The permittee shall notify the Executive Secretary in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Executive Secretary at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

- (1) Scheduled starting and completion dates.
- (2) Reason for disturbing the waste.
- (3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Executive Secretary may require changes in the emission control procedures to be used.
- (4) Location of any temporary storage site and the final disposal site.

All reports shall be in accordance with Provision I.S.2 of this permit.

II.C

Emissions Trading

(R307-415-6a(10))

Not applicable to this source.

II.D

Alternative Operating Scenarios.

(R307-415-6a(9))

Not applicable to this source.

II.E Source-specific Definitions.
[R307-415-6a]

Not applicable to this source.

SECTION III: PERMIT SHIELD

A permit shield was not granted for any specific requirements.

SECTION IV: ACID RAIN PROVISIONS

IV.A **This source is not subject to Title IV. This section is not applicable.**

REVIEWER COMMENTS

1. Comment on an item originating in this permit regarding Permitted Source Renewal permit (2010): CAM is not applicable to the renewal permit because there is no pollution control equipment in the permitted source. No changes in the renewal permit except some regulatory citations. [Last updated on 09/16/09]
2. Comment on an item originating in 40 CFR 60.154 regarding Landfill: Logan City Landfill Definition of "Significant Amount": A significant amount of improperly enclosed or uncovered waste is hereby defined as one cubic meter of asbestos-containing waste material. Based on EPA standard conversion factors for typical asbestos-waste containers, one cubic meter of waste material is approximately equal to 9.8 drums or barrels (35 gallons each) or 17.4 plastic bags. [Last updated on 11/03/2004]

**APPENDIX C – Tier 2 Testing Plan 2013 and
DAQ Acceptance Letter**



State of Utah

GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF AIR QUALITY
Bryce C. Bird
Director

COPY

June 5, 2013

DAQC-676-13
Site ID 12902 (B4)

Issa A. Hamud, P.E.
City of Logan
Logan City Environmental Dept.
950 West 600 North
Logan, Utah 84321

Dear Mr. Hamud:

Re: City of Logan – Sanitary Class I Landfill - Protocol Review and Test Date Confirmation –
Cache County

The testing protocol for the Logan City Landfill dated May 15, 2013, has been reviewed and found acceptable. The agreed upon test date is June 12-13, 2013.

Acceptance of a protocol does not relieve the owner/operator and the testing contractor from strict adherence to all applicable EPA methods, Utah Division of Air Quality (DAQ) policies, Utah Air Quality Rules (UAQR), and methods approved by the Executive Secretary. Any deviation from EPA methods, DAQ policies, UAQR, and methods approved by the Executive Secretary must be addressed separately and express written consent given prior to commencement of testing.

The DAQ requires that all test reports include a statement signed by a responsible official certifying that:

- A. Testing was conducted while the source was operating at the rate and/or conditions specified in the applicable approval order, operating permit, or federal regulation.
- B. During testing, the source combusted fuels, used raw materials, and maintained process conditions representative of normal operations, and operated under such other relevant conditions specified by the Executive Secretary.
- C. Based on information and belief formed after reasonable inquiry, the statements and information contained in the report are true, accurate, and complete.

If you have any questions, call me at (801) 536-4408 or e-mail me at rsirrine@utah.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Sirrine". The signature is fluid and cursive, with a long horizontal stroke at the end.

Robert Sirrine, Environmental Scientist
Division of Air Quality

RS:lk

cc: Bear River Health Department
Terracon Consultants, Inc.



May 15, 2013

Mr. Harold Burge
Utah Department of Environmental Quality
Division of Air Quality
195 N 1950 W
Salt Lake City, Utah 84114-4820

Subject: Tier 2 Testing Plan 2013
Logan City Sanitary Class I Landfill
Air Permit Facility No. 500103002
Terracon Project No. AL137277

Dear Mr. Burge:

Terracon Consultants Inc. (Terracon) is pleased to submit this plan to perform Tier 2 Landfill Gas Non-Methane Organic Compound (NMOC) testing and reporting for the Logan City Sanitary Class I Landfill located in Logan City, Utah. Testing for the NMOC concentration of landfill gas (LFG) is required every five years. The Tier 2 testing is required to conform to the criteria and sampling methodology detailed in the New Source Performance Standards (NSPS) for Municipal Solid Waste Landfills (40 CR 60, Subpart WWW) and to meet facility Title V air permit requirements.

In order to determine the potential emissions and pursuant to Monitoring Condition II.B.2.a.1(c) Tier 2 of the Title V Operating Permit #500103002, the facility is required to conduct a Tier 2 Testing every five years. The results of the testing will be submitted as a NMOC report for the Landfill within 30 days the completion of testing.

The following information outlines the plan for conducting Tier 2 testing at the Landfill in order to determine the site-specific NMOC concentration emissions:

Background

The City of Logan operates the Logan City Landfill, a municipal solid waste (MSW) landfill source, located in southwest 1/4 section of Section 31, Township 12 North, Range 1 East, Salt Lake Base and Meridian, Cache County, Utah. The facility accepts municipal and commercial waste. Logan City Landfill is a Title V source because 40 CFR 60 Subpart WWW and the Utah State Plan for MSW landfills (Subpart Cc) have required all landfills over 2.5 million megagrams to submit a Title V application. Logan City Landfill is subject to 40 CFR 60, Subpart A - General Provisions and to Subpart Cc - Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills. Logan City Landfill is also subject to Subpart M of the National Emission

Terracon Consultants, Inc. 640 Wilmington Avenue Salt Lake City, Utah 84106
P [801] 466-2223 F [801] 466-9616 terracon.com



**Logan City Sanitary Class I Landfill
Title V Permit Number: No. 500103002
Tier 2 Testing Plan 2013**

Standards for Hazardous Air Pollutants (NESHAP) -National Emission Standards for Asbestos: Standards for Active Waste Disposal Sites (40 CFR 61.154) as well as to Subpart A - General Provisions of the National Emission Standards for Hazardous Air Pollutants (NESHAP).

The Landfill has exercised the option of calculating the NMOC emission rate by performing site specific landfill gas sampling (Tier 2 Testing) as per their Title V permit, Sections II.B.2.a.1(a) and II.B.2.a.1(c).

Scope

Terracon proposes to collect a total of 25 landfill gas samples from the locations depicted on Figure 1. The sample locations were chosen in areas where waste has been in-place in excess of two years pursuant to 40 CFR 60, Subpart WWW. Sample locations may be adjusted in the field if difficult drilling conditions are encountered.

The gas samples will be collected utilizing a rig-mounted geoprobe rig, operated by Earth Probe Environmental Field Services, equipped with a Post Run Tubing (PRT) System. The geoprobe will be advanced seven (7) to ten (10) feet into the waste mass. Once maximum depth is reached, the PRT sampling point will be exposed to the waste mass. Plastic tubing will then be inserted through the drill stem to the exposed interval. The sampling train includes a pressure gauge, flow meter and a Landtec GEM2000 or equivalent that is used for purging and to obtain gas readings (CH₄, N₂, O₂, and CO₂). Terracon will wait until the O₂ levels are below 5% at each sampling location prior to collecting a summa canister composite sample. A peristaltic pump will then be attached to the plastic tubing and gas will be pumped into the summa canister utilizing a flow controller. A volume equivalent to approximately one-third of a summa canister will be extracted at each sampling point. The summa canisters will be filled, containing a composite of a maximum of three (3) samples each.

The rig-mounted geoprobe is very mobile in all types of soil conditions. If inclement weather prevents mobilization between sampling points or the landfill is too wet to drive on, a re-mobilization will be considered. Any unforeseen setbacks due to weather will be handled as they occur.

