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Background Information Document for Updating AP42 Section 2.4 for Estimating Emissions from Municipal Solid Waste Landfills

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Notice

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Abstract

This document was prepared for U.S. EPA's Office of Research and Development in support of EPA's Office of Air Quality Planning and Standards (OAQPS). The objective is to summarize available data used to update emissions factors for quantifying landfill gas emissions and combustion by-products using more up-to-date and representative data for U.S. municipal landfills. This document provides background information used in developing a draft of the AP-42 section 2.4 which provides guidance for developing estimates of landfill gas emissions for national, regional, and state emission inventories. EPA OAQPS will be conducting the review of Section 2.4. Once comments are addressed, the AP-42 section will be updated and available through EPA's Technology Transfer Network (TTN) Clearinghouse for Inventories & Emissions (http://www.epa.gov/ttn/chief/ap42/). This report is considered a stand-alone report providing details of available data and analysis for developing landfill gas emission factors and combustion by-products for a wider range of pollutants and technologies.

The inputs that are described in this report are used in EPA's Landfill Gas Emission Model (LandGEM) for developing inputs for state, regional, and national emission inventories. Data from 62 LFG emissions tests from landfills with waste in place on or after 1992 were used to develop updated factors for use in LandGEM. This document also provides updated and additional emission factors for combustion by-products for control devices such as flares, boilers, and engines.

Of the 293 emissions tests submitted to EPA for this update, over 200 contained inadequate documentation or information for use in this update. The reports that were used included LFG composition data and, in some cases, emissions data on LFG combustion by-products. These emissions tests were screened for quality and compiled to create emission factors for non-methane organic compounds (NMOC), as well as speciated compounds in LFG. This update expands the list of emission factors for LFG constituents from 44 to 167 and provides many more "A" quality rated emission factors. Likewise, combustion by-product emission factors for dioxins/furans were added in this update, along with improved ratings of the other combustion by-product emission factors as a result of the addition of new data.

Updated information is provided of changes in the design and operation of U.S. MSW landfills along with updated statistics on the amount of waste being landfilled. Guidance for measuring uncontrolled emissions is provided for quantifying area source emissions (OTM 10). EPA's recommended approach is based on the use of Optical Remote Sensing technology and Radial Plume Mapping (ORS-RPM) to characterize emissions from any leaks in the header pipes, extraction wells, side slopes, or cover material. The first-order equation used to estimate LFG emissions has been modified to add a factor to account for LFG capture efficiency. Due to the increase in the use of leachate recirculation, a gas production rate to characterize emissions from wet landfills has been added. Information on the air emission concerns regarding construction/demolition waste landfills and landfill fires have also been added to the AP-42 section.

Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Sally C. Gutierrez, Director
National Risk Management Research Laboratory

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We would like to thank those providing data and information used to help develop more up-to-date and credible emission factors for evaluating air emissions from landfills and combustion by-products from the control of landfill gas emissions. We would also like to thank those helping to review this report including Jim Topsale of EPA Region III; Tom Driscoll, K.C. Hustvedt, Ron Myers, and Hillary Ward of EPA's Office of Air Quality Planning and Standards; Rachel Goldstein of EPA's Landfill Methane Outreach Program (LMOP); and Bob Wright and Andy Miller of EPA's Office of Research and Development (ORD).

We would also like to thank the Environmental Research and Education Foundation (EREF). Through a Cooperative Research and Development Agreement (#200-C-09) between EPA ORD and EREF , co-funding was provided which helped to complete data collection and analysis. Co-funding was also received from EPA's LMOP program to help complete the data analysis to update combustion by-products from technologies utilizing methane (i.e., internal combustion engines, boilers, and turbines).

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1.0 INTRODUCTION

The document "Compilation of Air Pollutant Emission Factors" (AP-42) has been published periodically by the U.S. Environmental Protection Agency (EPA) since 1972. New emission source categories and updates to existing emission factors to supplement the AP-42 have been routinely published. These supplements are in response to the emission factor needs of the EPA, state, and local air pollution control programs, and industry. The prior update to this section was performed in 1998 (U.S. EPA, 1998).

This background information document describes the data analysis undertaken to develop updated emission factors and guidance for the AP-42 section for Municipal Solid Waste (MSW) Landfills. The data being used for this update is from industry-supplied information and additional data collected from state and local regulatory agencies. The most comprehensive set of data from measurements of five landfills of the header pipe gas and combustion by-products was also used in developing updated factors. This data is from a field study by EPA's Office of Research and Development (U.S. EPA, 2007a) which was co-funded by the Environmental Research and Education Foundation.

The data being used to update landfill gas emission factors is primarily from landfills with waste in place on or after 1992. Resource Conservation and Recovery Act (RCRA) Subtitle D regulations, specifically 40 CFR Part 258, were effective October 9, 1993, but applied to landfills accepting waste on or after October 9, 1991. It is, therefore, likely that landfills began instituting the provisions of Subtitle D during their operations around 1992. The regulatory provisions limited the types of waste that could be landfilled with municipal solid waste (MSW). For example, prior to RCRA Subtitle D, hazardous waste could be co-disposed with MSW. Therefore, a distinction is made between the landfill gas (LFG) constituents present in data from waste prior to 1992, and those that were measured at landfills with the majority of their waste in place on or after 1992. The previous update of AP-42 contained the data for LFG with waste in place on or before 1992. This document includes the addition of data for combustion by-products from flares, boilers, and engines (control data applies to both pre and post 1992 landfills). However, no additional data for gas turbines was received for this update. Therefore, the data present for turbines in the last AP-42 update were unchanged during this update. Chapter 2.7 presents the background information for the pre-1992 landfills, and supporting information from the previous version of the background information document is included as Appendix A for historical purposes. To assist the reader in determining where background information is located for a certain type of emission from a landfill or control device, the following table is provided to serve as a quick guide on where to go to obtain background information on the topics found in the AP-42 section:

AP-42 Chapter Topic:	Location in this Background Information Document:
Calculating Uncontrolled Landfill Gas Emissions	Chapter 2.1
Landfill Gas Constituents From Landfills with Waste in Place On or After 1992	Chapters 2.2 through 2.6
Landfill Gas Constituents From Landfills with Waste in Place Before 1992	Chapter 2.7
Control Device Emissions (for both pre and post-1992 Landfills)	Chapter 3.0
Mercury Emissions From Landfills with Waste in Place on or After 1992	Chapter 4.0
2008 Version of AP-42 Chapter 2.4 Municipal Solid Waste Landfills	Chapter 5.0

In addition to the new data analysis detailed in this background document, there were updates to the AP-42 chapter text which are briefly summarized below:

- The introduction to the AP-42 section contains a description of MSW landfills and related landfill statistics that were developed prior to the last update in 1998. This information has been updated including update updated statistics on U.S. waste disposal.

- Information was added on EPA's recommended approach for quantifying emissions from area sources (OTM 10; http://www.epa.gov/ttn/emc/tmethods.html). This approach uses optical remote sensing technology and radial plume mapping (ORS-RPM) to quantify uncontrolled emissions from landfills which includes leaks from header pipes, extraction wells, side slopes, and landfill cover material. (U.S. EPA, 2007b) Optical remote sensing technologies use an optical emission detector such as open-path Fourier transform infrared spectroscopy (FTIR), ultraviolet differential absorption spectroscopy (UV-DOAS), or open-path tunable diode laser absorption spectroscopy (OP-TDLAS); coupled with radial plume mapping software that processes path-integrated emission concentration data and meteorological data to yield an estimate of uncontrolled emissions. More information on ORS-RPM is described in the *Evaluation of Fugitive Emissions Using Ground-Based Optical Remote Sensing Technology* (EPA/600/R-07/032).

- Equation (1) in the AP-42 Section is used to estimate emissions from an uncontrolled landfill. In this update, a factor of 1.3 was added to Equation (1) to account for the fact that L_O is determined by the amount of gas collected by LFG collection systems. The design of these systems will typically result in a gas capture efficiency of only 75%. Therefore, 25% of the gas generated by the landfill is not captured and included in the development of L_O. The ratio of total gas to captured gas is a ratio of 100/75 or equivalent to 1.3. An analysis of the efficiency of typical LFG collection systems is presented in Appendix E. Previous equation being used did not account for total emissions which includes the quantity of gas that is collected plus any fugitive loss from leaks that can occur from header pipes, extraction wells, side slopes, and landfill cover material.

- There has been an increase in the occurrence of landfills that recirculate leachate to accelerate waste decomposition. An additional 'k' was added for use in the first-order equation to account for the increase in gas production from wet landfills. This was derived from a study that evaluated data from 29 wet landfills (Reinhart, 2005). For the purpose of AP-42, wet landfills are defined as landfills which add large amounts of liquid to the waste from recycled landfill leachate, condensate from LFG collection, and other sources of water such as treated wastewater.

- The use of petroleum contaminated soil or construction and demolition waste as daily cover may affect the characteristics of LFG. Primarily, non-methane organic compounds (NMOC) concentrations may be much higher in landfills where petroleum contaminated soil is used as daily cover. Likewise, sometimes elevated hydrogen sulfide concentrations are observed where wall board has been landfilled or recovered gypsum is used as daily cover

- Landfill fires, while uncommon, may occur from time to time. These fires may be significant sources of dioxins and other hazardous air pollutants resulting from incomplete combustion of material found in MSW.

References

Reinhart, Debra R., Ayman A. Faour, and Huaxin You, *First-Order Kinetic Gas Generation Model Parameters for Wet Landfills*, U. S. Environmental Protection Agency, (EPA-600/R-05/072), June 2005

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U.S. Environmental Protection Agency (1998). Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.4 Municipal Solid Waste Landfills, Research Triangle Park, NC, November 1998.

2.0 UNCONTROLLED LANDFILL GAS DATA ANALYSIS RESULTS

2.1 ESTIMATION OF UNCONTROLLED LANDFILL GAS EMISSIONS

To estimate uncontrolled emissions of the various compounds present in LFG, total uncontrolled LFG emissions must first be estimated. Emissions for uncontrolled LFG depend on several factors including: (1) the size, configuration, and operating conditions of the landfill; and (2) the characteristics of the refuse such as moisture content, age, and composition. Uncontrolled methane (CH_4) emissions may be estimated for individual landfills by using a theoretical first-order kinetic model of CH_4 production. This method of estimating emissions could result in conservative estimates of emissions, since it provides estimates of LFG generation and not LFG release to the atmosphere. Some capture and subsequent microbial degradation of organic LFG constituents within the landfill's surface layer may occur. However, LFG will take the path of least resistance so any leaks in the header pipe, extraction wells, side slopes, and cover material will be a potential source of fugitive loss. Although laboratory data is available, field test data on potential oxidation or biodegradation through the soil cover for individual constituents found in LFG was not available. Therefore the equation being used to estimate LFG emissions does not include a factor to account for potential reduction of emissions through soil cover.

The first-order kinetic model of CH_4 production in landfills is based on the following equation (U.S. EPA, 1991):

$$Q_{CH_4} = L_o \, R \, (e^{-kc} - e^{-kt}) \qquad (1)$$

where:

Q_{CH_4} = Methane generation rate at time t, m^3/yr;

L_O = Methane generation potential, m^3 CH_4/Mg refuse;

R = Average annual refuse acceptance rate during active life, Mg/yr;

e = Base log, unitless;

k = Methane generation rate constant, yr^{-1};

c = Time since landfill closure, yrs (c = 0 for active landfills); and

t = Time since the initial refuse placement, yrs.

Site-specific landfill information is generally available for variables R, c, and t. When refuse acceptance rate information is scant or unknown, R can be estimated by dividing the refuse in place by the age of the landfill (U.S. EPA, 1991). If a facility has documentation that a certain segment (cell) of a landfill has received only nondegradable refuse, then the waste from this segment of the landfill can be excluded from the calculation of R. Nondegradable refuse includes, but is not limited to, concrete, brick, stone, glass, plaster, piping, plastics, and metal objects. The average annual acceptance rate should only be estimated by this method when there is inadequate information available on the actual annual acceptance rate.

Values for the variables L_O and k must be estimated. The potential CH_4 generation capacity of refuse (L_O) is dependent on the organic (primarily cellulose) content of the refuse and can vary widely [6.2 to 270 m^3 CH_4/Mg refuse (200 to 8670 ft^3/ton)] (U.S. EPA, 1991). The value of the CH_4 generation constant (k) is dependent on moisture, pH, temperature, and other environmental factors, as well as landfill operating conditions (U.S. EPA, 1991).

A computer program that uses the theoretical model discussed above was developed by EPA and is known as Landfill Gas Emission Model or LandGEM (U.S. EPA, 2005). This model and User's Guide can be accessed from the Office of Air Quality Planning and Standards Technology Transfer Network Website (OAQPS TTN Web) in the Clearinghouse for Inventories and Emission Factors (CHIEF) technical area (URL http://www.epa.gov/ttncatc1/products.html#software).

LandGEM includes both regulatory default values and recommended AP-42 default values for L_O and k (see below). The regulatory defaults, called "CAA factors," were developed for regulatory compliance purposes [New Source Performance Standards (NSPS), National Emissions Standards for Hazardous Air Pollutants (NESHAP) and Emission Guidelines (EG)] and provide conservative default values for municipal landfills. As a result, the regulatory L_O and k default values may not be representative of specific landfills, and may not be appropriate for use in an emissions inventory. Therefore, the LandGEM also includes a set of factors called "inventory factors" that are recommended for use when estimating LFG emissions for inventory purposes. LandGEM computes the total CH_4 generation based on the age of each landfill segment.

The recommended AP-42 defaults for k when estimating CH_4 emissions for inventory purposes are presented in Table 2-1. These recommendations are based on a comparison of gas-yield forecasts with LFG recovery data (U.S. EPA, 1991).

TABLE 2-1. RECOMMENDED VALUES OF k FOR USE IN MODELING UNCONTROLLED LANDFILL GAS EMISSIONS

Landfill Conditions	Inventory k Value
Areas receiving <25 inches/yr rainfall (U.S. EPA, 1991)	0.02
Areas receiving >25 inches/yr rainfall (U.S. EPA, 1991)	0.04
Wet landfills (Reinhart, 2005)	0.3

Based on work conducted in the late 1980's and early 1990's, a default L_O value of 100 m^3/Mg (3,530 ft^3/ton) refuse has been recommended for emission inventory purposes (Pelt, 1993). This L_O value was recommended because it provided the best agreement between emissions derived from empirical (measured) data to predicted emissions. The results of this comparison are depicted in Table 2-2. It must be emphasized that when complying with the NSPS and Emission Guideline, the regulatory defaults for k and L_O must be applied.

As part of this update of landfill emission factors, additional guidance is provided for estimating the flow rate of LFG from both controlled and uncontrolled landfills. The L_O value mentioned above of 100 m^3/Mg was based on data obtained by EPA from tests at 40 landfills conducted in the late 1980's and early 1990's (U.S. EPA, 1991). When the data from these landfills was used to develop the constants for the first order decay equation, the amount of gas that is uncontrolled was not accounted for in the equation. To correct for this, a factor has been added to estimate total emissions (both collected and uncontrolled).

The overall collection efficiency of a LFG collection system is affected by two factors: the specific collection efficiency of the gas collection system, and the portion and age of the waste that is excluded from the collection system. Specific collection efficiencies can range greatly based on the design of the landfill design and how well it is maintained and operated. A highly efficient collection system will include a liner under the waste and a cover over the waste that is comprised of a geomembrane and a thick layer of low-porosity clay. Each gas well in the high efficiency system is typically sealed to the geomembrane with a thick plug of bentonite clay material. Each gas well in the system is maintained under a strong vacuum and is monitored monthly. The landfill surface is also monitored frequently to identify leaks and initiate repairs immediately. Collection efficiencies as high as

95% have been reported for well designed and maintained LFG collection systems. However, the collection efficiencies for a landfill that is unlined, has only a soil or porous clay cap and does not employ an aggressive operation and maintenance program might easily be as low as 50% to 60%.