Additionally, Terracon personnel will be on-site to collect and record field information and provide guidance for the subcontractor. Terracon anticipates the field activities to be completed within three working days.

Once the sample is collected at each sampling point, Terracon will fill each penetration hole with a blend of clayey soils and/or bentonite uncoated pellets to the surface. The bentonite pellets will be compacted using hand tools and hydrated to seal the hole.

Logan City Sanitary Class I Landfill
Title V Permit Number: No. 500103002
Tier 2 Testing Plan 2013

Upon receipt of the analytical data and calculation of the site-specific NMOC concentration, and after Terracon has been provided waste totals for the Landfill since operations have begun to the year 2012, Terracon will re-evaluate the compliance status of the Landfill in terms of NSPS, utilizing the site-specific NMOC concentration and the EPA Landfill Gas Emission Model (LandGEM). The Landfill will receive a draft NMOC report for review and comment. Subsequently, Terracon will provide the Landfill with two (2) copies of the final report detailing the results of the Tier 2 sampling for their submittal to the regulatory agency.

Should you have any questions or require any additional information after the review of this document, please feel free to contact me at cdeaton@terracon.com / (801) 466-2223 or David Hopkins at dvhopkins@terracon.com / (501) 847-9292.

Sincerely,

Terracon



Craig Eaton, P.G.
Manager of Environmental Services



David Hopkins, P.G.
Authorized Project Reviewer

Attachment 1: FIGURE 1 – Logan City Sanitary Class I Landfill Tier 2 Proposed Sampling Locations

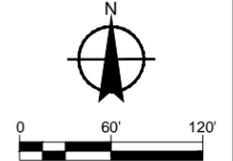
Attachment 1

FIGURE 1 – Logan City Sanitary Class I Landfill Tier 2 Proposed Sampling Locations

\\E:\Projects\2013\AL137277\Working\ElRea\Map\Expos\AL137277.dwg - E:_562013_1105259 AM_mbradley - ANS\Full\646417.DWG - 11.00.inch.plt



Legend
 Proposed Sampling Grid
 Proposed Sample Location



Logan City Sanitary Class I Landfill
 Title V Permit #500103002
 Tier 2 Testing Plan 2013
 Logan, Utah

Figure 1 - Logan City Sanitary Class I Landfill Tier 2 Proposed Sampling Locations

PROJECT No:	AL137277
SHEET:	1
DRAWN BY:	MBradley
DATE:	5-3-13
REVISED BY:	
DATE:	
REVIEWED BY:	
DATE:	

APPENDIX D – Field Data Sheets

APPENDIX E – Laboratory Analytical Report



July 1, 2013

Terracon Consultants
ATTN: Craig Eaton
640 E. Wilmington Ave.
Salt Lake City, UT 84106



D.O. ELAP
ADE-1461
EPA Methods TO-3,
TO14A, TO15 SIM & Scan,
ASTM D1946



LA Cert 04140
EPA Methods TO3, TO14A, TO15, 25C/3C,
RSK-175
TX Cert T104704450-09-TX
EPA Methods TO14A, TO15

LABORATORY TEST RESULTS

Project Reference: Logan Landfill Tier 2 Sampling; AL137277
Lab Number: E061907-01/09

Enclosed are results for sample(s) received 6/19/13 by Air Technology Laboratories. Analyses were performed according to specifications on the chain of custody provided with the sample(s).

Report Narrative:

- Unless otherwise noted in the report, sample analyses were performed within method performance criteria and meet all requirements of the NELAC Standards.
- The enclosed results relate only to the sample(s).

Preliminary results were e-mailed to Craig Eaton, Jeff Kolmel and David Jaros on 6/28/13.

ATL appreciates the opportunity to provide testing services to your company. If you have any questions regarding these results, please call me at (626) 964-4032.

Sincerely,

A handwritten signature in blue ink, appearing to read "Mark Johnson".

Mark Johnson
Operations Manager
MJohnson@AirTechLabs.com

Note: The cover letter is an integral part of this analytical report.



18501 E. Gale Ave., Suite 130
 City of Industry, CA 91748
 Ph: 626-964-4032
 Fax: 626-964-5832

Project No.: AL137277

Project Name: Logan Landfill Tier 2 Sampling

Report To: Craig Eaton + Jeff Kolmel, David Jacos

Company: Terracon

Street: 640 E. Wilmington Ave.

City/State/Zip: Salt Lake City UT

Phone & Fax: 801 466 2223

e-mail: Eaton@ihi-env.com, Kolmel@ihi-env.com, djjacos@terracon.com

CHAIN OF CUSTODY RECORD

TURNAROUND TIME		DELIVERABLES		PAGE: 1 OF 1	
Standard	<input checked="" type="checkbox"/> 48 hours	EDD	<input checked="" type="checkbox"/> Change	Condition upon receipt:	
Same Day	<input type="checkbox"/> 72 hours	EDF	<input type="checkbox"/> per jumps	Sealed	Yes <input type="checkbox"/> No <input type="checkbox"/>
24 hours	<input type="checkbox"/> 96 hours	LEVEL 3	<input type="checkbox"/>	Intact	Yes <input type="checkbox"/> No <input type="checkbox"/>
Other:		LEVEL 4	<input type="checkbox"/>	Chilled	_____ deg C

BILLING

P.O. No.: AL137277

Bill to:

ANALYSIS REQUEST

NMOCs (25C/3C)

LAB USE ONLY	SAMPLE IDENTIFICATION			SAMPLE TIME	MATRIX	CONTAINER TYPE
	SAMPLE DATE	SAMPLE TIME	MATRIX	CONTAINER TYPE		
FD061907-01	6/12/13	10:17	Gas	Suma	X	
-02	6/12/13	12:08			X	
-03	6/12/13	13:33			X	
-04	6/12/13	14:31			X	
-05	6/12/13	16:04			X	
-06	6/13/13	09:56			X	
-07	6/13/13	10:39			X	
-08	6/13/13	11:49			X	
-09	6/13/13	13:49			X	

COMMENTS

AUTHORIZATION TO PERFORM WORK	DATE/TIME	COMPANY
SAMPLED BY Jeff Kolmel	DATE/TIME 6/12/13 + 6/13/13	COMPANY Terracon
RELINQUISHED BY Jeff Kolmel	DATE/TIME 6/13/13 10:30	RECEIVED BY WPS
RELINQUISHED BY WPS	DATE/TIME 6/19/13 1144	RECEIVED BY Duffy
RELINQUISHED BY	DATE/TIME	RECEIVED BY

METHOD OF TRANSPORT (circle one): Walk-In FedEx (UPS) Courier ATLI Other

DISTRIBUTION: White & Yellow - Lab Copies / Pink - Customer Copy

Preservation: H=HCL N=None / Container: B=Bag C=Can V=VOA O=Other Rev. 03 - 5/7/09

Client: Terracon
Attn: Craig Eaton

Project Name: Logan Landfill Tier 2 Sampling
Project Number: AL137277
Date Received: 6/19/2013
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

Lab Number:		E061907-01	E061907-02	E061907-03	E061907-04	E061907-05						
Client Sample ID:		AL137277-1	AL137277-2	AL137277-3	AL137277-4	AL137277-5						
Date Collected:		6/12/2013	6/12/2013	6/12/2013	6/12/2013	6/12/2013						
Date Analyzed:		6/27/2013	6/27/2013	6/28/2013	6/28/2013	6/28/2013						
Analyst Initials:		MJ	MJ	MJ	MJ	MJ						
QC Batch:		130627GC8A1	130627GC8A1	130627GC8A1	130627GC8A1	130627GC8A1						
Dilution Factor:		3.4	3.4	3.4	3.2	3.2						
ANALYTE	Units	PQL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
TNMOC	ppmv C	10	1,400	34	1,500	34	1,100	34	1,700	32	1,500	32
TNMOC uncorr*	ppmv C	10	820	34	1,400	34	1,000	34	1,300	32	1,400	32
Nitrogen	% v/v	1.0	29	3.4	ND	3.4	4.4	3.4	14	3.2	ND	3.2
Oxygen	% v/v	0.50	3.0	1.7	ND	1.7	ND	1.7	3.8	1.6	ND	1.6

ND = Not detected at or above reporting limit.