TABLE 2-2. COMPARISON OF MODELED AND EMPIRICAL LFG GENERATION DATA WHEN L_O IS SET AT 100 m^3/Mg[a]

Landfill[b]	Predicted CH_4 (10^6 m^3/yr)	Predicted/ Empirical CH_4	Landfill[b]	Predicted CH_4 (10^6 m^3/yr)	Predicted/ Empirical CH_4
a	37.6	0.68	u	4.62	0.63
b	39.9	0.77	v	10.5	1.44
c	31.8	0.73	w	4.28	0.72
d	49.8	1.51	x	5.62	0.96
e	12.1	0.53	y	2.39	0.44
f	17.3	0.82	z	9.59	1.84
g	23.6	1.28	aa	5.08	1.08
h	8.61	0.49	bb	4.93	1.15
i	14.9	0.93	cc	3.93	0.93
j	14.5	0.94	dd	2.74	1.03
k	14.2	0.96	ee	8.37	3.23
l	7.16	0.50	ff	117	0.83
m	18.0	1.31	gg	14.4	0.58
n	8.57	0.76	hh	23.0	1.44
o	4.56	0.48	ii	29.6	2.19
p	17.4	1.87	jj	19.3	1.47
q	10.2	1.21	kk	22.4	1.71
r	6.95	0.87	ll	41.3	4.00
s	2.29	0.29	mm	7.14	0.81
t	3.49	0.45	nn	1.07	0.29
	Average				1.10
	Maximum				3.23
	Minimum				0.29
	Standard Dev.				0.73

[a] k = 0.04
[b] Landfill names are considered to be confidential.

The second factor which has a very significant influence on collection efficiency is the portion and age of the waste that is excluded from the gas collection system. There is normally a lag time between the placement of waste in a new landfill cell and the installation of a gas collection system in the cell. Landfills that have reached a sufficient size (i.e., waste in place is equal or greater than 2.5 million tons of waste) and NMOC emissions equal or exceed 50 megagrams per year are required by NSPS and EG to install a gas collection system. The time table specified in the NSPS/EG is that gas collection is to be installed in open cells within five years of initial waste placement and in cells that have been closed for two or more years. As a result, a typical landfill will not have the most recent two to five years of waste included within its gas collection system. The impact of excluding the most recent portions of their waste mass from the collection system is magnified by the fact that the LFG emission rate is greatest in the first years of the waste's life and drops rapidly with time.

Therefore, a system capable of collecting 90% of the gas generated from the landfill cells in which it is installed is operating at reduced landfill-wide collection efficiency (i.e., less than 90%) due to the loss of uncollected gas from cells that have yet to be capped and connected to the collection system. All active landfills contain open cells and waste cells that have yet to be capped and fitted with a gas collection system. Table 2-3 demonstrates the impact of the delay in collecting gas from newer cells. The values in this table were generated using the first order decay model (Pelt, 1993) and assuming a L_O of 100 and a k of 0.04. The landfill was assumed to be operating (i.e., accepting waste) over a 20 year timeframe.

The years of delay between the placement of waste in a cell and the installation of wells in the cell are presented in the first column of Table 2-3. The effective landfill-wide collection efficiency of the gas collection system is presented in the second and third columns for gas collection systems with efficiencies of 90% and 85%, respectively. Large active landfills will typically install gas collection systems within two to five years after waste placement in a given cell, as required by the NSPS. As shown in Table 2-3, the effective landfill-wide collection efficiency of a gas collection system which is installed in waste cells two to five years after they are filled varies from 57% to 77% for systems with 85% to 90% efficiency. If a landfill is closed, all cells will be capped and the landfill-wide collection efficiency will be the same as the specific efficiency of the collection system, or 85% to 90%.

TABLE 2-3. IMPACT OF DELAYS IN COLLECTING GAS FROM NEWER LANDFILL CELLS

Time Between Waste Placement and Initial Gas Collection for Individual Cells (years)	Effective Landfill-wide Gas Collection Efficiency	
	System Collection Efficiency 90%	System Collection Efficiency 85%
1	84	79
2	77	73
3	72	68
4	66	62
5	60	57
6	55	52

It is assumed that the landfills used to develop L_O and k for use in the first order decay LFG generation equation included a similar number of both open and closed landfills. Typically these landfills in the late 1980's and early 1990's would have had specific collection efficiencies of 85% to 90% for the closed cells where the system was installed. The closed landfills might have an overall efficiency of 85%-90% and the open landfills might have an efficiency ranging from 57% to 77%. Based on these assumptions, the overall set of landfills used to develop L_O and k would have had overall collection efficiencies ranging from 57% to 90% and possibly averaging 75%.

Using the analysis presented on the range in gas collection efficiency, a factor is added to account for the gas that is not collected given that empirical data was used to develop input for the first-order decomposition rate equation. If on average 75% gas generated at the landfills listed in Table 2-2 is collected, then actual gas production from landfills would then be 100/75 or 1.3 times greater than the gas flow measured in the gas collection systems. The first order decay model developed by the EPA (Pelt, 1993) would then be expressed as:

$$Q_{CH_4} = 1.3 L_o R (e^{-kc} - e^{-kt}) \quad (2)$$

where:

- Q_{CH_4} = Methane generation rate at time t, m^3/yr;
- L_o = Methane generation potential, m^3 CH_4/Mg of “wet” or “as received” refuse;
- R = Average annual refuse acceptance rate during active life, Mg of “wet” or “as received” refuse /yr;
- e = Base log, unitless;
- k = Methane generation rate constant, yr^{-1};
- c = Time since landfill closure, yrs (c = 0 for active landfills); and
- t = Time since the initial refuse placement, yrs.

When annual refuse acceptance data is available, the following form of Equation (2) is used. This is the equation that is used in EPA’s Landfill Gas Emissions Model (LandGEM). Due to the complexity of the double summation, Equation (2 alt) is normally implemented within a computer model. Equation (2 alt.) is more accurate because it accounts for the varying annual refuse flows and it calculates each year’s gas flow in $^1/_{10th}$ year increments.

$$Q_{CH_4} = 1.3 \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \frac{R_i}{10} e^{-kt_{ij}} \quad \text{(2 alternate)}$$

where:

- Q_{CH_4} = Methane generation rate at time t, m^3/yr;
- L_o = Methane generation potential, m^3 CH_4/Mg of “wet” or “as received” refuse;
- R_i = Annual refuse acceptance rate for year i, Mg of “wet” or “as received” refuse /yr;
- e = Base log, unitless;
- k = Methane generation rate constant, yr^{-1};
- c = Time since landfill closure, yrs (c = 0 for active landfills); and
- t = Time since the initial refuse placement, yrs.
- i = year in life of the landfill
- j = $^1/_{10th}$ year increment in the calculation.

Equations (2) and (2 alt) are different from the equations used previously by EPA in AP-42 and in other models such as LandGEM, by the addition of the constant 1.3 at the front of the equation. This 1.3 constant compensates the value of L_O that had been developed based on systems nominally collecting only an estimated 75% of the LFG emissions.

There is a significant level of uncertainty in Equation 2 and its recommended defaults values for k and L_o. The recommended defaults k and L_o for conventional landfills, based upon the best fit to 40 different landfills, yielded predicted CH_4 emissions that ranged from ~30 to 400% of measured values and had a relative standard deviation of 0.73 (Table 2-2). The default values for wet landfills were based on a more limited set of data and are expected to contain even greater uncertainty.

When gas generation reaches steady-state conditions, sampled LFG consists of approximately equal amounts of carbon dioxide (CO_2) and CH_4; and only trace amounts of NMOC (typically, less than two percent). Therefore, the estimate derived for CH_4 generation using the landfill model can also be used to estimate CO_2 generation (i.e., $CO_2 = CH_4$) (U.S. EPA, 1991). In addition, total LFG flow can be assumed to be equal to twice the CH_4 flow.

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2.2 DATA SUMMARY

A total of 293 emission tests were submitted to EPA that included LFG composition data. As listed in Table 2-4, a portion of these were not used because either the report did not present actual test data (they were based on emission models) or the test report was too incomplete to evaluate the quality of the data. Of the potentially useful tests, several (22) analyze LFG obtained through use of a "punch-probe," while 62 tests contain data for gas samples from LFG collection system headers. The emissions data from the collection system headers are assumed to be representative of the gas generated by the entire landfill and not selected locations, as may be the case with punch probe analyses. Therefore, in developing default emission factors for updating AP-42, only the emissions test data for the 62 tests taken from gas collection system headers are analyzed in this report.

The reference section to this chapter, and in the AP-42 chapter, lists the specific emission tests from which data were utilized. Appendix B contains the list of all 293 emission tests that were reviewed as part of this update.

TABLE 2-4. SUMMARY OF LANDFILL GAS EMISSIONS TESTS

Number of emission test reports	293
Number of reports that were not able to be used due to inadequate documentation or information	209
Number of punch-probe tests	22
Number of gas collection header tests	62

Landfill gas collection system header pipes were sampled for NMOC, reduced sulfur compounds, and speciated organics. Measured pollutant concentrations (i.e., as measured by EPA Reference Method 25C), must be corrected for air infiltration which can occur by two different mechanisms: LFG sample dilution and air intrusion into the landfill. These corrections require site-specific data for the LFG CH_4, CO_2, nitrogen (N_2), and oxygen (O_2) content. If the ratio of N_2 to O_2 is less than or equal to 4.0 (as found in ambient air), then the total pollutant concentration is adjusted for sample dilution by assuming that CO_2 and CH_2 are the primary (100 percent) constituents of LFG, and the following equation is used:

$$C_P \text{ (corrected for air infiltration)} = \frac{C_P \text{ x } (1 \text{x} 10^6)}{C_{CO_2} + C_{CH_4}} \quad (3)$$

where:

C_P = Concentration of pollutant P in LFG (i.e., NMOC as hexane), ppmv;
C_{CO2} = CO_2 concentration in LFG, ppmv;
Q_{CH4} = CH_4 Concentration in LFG, ppmv; and
$1 \text{ x } 10^6$ = Constant used to correct concentration of P to units of ppmv.

If the ratio of N_2 to O_2 concentrations (i.e., C_{N2}, C_{O2}) is greater than 4.0, then the total pollutant concentration should be adjusted for air intrusion into the landfill by using Equation (3) and adding the concentration of N_2 (i.e., C_{N2}) to the denominator. Values for C_{CO2}, C_{CH4}, C_{N2}, C_{O2}, can usually be found in the source test report for the particular landfill along with the total pollutant concentration data.