PQL = Practical Quantitation Limit.

TNMOC = Total Non-Methane Organic Carbon.

TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.

NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By:



Mark Johnson
Operations Manager

Date:

6-28-13

The cover letter is an integral part of this analytical report.



Client: Terracon
Attn: Craig Eaton

Project Name: Logan Landfill Tier 2 Sampling
Project Number: AL137277
Date Received: 6/19/2013
Matrix: Vapor

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

Lab Number:		E061907-06	E061907-07	E061907-08	E061907-09							
Client Sample ID:		AL137277-6	AL137277-7	AL137277-8	AL137277-9							
Date Collected:		6/13/2013	6/13/2013	6/13/2013	6/13/2013							
Date Analyzed:		6/28/2013	6/28/2013	6/28/2013	6/28/2013							
Analyst Initials:		MJ	MJ	MJ	MJ							
QC Batch:		130627GC8A1	130627GC8A1	130627GC8A1	130627GC8A1							
Dilution Factor:		3.2	3.4	3.4	3.2							
ANALYTE	Units	PQL	Result	RL	Result	RL	Result	RL	Result	RL		
TNMOC	ppmv C	10	720	32	540	34	1,300	34	1,600	32		
TNMOC uncorr*	ppmv C	10	680	32	460	34	1,200	34	1,400	32		
Nitrogen	% v/v	1.0	ND	3.2	8.5	3.4	ND	3.4	5.1	3.2		
Oxygen	% v/v	0.50	ND	1.6	2.3	1.7	ND	1.7	ND	1.6		

ND = Not detected at or above reporting limit.

PQL = Practical Quantitation Limit.

TNMOC = Total Non-Methane Organic Carbon.

TNMOC uncorr* = TNMOC concentration in sample without nitrogen/moisture correction.

NA = Nitrogen/moisture correction causes division by zero.

Reviewed/Approved By:



Mark Johnson
Operations Manager

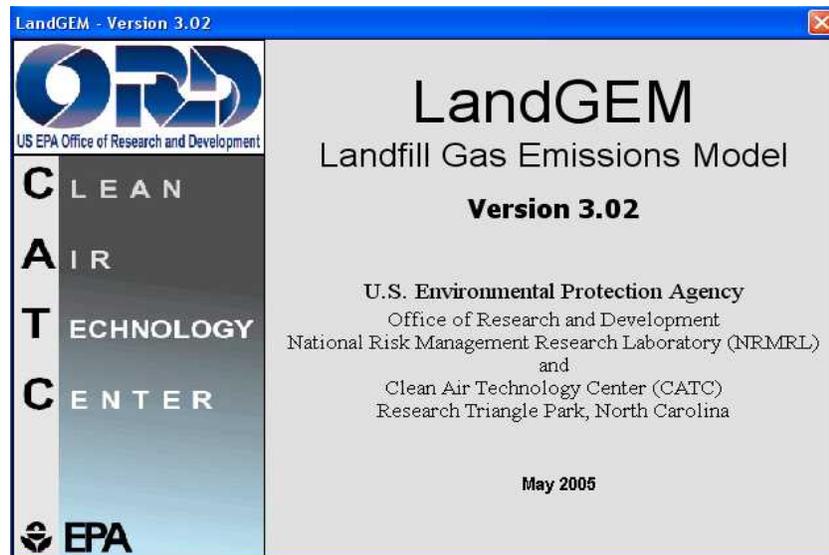
Date:

6-28-13

The cover letter is an integral part of this analytical report.



APPENDIX F – Landfill Gas Emissions Model Output



Summary Report

Landfill Name or Identifier: Logan City Sanitary Landfill

Date: Tuesday, July 30, 2013

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_{CH_4} = 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 conventional 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	1960	
Landfill Closure Year (with 80-year limit)	2039	
Actual Closure Year (without limit)	2044	
Have Model Calculate Closure Year?	Yes	
Waste Design Capacity	6,011,732	<i>short tons</i>

The 80-year waste acceptance limit of the model has been exceeded before the Waste Design Capacity was reached. The model will assume the 80th year of waste acceptance as the final year to estimate emissions. See Section 2.6 of the User's Manual.

MODEL PARAMETERS

Methane Generation Rate, k	0.020	<i>year⁻¹</i>
Potential Methane Generation Capacity, L ₀	170	<i>m³/Mg</i>
NMOC Concentration	210	<i>ppmv as hexane</i>
Methane Content	50	<i>% by volume</i>

GASES / POLLUTANTS SELECTED

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

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1960	3,405	3,746	0	0
1961	3,471	3,818	3,405	3,746
1962	3,890	4,279	6,876	7,564
1963	4,323	4,755	10,766	11,843
1964	4,768	5,245	15,089	16,598
1965	5,226	5,749	19,857	21,843
1966	5,888	6,477	25,084	27,592
1967	6,569	7,226	30,972	34,069
1968	7,270	7,997	37,541	41,295
1969	7,990	8,789	44,811	49,292
1970	8,730	9,603	52,801	58,081
1971	9,528	10,481	61,531	67,684
1972	10,350	11,385	71,059	78,165
1973	11,197	12,317	81,409	89,550
1974	12,068	13,275	92,606	101,867
1975	27,002	29,702	104,675	115,142
1976	28,971	31,868	131,676	144,844
1977	30,992	34,091	160,647	176,712
1978	33,066	36,373	191,639	210,803
1979	35,195	38,714	224,705	247,176
1980	37,375	41,113	259,900	285,890
1981	39,814	43,795	297,275	327,003
1982	42,321	46,553	337,089	370,798
1983	44,898	49,388	379,410	417,351
1984	47,545	52,299	424,308	466,739
1985	50,262	55,288	471,853	519,038
1986	53,048	58,353	522,115	574,326
1987	55,904	61,494	575,163	632,679
1988	58,665	64,531	631,066	694,173
1989	61,727	67,900	689,731	758,704
1990	64,889	71,378	751,458	826,604
1991	68,153	74,968	816,347	897,982
1992	70,288	77,317	884,500	972,950
1993	70,750	77,825	954,788	1,050,267
1994	55,255	60,781	1,025,538	1,128,092
1995	61,195	67,315	1,080,794	1,188,873
1996	63,692	70,061	1,141,989	1,256,188
1997	68,393	75,232	1,205,681	1,326,249
1998	71,948	79,143	1,274,074	1,401,481
1999	73,985	81,383	1,346,022	1,480,624