Most of the tests contained data on O_2, CO_2, CH_4 and N_2 content of the gas, as shown in Table 2-5, so that corrected values may be calculated. (While no reports present corrected data, Table 2-5 contains those tests for which corrected values could be calculated.) Table 2-6 displays NMOC values both uncorrected (i.e., as reported) and corrected for air infiltration. For simplicity, the AP-42 chapter and Table 2-7 of this section present the data that has been corrected for air infiltration only. A summary of uncorrected data is presented in Appendix C.

TABLE 2-5. SUMMARY OF TEST REPORT DATA CONTENTS (COUNTS OF DATA POINTS WITHIN TEST)

Test Report ID	CH_4	CO_2	N_2	O_2	CO		NMOC (as hexane)		Speciated Organic and Sulfur Compounds		Total	
					C	UC	C	UC	C	UC	C	UC[a]
TR-076	0	0	1	1	0	0	0	1	0	0	0	3
TR-084	0	0	1	1	0	0	0	1	0	0	0	3
TR-086	0	0	1	1	0	0	0	1	0	0	0	3
TR-114	0	0	1	0	0	0	0	1	0	0	0	2
TR-115	0	0	0	0	0	0	0	1	0	0	0	1
TR-134	0	0	1	1	0	0	0	1	0	0	0	3
TR-141	0	0	1	1	0	0	0	1	0	0	0	3
TR-145	1	1	1	1	1	1	1	1	28	28	30	34
TR-146	1	1	1	1	0	0	1	1	3	3	4	8
TR-147	0	0	0	0	0	1	0	1	0	1	0	3
TR-148	1	1	1	1	1	1	1	1	15	15	17	21
TR-153	1	1	1	1	0	0	1	1	0	0	1	5
TR-156	1	1	1	1	0	0	1	1	0	0	1	5
TR-157	1	1	1	1	0	0	1	1	0	0	1	5
TR-159	1	1	1	1	0	0	1	1	0	0	1	5
TR-160	0	0	0	0	0	0	0	1	0	0	0	1
TR-165	1	1	1	1	0	0	1	1	27	27	28	32
TR-167	1	1	1	1	0	0	1	1	27	27	28	32
TR-168	1	1	1	1	0	0	1	1	27	27	28	32
TR-169	1	1	1	1	0	0	1	1	27	27	28	32
TR-171	1	1	1	1	0	0	1	1	27	27	28	32
TR-173	1	1	1	1	0	0	1	1	27	27	28	32
TR-175	1	1	1	1	1	1	1	1	27	27	29	33
TR-176	1	1	1	1	0	0	1	1	21	21	22	26
TR-178	1	1	1	1	0	0	1	1	27	27	28	32
TR-179	1	1	0	1	0	0	0	1	0	27	0	31
TR-181	1	1	1	1	0	0	1	1	27	27	28	32

TABLE 2-5 (CONTINUED). SUMMARY OF TEST REPORT DATA CONTENTS (COUNTS OF DATA POINTS WITHIN TEST)

Test Report ID	CH_4	CO_2	N_2	O_2	CO		NMOC (as hexane)		Speciated Organic and Sulfur Compounds		Total	
					C	UC	C	UC	C	UC	C	UC[a]
TR-182	1	1	1	1	0	0	1	1	27	27	28	32
TR-183	1	1	1	1	0	0	1	1	27	27	28	32
TR-187	1	1	1	1	0	0	1	1	47	47	48	52
TR-188	1	1	1	1	1	1	0	0	108	108	109	113
TR-189	1	1	1	1	1	1	0	0	113	113	114	118
TR-190	1	1	1	1	0	0	0	0	107	107	107	111
TR-191	1	1	1	1	0	0	0	0	107	107	107	111
TR-194	1	1	0	1	0	1	0	0	0	98	0	102
TR-195	0	0	0	0	0	0	0	0	0	526	0	526
TR-196	1	1	1	1	0	0	1	1	27	27	28	32
TR-199	1	1	1	1	0	0	1	1	23	23	24	28
TR-205	1	1	1	1	0	0	1	1	27	27	28	32
TR-207	1	1	1	1	0	0	1	1	25	25	26	30
TR-209	1	1	1	1	0	1	1	1	28	28	29	34
TR-220	1	1	1	1	0	0	1	1	22	22	23	27
TR-226	1	1	1	1	1	1	1	1	0	0	2	6
TR-229	1	1	1	1	0	0	1	1	30	30	31	35
TR-236	0	0	0	0	0	0	0	0	0	7	0	7
TR-241	1	1	1	1	0	0	0	0	5	5	5	9
TR-251	1	1	1	1	0	0	1	1	27	27	28	32
TR-253	1	1	1	1	0	0	1	1	27	27	28	32
TR-255	1	1	1	1	0	0	1	1	27	27	28	32
TR-258	0	0	0	0	0	0	0	1	0	0	0	1
TR-259	1	1	1	1	0	0	1	1	27	27	28	32
TR-260	1	1	1	1	0	0	1	1	26	26	27	31
TR-261	1	1	1	1	0	0	1	1	27	27	28	32
TR-264	1	1	1	1	0	0	1	1	27	27	28	32
TR-266	1	1	0	1	0	1	1	1	9	9	10	14
TR-272	2	2	1	1	0	0	1	1	68	68	69	75
TR-273	2	2	1	1	0	0	1	1	67	67	68	74
TR-284	2	2	1	1	0	0	1	1	56	56	57	63
TR-287	2	2	1	1	0	0	1	1	56	56	57	63
TR-290	1	1	1	1	0	0	1	1	27	27	28	32