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2000	72,869	80,156	1,420,006	1,562,007
2001	78,194	86,013	1,492,875	1,642,163
2002	76,540	84,194	1,571,069	1,728,176
2003	72,254	79,479	1,647,609	1,812,370
2004	77,603	85,363	1,719,863	1,891,849
2005	80,962	89,058	1,797,465	1,977,212
2006	81,350	89,485	1,878,427	2,066,270
2007	75,345	82,879	1,959,777	2,155,755
2008	71,445	78,590	2,035,122	2,238,634
2009	70,025	77,028	2,106,567	2,317,224
2010	72,826	80,109	2,176,593	2,394,252
2011	71,074	78,181	2,249,419	2,474,361
2012	66,561	73,217	2,320,493	2,552,542
2013	97,636	107,400	2,387,054	2,625,759
2014	97,636	107,400	2,484,690	2,733,159
2015	97,636	107,400	2,582,326	2,840,559
2016	97,636	107,400	2,679,963	2,947,959
2017	97,636	107,400	2,777,599	3,055,359
2018	97,636	107,400	2,875,235	3,162,759
2019	97,636	107,400	2,972,872	3,270,159
2020	97,636	107,400	3,070,508	3,377,559
2021	97,636	107,400	3,168,145	3,484,959
2022	97,636	107,400	3,265,781	3,592,359
2023	97,636	107,400	3,363,417	3,699,759
2024	97,636	107,400	3,461,054	3,807,159
2025	97,636	107,400	3,558,690	3,914,559
2026	97,636	107,400	3,656,326	4,021,959
2027	97,636	107,400	3,753,963	4,129,359
2028	97,636	107,400	3,851,599	4,236,759
2029	97,636	107,400	3,949,235	4,344,159
2030	97,636	107,400	4,046,872	4,451,559
2031	97,636	107,400	4,144,508	4,558,959
2032	97,636	107,400	4,242,145	4,666,359
2033	97,636	107,400	4,339,781	4,773,759
2034	97,636	107,400	4,437,417	4,881,159
2035	97,636	107,400	4,535,054	4,988,559
2036	97,636	107,400	4,632,690	5,095,959
2037	97,636	107,400	4,730,326	5,203,359
2038	97,636	107,400	4,827,963	5,310,759
2039	97,636	107,400	4,925,599	5,418,159

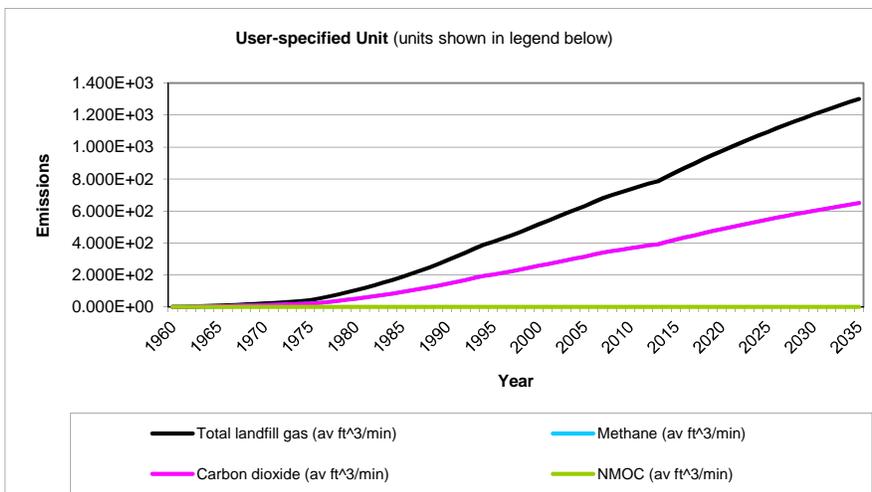
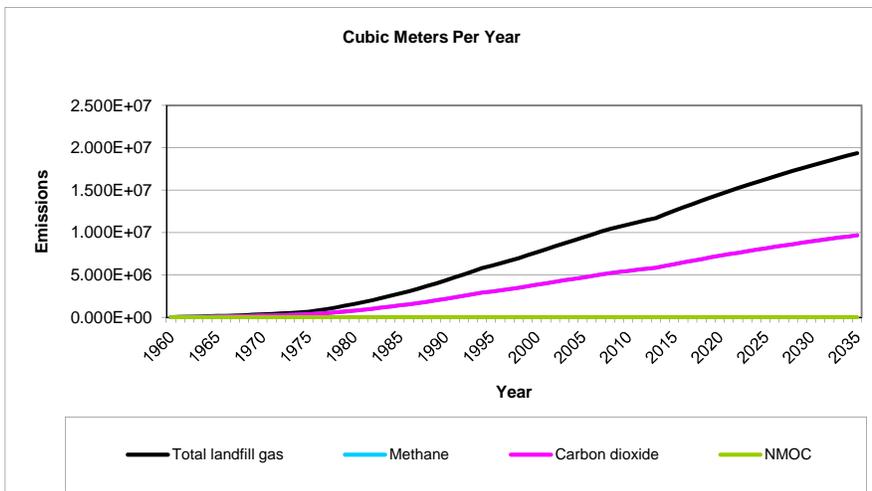
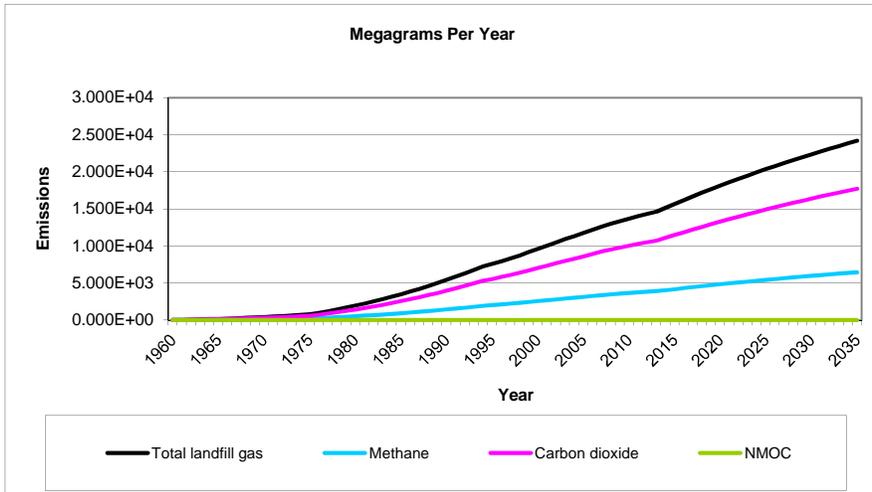
Pollutant Parameters

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

Pollutant Parameters (Continued)

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

Graphs



Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1960	0	0	0	0	0	0
1961	2.866E+01	2.295E+04	1.542E+00	7.656E+00	1.147E+04	7.710E-01
1962	5.730E+01	4.589E+04	3.083E+00	1.531E+01	2.294E+04	1.542E+00
1963	8.891E+01	7.119E+04	4.783E+00	2.375E+01	3.560E+04	2.392E+00
1964	1.235E+02	9.892E+04	6.646E+00	3.300E+01	4.946E+04	3.323E+00
1965	1.612E+02	1.291E+05	8.674E+00	4.306E+01	6.455E+04	4.337E+00
1966	2.020E+02	1.618E+05	1.087E+01	5.396E+01	8.088E+04	5.434E+00
1967	2.476E+02	1.982E+05	1.332E+01	6.613E+01	9.912E+04	6.660E+00
1968	2.979E+02	2.386E+05	1.603E+01	7.958E+01	1.193E+05	8.015E+00
1969	3.532E+02	2.828E+05	1.900E+01	9.435E+01	1.414E+05	9.502E+00
1970	4.135E+02	3.311E+05	2.225E+01	1.104E+02	1.655E+05	1.112E+01
1971	4.788E+02	3.834E+05	2.576E+01	1.279E+02	1.917E+05	1.288E+01
1972	5.495E+02	4.400E+05	2.956E+01	1.468E+02	2.200E+05	1.478E+01
1973	6.257E+02	5.010E+05	3.366E+01	1.671E+02	2.505E+05	1.683E+01
1974	7.075E+02	5.666E+05	3.807E+01	1.890E+02	2.833E+05	1.903E+01
1975	7.951E+02	6.367E+05	4.278E+01	2.124E+02	3.183E+05	2.139E+01
1976	1.007E+03	8.060E+05	5.416E+01	2.689E+02	4.030E+05	2.708E+01
1977	1.230E+03	9.853E+05	6.620E+01	3.287E+02	4.927E+05	3.310E+01
1978	1.467E+03	1.175E+06	7.893E+01	3.918E+02	5.873E+05	3.946E+01
1979	1.716E+03	1.374E+06	9.234E+01	4.584E+02	6.871E+05	4.617E+01
1980	1.978E+03	1.584E+06	1.064E+02	5.285E+02	7.921E+05	5.322E+01
1981	2.254E+03	1.805E+06	1.213E+02	6.020E+02	9.024E+05	6.063E+01
1982	2.544E+03	2.037E+06	1.369E+02	6.796E+02	1.019E+06	6.844E+01
1983	2.850E+03	2.282E+06	1.533E+02	7.613E+02	1.141E+06	7.667E+01
1984	3.171E+03	2.540E+06	1.706E+02	8.471E+02	1.270E+06	8.532E+01
1985	3.509E+03	2.810E+06	1.888E+02	9.372E+02	1.405E+06	9.439E+01
1986	3.862E+03	3.093E+06	2.078E+02	1.032E+03	1.546E+06	1.039E+02
1987	4.232E+03	3.389E+06	2.277E+02	1.130E+03	1.695E+06	1.139E+02
1988	4.619E+03	3.699E+06	2.485E+02	1.234E+03	1.849E+06	1.243E+02
1989	5.021E+03	4.021E+06	2.702E+02	1.341E+03	2.010E+06	1.351E+02
1990	5.441E+03	4.357E+06	2.928E+02	1.453E+03	2.179E+06	1.464E+02
1991	5.880E+03	4.708E+06	3.163E+02	1.571E+03	2.354E+06	1.582E+02
1992	6.337E+03	5.074E+06	3.409E+02	1.693E+03	2.537E+06	1.705E+02
1993	6.803E+03	5.447E+06	3.660E+02	1.817E+03	2.724E+06	1.830E+02
1994	7.264E+03	5.816E+06	3.908E+02	1.940E+03	2.908E+06	1.954E+02
1995	7.585E+03	6.074E+06	4.081E+02	2.026E+03	3.037E+06	2.040E+02
1996	7.950E+03	6.366E+06	4.277E+02	2.123E+03	3.183E+06	2.139E+02
1997	8.328E+03	6.669E+06	4.481E+02	2.225E+03	3.334E+06	2.240E+02
1998	8.739E+03	6.998E+06	4.702E+02	2.334E+03	3.499E+06	2.351E+02
1999	9.171E+03	7.344E+06	4.934E+02	2.450E+03	3.672E+06	2.467E+02
2000	9.613E+03	7.697E+06	5.172E+02	2.568E+03	3.849E+06	2.586E+02
2001	1.004E+04	8.036E+06	5.399E+02	2.681E+03	4.018E+06	2.700E+02
2002	1.049E+04	8.404E+06	5.646E+02	2.803E+03	4.202E+06	2.823E+02
2003	1.093E+04	8.753E+06	5.881E+02	2.920E+03	4.377E+06	2.941E+02
2004	1.132E+04	9.067E+06	6.092E+02	3.024E+03	4.533E+06	3.046E+02
2005	1.175E+04	9.410E+06	6.323E+02	3.139E+03	4.705E+06	3.161E+02
2006	1.220E+04	9.770E+06	6.564E+02	3.259E+03	4.885E+06	3.282E+02
2007	1.264E+04	1.012E+07	6.802E+02	3.377E+03	5.062E+06	3.401E+02
2008	1.303E+04	1.043E+07	7.009E+02	3.480E+03	5.216E+06	3.504E+02
2009	1.337E+04	1.071E+07	7.194E+02	3.571E+03	5.353E+06	3.597E+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)
2010	1.370E+04	1.097E+07	7.368E+02	3.658E+03	5.483E+06	3.684E+02
2011	1.404E+04	1.124E+07	7.552E+02	3.749E+03	5.620E+06	3.776E+02
2012	1.436E+04	1.150E+07	7.724E+02	3.835E+03	5.748E+06	3.862E+02
2013	1.463E+04	1.172E+07	7.873E+02	3.909E+03	5.859E+06	3.936E+02
2014	1.516E+04	1.214E+07	8.159E+02	4.051E+03	6.072E+06	4.080E+02
2015	1.569E+04	1.256E+07	8.440E+02	4.190E+03	6.280E+06	4.220E+02
2016	1.620E+04	1.297E+07	8.715E+02	4.327E+03	6.485E+06	4.357E+02
2017	1.670E+04	1.337E+07	8.984E+02	4.460E+03	6.686E+06	4.492E+02
2018	1.719E+04	1.376E+07	9.248E+02	4.591E+03	6.882E+06	4.624E+02
2019	1.767E+04	1.415E+07	9.507E+02	4.720E+03	7.075E+06	4.754E+02
2020	1.814E+04	1.453E+07	9.761E+02	4.846E+03	7.264E+06	4.881E+02
2021	1.861E+04	1.490E+07	1.001E+03	4.970E+03	7.449E+06	5.005E+02
2022	1.906E+04	1.526E+07	1.025E+03	5.091E+03	7.631E+06	5.127E+02
2023	1.950E+04	1.562E+07	1.049E+03	5.209E+03	7.808E+06	5.246E+02
2024	1.994E+04	1.597E+07	1.073E+03	5.326E+03	7.983E+06	5.364E+02
2025	2.037E+04	1.631E+07	1.096E+03	5.440E+03	8.154E+06	5.478E+02
2026	2.078E+04	1.664E+07	1.118E+03	5.552E+03	8.321E+06	5.591E+02
2027	2.119E+04	1.697E+07	1.140E+03	5.661E+03	8.486E+06	5.701E+02
2028	2.160E+04	1.729E+07	1.162E+03	5.768E+03	8.646E+06	5.810E+02
2029	2.199E+04	1.761E+07	1.183E+03	5.874E+03	8.804E+06	5.916E+02