TABLE 2-5 (CONTINUED). SUMMARY OF TEST REPORT DATA CONTENTS (COUNTS OF DATA POINTS WITHIN TEST)

Test Report ID	CH_4	CO_2	N_2	O_2	CO		NMOC (as hexane)		Speciated Organic and Sulfur Compounds		Total	
					C	UC	C	UC	C	UC	C	UC[a]
TR-292	2	2	1	1	0	0	1	1	33	33	34	40
TR-293a	1	1	1	1	0	0	1	1	30	30	31	35
TR-293b	1	1	1	1	0	0	1	1	26	26	27	31
Total	**56**	**54**	**52**	**54**	**6**	**10**	**44**	**55**	**1,537**	**2,196**	**1,585**	**2,473**

C = Corrected for air infiltration
UC = Uncorrected
[a] Uncorrected Total includes CH_4, CO_2, N_2, and O_2 data points.

2.3 NMOC AND VOC

Fifty-four test reports contained NMOC data. Forty-three of these contained sufficient data to calculate a value corrected for air infiltration. The corrected values were calculated using Equation 2. The data from the 54 test reports, corrected value (if possible to calculate), and the test method are reported in Table 2-6. In addition, summary statistics are presented at the bottom of the table. Based on guidance contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), each of the tests with the corrected value calculated are assumed to be rated as "A," because the tests were performed by a sound methodology and reported in enough detail for adequate validation. None of the NMOC concentrations were below the detection limit (BDL).

Taking the mean value of the corrected NMOC data yields a default emission factor of 838 ppmv, which compares to the pre-1992 AP-42 default value of 595 ppmv for "No or Unknown co-disposal landfills" (see Table 2.4-2 in the AP-42 chapter, included as section 5.0 of this document). An overall emission factor ranking of "A" is recommended for NMOC. This rating exemplifies the fact that the default NMOC emission factors were developed using A-rated test data from a large number of facilities. The pre-1992 AP-42 default emission factor for NMOC at "No or Unknown co-disposal" landfills is ranked as "B."

To determine the volatile organic compound (VOC) emission factor, the compounds listed in 40 CFR 51.100(s)(1) which have negligible chemical photoreactivity were removed from the overall NMOC concentration. This determination was possible for 34 emission tests that contained both speciated data and NMOC data. Consistent with the previous AP-42 update background document (U.S. EPA, 1997b), the following compounds from 40 CFR 51.100(s)(1) were removed from the NMOC concentration to obtain a VOC fraction: ethane, chlorodifluoromethane, acetone, dichloromethane, 1,1,1-Trichloroethane (methyl chloroform), dichlorodifluoromethane, perchloroethylene. Note that 40 CFR 51.100(s)(1) contains more compounds than those listed above, but this list envelops the LFG constituents that are listed in 51.100(s)(1) that are most prevalent in LFG. Since NMOC is presented as hexane (i.e., six carbons), the non-VOC compound concentrations are converted to be on the same six-carbon basis also so that they may be subtracted from the NMOC concentration value. The data used to develop the VOC emission factor and the resulting VOC fraction calculations are presented in Appendix D.

The resulting fraction of NMOC that is VOC is 0.997, based on data from 34 emission test reports (see Appendix D for data and calculation). All of these test reports are considered to be "A" quality. This fraction was multiplied by the corrected NMOC concentration value to obtain a VOC emission factor of 835 ppmv. The recommended emission factor ranking is "A" because a large number of "A" quality tests were used to develop the emission factor. Appendix E presents statistical data graphs of the NMOC data.

TABLE 2-6. SUMMARY OF TESTING RESULTS FOR NON-METHANE ORGANIC COMPOUNDS (NMOC) – CORRECTED AND UNCORRECTED FOR AIR INFILTRATION

Test Report ID	Test Method	Corrected Average Concentration (ppm as hexane)	Average Concentration (ppm as hexane)
TR-076	EPA Method 25C		157
TR-084	EPA Method 25C / Method 3C		117
TR-086	EPA Method 25C / Method 3C		121

TABLE 2-6 (CONTINUED). SUMMARY OF TESTING RESULTS FOR NON-METHANE ORGANIC COMPOUNDS (NMOC) – CORRECTED AND UNCORRECTED FOR AIR INFILTRATION