2030	2.238E+04	1.792E+07	1.204E+03	5.977E+03	8.959E+06	6.019E+02
2031	2.275E+04	1.822E+07	1.224E+03	6.078E+03	9.111E+06	6.121E+02
2032	2.313E+04	1.852E+07	1.244E+03	6.177E+03	9.259E+06	6.221E+02
2033	2.349E+04	1.881E+07	1.264E+03	6.274E+03	9.405E+06	6.319E+02
2034	2.385E+04	1.910E+07	1.283E+03	6.370E+03	9.548E+06	6.415E+02
2035	2.420E+04	1.937E+07	1.302E+03	6.463E+03	9.687E+06	6.509E+02
2036	2.454E+04	1.965E+07	1.320E+03	6.554E+03	9.825E+06	6.601E+02
2037	2.487E+04	1.992E+07	1.338E+03	6.644E+03	9.959E+06	6.692E+02
2038	2.520E+04	2.018E+07	1.356E+03	6.732E+03	1.009E+07	6.780E+02
2039	2.553E+04	2.044E+07	1.373E+03	6.818E+03	1.022E+07	6.867E+02
2040	2.584E+04	2.069E+07	1.390E+03	6.903E+03	1.035E+07	6.952E+02
2041	2.533E+04	2.028E+07	1.363E+03	6.766E+03	1.014E+07	6.814E+02
2042	2.483E+04	1.988E+07	1.336E+03	6.632E+03	9.941E+06	6.679E+02
2043	2.434E+04	1.949E+07	1.309E+03	6.501E+03	9.744E+06	6.547E+02
2044	2.386E+04	1.910E+07	1.283E+03	6.372E+03	9.551E+06	6.417E+02
2045	2.338E+04	1.872E+07	1.258E+03	6.246E+03	9.362E+06	6.290E+02
2046	2.292E+04	1.835E+07	1.233E+03	6.122E+03	9.177E+06	6.166E+02
2047	2.247E+04	1.799E+07	1.209E+03	6.001E+03	8.995E+06	6.044E+02
2048	2.202E+04	1.763E+07	1.185E+03	5.882E+03	8.817E+06	5.924E+02
2049	2.159E+04	1.728E+07	1.161E+03	5.766E+03	8.642E+06	5.807E+02
2050	2.116E+04	1.694E+07	1.138E+03	5.652E+03	8.471E+06	5.692E+02
2051	2.074E+04	1.661E+07	1.116E+03	5.540E+03	8.303E+06	5.579E+02
2052	2.033E+04	1.628E+07	1.094E+03	5.430E+03	8.139E+06	5.469E+02
2053	1.993E+04	1.596E+07	1.072E+03	5.322E+03	7.978E+06	5.360E+02
2054	1.953E+04	1.564E+07	1.051E+03	5.217E+03	7.820E+06	5.254E+02
2055	1.914E+04	1.533E+07	1.030E+03	5.114E+03	7.665E+06	5.150E+02
2056	1.877E+04	1.503E+07	1.010E+03	5.012E+03	7.513E+06	5.048E+02
2057	1.839E+04	1.473E+07	9.896E+02	4.913E+03	7.364E+06	4.948E+02
2058	1.803E+04	1.444E+07	9.700E+02	4.816E+03	7.219E+06	4.850E+02
2059	1.767E+04	1.415E+07	9.508E+02	4.721E+03	7.076E+06	4.754E+02
2060	1.732E+04	1.387E+07	9.320E+02	4.627E+03	6.936E+06	4.660E+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)
2061	1.698E+04	1.360E+07	9.135E+02	4.535E+03	6.798E+06	4.568E+02
2062	1.664E+04	1.333E+07	8.955E+02	4.446E+03	6.664E+06	4.477E+02
2063	1.631E+04	1.306E+07	8.777E+02	4.358E+03	6.532E+06	4.389E+02
2064	1.599E+04	1.280E+07	8.603E+02	4.271E+03	6.402E+06	4.302E+02
2065	1.567E+04	1.255E+07	8.433E+02	4.187E+03	6.276E+06	4.217E+02
2066	1.536E+04	1.230E+07	8.266E+02	4.104E+03	6.151E+06	4.133E+02
2067	1.506E+04	1.206E+07	8.102E+02	4.023E+03	6.030E+06	4.051E+02
2068	1.476E+04	1.182E+07	7.942E+02	3.943E+03	5.910E+06	3.971E+02
2069	1.447E+04	1.159E+07	7.785E+02	3.865E+03	5.793E+06	3.892E+02
2070	1.418E+04	1.136E+07	7.631E+02	3.788E+03	5.678E+06	3.815E+02
2071	1.390E+04	1.113E+07	7.480E+02	3.713E+03	5.566E+06	3.740E+02
2072	1.363E+04	1.091E+07	7.331E+02	3.640E+03	5.456E+06	3.666E+02
2073	1.336E+04	1.070E+07	7.186E+02	3.568E+03	5.348E+06	3.593E+02
2074	1.309E+04	1.048E+07	7.044E+02	3.497E+03	5.242E+06	3.522E+02
2075	1.283E+04	1.028E+07	6.904E+02	3.428E+03	5.138E+06	3.452E+02
2076	1.258E+04	1.007E+07	6.768E+02	3.360E+03	5.036E+06	3.384E+02
2077	1.233E+04	9.873E+06	6.634E+02	3.293E+03	4.937E+06	3.317E+02
2078	1.209E+04	9.678E+06	6.502E+02	3.228E+03	4.839E+06	3.251E+02
2079	1.185E+04	9.486E+06	6.374E+02	3.164E+03	4.743E+06	3.187E+02
2080	1.161E+04	9.298E+06	6.247E+02	3.102E+03	4.649E+06	3.124E+02
2081	1.138E+04	9.114E+06	6.124E+02	3.040E+03	4.557E+06	3.062E+02
2082	1.116E+04	8.934E+06	6.002E+02	2.980E+03	4.467E+06	3.001E+02
2083	1.094E+04	8.757E+06	5.884E+02	2.921E+03	4.378E+06	2.942E+02
2084	1.072E+04	8.583E+06	5.767E+02	2.863E+03	4.292E+06	2.884E+02
2085	1.051E+04	8.413E+06	5.653E+02	2.806E+03	4.207E+06	2.826E+02
2086	1.030E+04	8.247E+06	5.541E+02	2.751E+03	4.123E+06	2.770E+02
2087	1.009E+04	8.083E+06	5.431E+02	2.696E+03	4.042E+06	2.716E+02
2088	9.895E+03	7.923E+06	5.324E+02	2.643E+03	3.962E+06	2.662E+02
2089	9.699E+03	7.766E+06	5.218E+02	2.591E+03	3.883E+06	2.609E+02
2090	9.507E+03	7.613E+06	5.115E+02	2.539E+03	3.806E+06	2.557E+02
2091	9.319E+03	7.462E+06	5.014E+02	2.489E+03	3.731E+06	2.507E+02
2092	9.134E+03	7.314E+06	4.914E+02	2.440E+03	3.657E+06	2.457E+02
2093	8.953E+03	7.169E+06	4.817E+02	2.392E+03	3.585E+06	2.409E+02
2094	8.776E+03	7.027E+06	4.722E+02	2.344E+03	3.514E+06	2.361E+02
2095	8.602E+03	6.888E+06	4.628E+02	2.298E+03	3.444E+06	2.314E+02
2096	8.432E+03	6.752E+06	4.537E+02	2.252E+03	3.376E+06	2.268E+02
2097	8.265E+03	6.618E+06	4.447E+02	2.208E+03	3.309E+06	2.223E+02
2098	8.101E+03	6.487E+06	4.359E+02	2.164E+03	3.244E+06	2.179E+02
2099	7.941E+03	6.359E+06	4.272E+02	2.121E+03	3.179E+06	2.136E+02
2100	7.784E+03	6.233E+06	4.188E+02	2.079E+03	3.116E+06	2.094E+02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1960	0	0	0	0	0	0
1961	2.100E+01	1.147E+04	7.710E-01	1.731E-02	4.828E+00	3.244E-04
1962	4.200E+01	2.294E+04	1.542E+00	3.460E-02	9.653E+00	6.486E-04
1963	6.516E+01	3.560E+04	2.392E+00	5.368E-02	1.498E+01	1.006E-03
1964	9.053E+01	4.946E+04	3.323E+00	7.459E-02	2.081E+01	1.398E-03
1965	1.181E+02	6.455E+04	4.337E+00	9.734E-02	2.716E+01	1.825E-03
1966	1.480E+02	8.088E+04	5.434E+00	1.220E-01	3.403E+01	2.286E-03
1967	1.814E+02	9.912E+04	6.660E+00	1.495E-01	4.170E+01	2.802E-03
1968	2.184E+02	1.193E+05	8.015E+00	1.799E-01	5.019E+01	3.372E-03
1969	2.589E+02	1.414E+05	9.502E+00	2.133E-01	5.950E+01	3.998E-03
1970	3.030E+02	1.655E+05	1.112E+01	2.497E-01	6.965E+01	4.680E-03
1971	3.509E+02	1.917E+05	1.288E+01	2.891E-01	8.065E+01	5.419E-03
1972	4.027E+02	2.200E+05	1.478E+01	3.318E-01	9.256E+01	6.219E-03
1973	4.586E+02	2.505E+05	1.683E+01	3.778E-01	1.054E+02	7.082E-03
1974	5.186E+02	2.833E+05	1.903E+01	4.272E-01	1.192E+02	8.008E-03
1975	5.827E+02	3.183E+05	2.139E+01	4.801E-01	1.339E+02	8.999E-03
1976	7.377E+02	4.030E+05	2.708E+01	6.078E-01	1.696E+02	1.139E-02
1977	9.018E+02	4.927E+05	3.310E+01	7.430E-01	2.073E+02	1.393E-02
1978	1.075E+03	5.873E+05	3.946E+01	8.858E-01	2.471E+02	1.660E-02
1979	1.258E+03	6.871E+05	4.617E+01	1.036E+00	2.891E+02	1.942E-02
1980	1.450E+03	7.921E+05	5.322E+01	1.195E+00	3.333E+02	2.239E-02
1981	1.652E+03	9.024E+05	6.063E+01	1.361E+00	3.797E+02	2.551E-02
1982	1.865E+03	1.019E+06	6.844E+01	1.536E+00	4.286E+02	2.880E-02
1983	2.089E+03	1.141E+06	7.667E+01	1.721E+00	4.801E+02	3.226E-02
1984	2.324E+03	1.270E+06	8.532E+01	1.915E+00	5.342E+02	3.590E-02
1985	2.572E+03	1.405E+06	9.439E+01	2.119E+00	5.911E+02	3.971E-02
1986	2.831E+03	1.546E+06	1.039E+02	2.332E+00	6.506E+02	4.372E-02
1987	3.102E+03	1.695E+06	1.139E+02	2.556E+00	7.130E+02	4.790E-02
1988	3.385E+03	1.849E+06	1.243E+02	2.789E+00	7.781E+02	5.228E-02
1989	3.680E+03	2.010E+06	1.351E+02	3.032E+00	8.459E+02	5.683E-02
1990	3.988E+03	2.179E+06	1.464E+02	3.286E+00	9.166E+02	6.159E-02
1991	4.309E+03	2.354E+06	1.582E+02	3.550E+00	9.905E+02	6.655E-02
1992	4.644E+03	2.537E+06	1.705E+02	3.826E+00	1.067E+03	7.172E-02
1993	4.986E+03	2.724E+06	1.830E+02	4.108E+00	1.146E+03	7.700E-02
1994	5.323E+03	2.908E+06	1.954E+02	4.386E+00	1.224E+03	8.221E-02
1995	5.559E+03	3.037E+06	2.040E+02	4.580E+00	1.278E+03	8.585E-02
1996	5.826E+03	3.183E+06	2.139E+02	4.800E+00	1.339E+03	8.998E-02
1997	6.104E+03	3.334E+06	2.240E+02	5.029E+00	1.403E+03	9.426E-02
1998	6.405E+03	3.499E+06	2.351E+02	5.277E+00	1.472E+03	9.891E-02
1999	6.722E+03	3.672E+06	2.467E+02	5.538E+00	1.545E+03	1.038E-01
2000	7.045E+03	3.849E+06	2.586E+02	5.804E+00	1.619E+03	1.088E-01
2001	7.355E+03	4.018E+06	2.700E+02	6.060E+00	1.691E+03	1.136E-01
2002	7.692E+03	4.202E+06	2.823E+02	6.337E+00	1.768E+03	1.188E-01
2003	8.011E+03	4.377E+06	2.941E+02	6.600E+00	1.841E+03	1.237E-01
2004	8.298E+03	4.533E+06	3.046E+02	6.837E+00	1.907E+03	1.282E-01
2005	8.613E+03	4.705E+06	3.161E+02	7.096E+00	1.980E+03	1.330E-01
2006	8.942E+03	4.885E+06	3.282E+02	7.367E+00	2.055E+03	1.381E-01
2007	9.266E+03	5.062E+06	3.401E+02	7.634E+00	2.130E+03	1.431E-01
2008	9.547E+03	5.216E+06	3.504E+02	7.866E+00	2.194E+03	1.474E-01
2009	9.799E+03	5.353E+06	3.597E+02	8.073E+00	2.252E+03	1.513E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2010	1.004E+04	5.483E+06	3.684E+02	8.269E+00	2.307E+03	1.550E-01
2011	1.029E+04	5.620E+06	3.776E+02	8.476E+00	2.365E+03	1.589E-01
2012	1.052E+04	5.748E+06	3.862E+02	8.669E+00	2.419E+03	1.625E-01
2013	1.072E+04	5.859E+06	3.936E+02	8.836E+00	2.465E+03	1.656E-01
2014	1.111E+04	6.072E+06	4.080E+02	9.157E+00	2.555E+03	1.716E-01
2015	1.150E+04	6.280E+06	4.220E+02	9.472E+00	2.642E+03	1.775E-01
2016	1.187E+04	6.485E+06	4.357E+02	9.780E+00	2.729E+03	1.833E-01
2017	1.224E+04	6.686E+06	4.492E+02	1.008E+01	2.813E+03	1.890E-01
2018	1.260E+04	6.882E+06	4.624E+02	1.038E+01	2.896E+03	1.946E-01
2019	1.295E+04	7.075E+06	4.754E+02	1.067E+01	2.977E+03	2.000E-01
2020	1.330E+04	7.264E+06	4.881E+02	1.095E+01	3.056E+03	2.053E-01
2021	1.364E+04	7.449E+06	5.005E+02	1.123E+01	3.134E+03	2.106E-01
2022	1.397E+04	7.631E+06	5.127E+02	1.151E+01	3.210E+03	2.157E-01
2023	1.429E+04	7.808E+06	5.246E+02	1.178E+01	3.285E+03	2.207E-01
2024	1.461E+04	7.983E+06	5.364E+02	1.204E+01	3.359E+03	2.257E-01
2025	1.493E+04	8.154E+06	5.478E+02	1.230E+01	3.431E+03	2.305E-01
2026	1.523E+04	8.321E+06	5.591E+02	1.255E+01	3.501E+03	2.352E-01
2027	1.553E+04	8.486E+06	5.701E+02	1.280E+01	3.570E+03	2.399E-01
2028	1.583E+04	8.646E+06	5.810E+02	1.304E+01	3.638E+03	2.444E-01
2029	1.612E+04	8.804E+06	5.916E+02	1.328E+01	3.704E+03	2.489E-01
2030	1.640E+04	8.959E+06	6.019E+02	1.351E+01	3.769E+03	2.533E-01
2031	1.668E+04	9.111E+06	6.121E+02	1.374E+01	3.833E+03	2.575E-01
2032	1.695E+04	9.259E+06	6.221E+02	1.396E+01	3.896E+03	2.618E-01
2033	1.722E+04	9.405E+06	6.319E+02	1.418E+01	3.957E+03	2.659E-01
2034	1.748E+04	9.548E+06	6.415E+02	1.440E+01	4.017E+03	2.699E-01
2035	1.773E+04	9.687E+06	6.509E+02	1.461E+01	4.076E+03	2.739E-01
2036	1.798E+04	9.825E+06	6.601E+02	1.482E+01	4.134E+03	2.777E-01
2037	1.823E+04	9.959E+06	6.692E+02	1.502E+01	4.190E+03	2.815E-01
2038	1.847E+04	1.009E+07	6.780E+02	1.522E+01	4.246E+03	2.853E-01
2039	1.871E+04	1.022E+07	6.867E+02	1.541E+01	4.300E+03	2.889E-01
2040	1.894E+04	1.035E+07	6.952E+02	1.560E+01	4.353E+03	2.925E-01
2041	1.856E+04	1.014E+07	6.814E+02	1.530E+01	4.267E+03	2.867E-01
2042	1.820E+04	9.941E+06	6.679E+02	1.499E+01	4.183E+03	2.810E-01
2043	1.784E+04	9.744E+06	6.547E+02	1.470E+01	4.100E+03	2.755E-01
2044	1.748E+04	9.551E+06	6.417E+02	1.440E+01	4.019E+03	2.700E-01
2045	1.714E+04	9.362E+06	6.290E+02	1.412E+01	3.939E+03	2.647E-01
2046	1.680E+04	9.177E+06	6.166E+02	1.384E+01	3.861E+03	2.594E-01
2047	1.647E+04	8.995E+06	6.044E+02	1.357E+01	3.785E+03	2.543E-01
2048	1.614E+04	8.817E+06	5.924E+02	1.330E+01	3.710E+03	2.492E-01
2049	1.582E+04	8.642E+06	5.807E+02	1.303E+01	3.636E+03	2.443E-01
2050	1.551E+04	8.471E+06	5.692E+02	1.278E+01	3.564E+03	2.395E-01
2051	1.520E+04	8.303E+06	5.579E+02	1.252E+01	3.494E+03	2.347E-01
2052	1.490E+04	8.139E+06	5.469E+02	1.227E+01	3.424E+03	2.301E-01
2053	1.460E+04	7.978E+06	5.360E+02	1.203E+01	3.357E+03	2.255E-01
2054	1.431E+04	7.820E+06	5.254E+02	1.179E+01	3.290E+03	2.211E-01
2055	1.403E+04	7.665E+06	5.150E+02	1.156E+01	3.225E+03	2.167E-01
2056	1.375E+04	7.513E+06	5.048E+02	1.133E+01	3.161E+03	2.124E-01
2057	1.348E+04	7.364E+06	4.948E+02	1.111E+01	3.099E+03	2.082E-01
2058	1.321E+04	7.219E+06	4.850E+02	1.089E+01	3.037E+03	2.041E-01
2059	1.295E+04	7.076E+06	4.754E+02	1.067E+01	2.977E+03	2.000E-01
2060	1.270E+04	6.936E+06	4.660E+02	1.046E+01	2.918E+03	1.961E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2061	1.244E+04	6.798E+06	4.568E+02	1.025E+01	2.860E+03	1.922E-01
2062	1.220E+04	6.664E+06	4.477E+02	1.005E+01	2.804E+03	1.884E-01
2063	1.196E+04	6.532E+06	4.389E+02	9.851E+00	2.748E+03	1.846E-01
2064	1.172E+04	6.402E+06	4.302E+02	9.656E+00	2.694E+03	1.810E-01
2065	1.149E+04	6.276E+06	4.217E+02	9.464E+00	2.640E+03	1.774E-01
2066	1.126E+04	6.151E+06	4.133E+02	9.277E+00	2.588E+03	1.739E-01
2067	1.104E+04	6.030E+06	4.051E+02	9.093E+00	2.537E+03	1.705E-01
2068	1.082E+04	5.910E+06	3.971E+02	8.913E+00	2.487E+03	1.671E-01
2069	1.060E+04	5.793E+06	3.892E+02	8.737E+00	2.437E+03	1.638E-01
2070	1.039E+04	5.678E+06	3.815E+02	8.564E+00	2.389E+03	1.605E-01
2071	1.019E+04	5.566E+06	3.740E+02	8.394E+00	2.342E+03	1.573E-01
2072	9.987E+03	5.456E+06	3.666E+02	8.228E+00	2.295E+03	1.542E-01
2073	9.789E+03	5.348E+06	3.593E+02	8.065E+00	2.250E+03	1.512E-01
2074	9.595E+03	5.242E+06	3.522E+02	7.905E+00	2.205E+03	1.482E-01
2075	9.405E+03	5.138E+06	3.452E+02	7.749E+00	2.162E+03	1.452E-01
2076	9.219E+03	5.036E+06	3.384E+02	7.595E+00	2.119E+03	1.424E-01
2077	9.036E+03	4.937E+06	3.317E+02	7.445E+00	2.077E+03	1.396E-01
2078	8.857E+03	4.839E+06	3.251E+02	7.298E+00	2.036E+03	1.368E-01
2079	8.682E+03	4.743E+06	3.187E+02	7.153E+00	1.996E+03	1.341E-01
2080	8.510E+03	4.649E+06	3.124E+02	7.011E+00	1.956E+03	1.314E-01
2081	8.342E+03	4.557E+06	3.062E+02	6.873E+00	1.917E+03	1.288E-01
2082	8.176E+03	4.467E+06	3.001E+02	6.736E+00	1.879E+03	1.263E-01
2083	8.015E+03	4.378E+06	2.942E+02	6.603E+00	1.842E+03	1.238E-01
2084	7.856E+03	4.292E+06	2.884E+02	6.472E+00	1.806E+03	1.213E-01
2085	7.700E+03	4.207E+06	2.826E+02	6.344E+00	1.770E+03	1.189E-01
2086	7.548E+03	4.123E+06	2.770E+02	6.219E+00	1.735E+03	1.166E-01
2087	7.398E+03	4.042E+06	2.716E+02	6.095E+00	1.701E+03	1.143E-01
2088	7.252E+03	3.962E+06	2.662E+02	5.975E+00	1.667E+03	1.120E-01
2089	7.108E+03	3.883E+06	2.609E+02	5.856E+00	1.634E+03	1.098E-01
2090	6.967E+03	3.806E+06	2.557E+02	5.740E+00	1.601E+03	1.076E-01
2091	6.830E+03	3.731E+06	2.507E+02	5.627E+00	1.570E+03	1.055E-01
2092	6.694E+03	3.657E+06	2.457E+02	5.515E+00	1.539E+03	1.034E-01
2093	6.562E+03	3.585E+06	2.409E+02	5.406E+00	1.508E+03	1.013E-01
2094	6.432E+03	3.514E+06	2.361E+02	5.299E+00	1.478E+03	9.933E-02
2095	6.304E+03	3.444E+06	2.314E+02	5.194E+00	1.449E+03	9.736E-02
2096	6.180E+03	3.376E+06	2.268E+02	5.091E+00	1.420E+03	9.544E-02
2097	6.057E+03	3.309E+06	2.223E+02	4.991E+00	1.392E+03	9.355E-02
2098	5.937E+03	3.244E+06	2.179E+02	4.892E+00	1.365E+03	9.169E-02
2099	5.820E+03	3.179E+06	2.136E+02	4.795E+00	1.338E+03	8.988E-02
2100	5.704E+03	3.116E+06	2.094E+02	4.700E+00	1.311E+03	8.810E-02