Test Report ID	Test Method	Corrected Average Concentration (ppm as hexane)	Average Concentration (ppm as hexane)
TR-114	EPA Method 25C		53
TR-115	EPA Method 25C		82
TR-134	EPA Method 25C		944
TR-141	EPA Method 25C		180
TR-145	EPA Method 25C	635	628
TR-146	SCAQMD Method 25.2	927	922
TR-147	EPA Method 25C		298
TR-148	EPA Method 18 / EPA Method 25C	332	331
TR-153	EPA Method 25C	721	726
TR-156	EPA Method 25C	575	573
TR-157	EPA Method 25C	574	571
TR-159	NJATM 3.9	31	31
TR-160	EPA Method 18		421
TR-165	SCAQMD Method 25.2	713	698
TR-167	SCAQMD Draft Method 25.2	673	665
TR-168	SCAQMD Method 25.2	1,314	1,294
TR-169	SCAQMD Draft Method 25.2	1,389	1,349
TR-171	SCAQMD Draft Method 25.2	1,021	993
TR-173	SCAQMD Method 25.1	1,425	1,400
TR-175	SCAQMD Method 25.1	161	110
TR-176	SCAQMD Draft Method 25.2	623	577
TR-178	SCAQMD Method 25.1	1,947	1,882
TR-179	SCAQMD Method 25.1		1,244
TR-181	SCAQMD Draft Method 25.2	649	627
TR-182	SCAQMD Draft Method 25.2	596	578
TR-183	SCAQMD Method 25.1	734	717
TR-187	SCAQMD Method 25.2	870	847
TR-196	EPA Method 25 Modified	889	883
TR-199	SCAQMD Method 25.1	193	176
TR-205	SCAQMD Draft Method 25.2	647	627
TR-207	SCAQMD Method 25.1	617	560
TR-209	EPA Method TO-12 Modified	536	529
TR-220	SCAQMD Draft Method 25.2	704	668
TR-226	NJDEP Method 3.9 (Modified) / GC	167	145
TR-229	SCAQMD Draft Method 25.2	564	527
TR-251	SCAQMD Method 25.1	1,067	1,031
TR-253	SCAQMD Draft Method 25.2	583	573
TR-255	SCAQMD Method 25.1	1,122	1,104
TR-258	EPA Method TO-12		137
TR-259	SCAQMD Draft Method 25.2	1,349	1,286
TR-260	SCAQMD Draft Method 25.2	1,349	1,294
TR-261	SCAQMD Draft Method 25.2	1,321	1,279

TABLE 2-6 (CONTINUED). SUMMARY OF TESTING RESULTS FOR NON-METHANE ORGANIC COMPOUNDS (NMOC) – CORRECTED AND UNCORRECTED FOR AIR INFILTRATION

Test Report ID	Test Method	Corrected Average Concentration (ppm as hexane)	Average Concentration (ppm as hexane)
TR-264	SCAQMD Method 25.1	537	523
TR-266	SCAQMD Method 100.1 and EPA Methods 6C and 7E	245	151
TR-272	EPA Method 25C	386	374
TR-273	EPA Method 25C	526	355
TR-284	EPA Method 25C	5,387[a]	5,870[a]
TR-287	EPA Method 25C	868	1,006
TR-290	Fuel Gas Analysis (SCAQMD Draft 25.2)	972	954
TR-292	EPA Method 25C	242	233
TR-293a	EPA Method 25C	378	446
TR-293b	EPA Method 25C	297	317
	Number of Test Reports	**44**	**55**
	Minimum	**31**	**31**
	Maximum	**5,387**	**5,870**
	Mean	**838**	**731**
	Standard Deviation	**811**	**824**
	95% Confidence Interval	**± 240**	**± 218**

[a] The TR-284 landfill utilized petroleum-contaminated soil as daily cover, which helps illustrate the potential for increased emissions of NMOC when this daily cover is used at a landfill.

To estimate uncontrolled emissions of NMOC or other LFG constituents, such as those listed in Table 2-7, the following equation should be used:

$$Q_P = \frac{Q_{CH4} \text{ x } C_P}{C_{CH_4} \text{ x } (1 \text{x} 10^6)} \qquad (4)$$

where:

Q_P = Emission rate of pollutant P (i.e., NMOC), m^3/yr;
Q_{CH4} = CH_4 generation rate, m^3/yr (from Equation 1);
C_P = Concentration of pollutant P in LFG, ppmv; and
C_{CH4} = Concentration of CH_4 in the LFG (assumed to be 50% expressed as 0.5)

Uncontrolled mass emissions per year of total NMOC (as hexane) and speciated organic and inorganic compounds can be estimated by the following equation:

$$UM_P = Q_P \text{ x } \frac{MW_P \text{ x} 1 \text{ atm}}{(8.205 \text{x} 10^{-5} \text{ m}^3 - \text{atm/gmol} - {}^{o}\text{K}) \text{ x } (1000\text{g/kg}) \text{ x } (273 + T)} \qquad (5)$$

where:

UM_P = Uncontrolled mass emissions of pollutant P (i.e., NMOC), kg/yr;
MW_P = Molecular weight of P, g/gmol (i.e., 86.18 for NMOC as hexane);

Q_P = Emission rate of pollutant P, m^3/yr; and
T = Temperature of LFG, ^oC.

This equation assumes that the operating pressure of the system is approximately 1 atmosphere. If the temperature of the LFG is not known, a temperature of 25 ^oC (77 ^oF) is recommended.

2.4 SPECIATED ORGANICS AND REDUCED SULFUR COMPOUNDS

Forty-seven test reports contained speciated organic and reduced sulfur compound data that could be corrected for air infiltration. An additional 20 test reports contained data that were not able to be corrected. For the speciated organic data, EPA Method 25C was used to obtain the majority of the data. Other methods used to determine speciated organic concentrations were EPA Methods TO-14 and TO-15, and South Coast Air Quality Management District's (SCAQMD) Method 25.2. For reduced sulfur measurements, EPA Method 18 and SCAQMD Method 307 were used.

EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), were followed when addressing BDL test runs. In most cases, there were some runs that were below detection limit and others that were above. However, for a few compounds, there were no tests (or individual runs) that measured above the detection limit. Per the EPA's guidance (U.S. EPA, 1997a), in these cases the emission factor recorded is "BDL," with a reference to the range of method detection limits (MDL) reported.

Table 2-8 presents the default emission factor information for the speciated organic compounds and reduced sulfur compounds that were corrected for air infiltration. As discussed earlier, these data will be presented in the AP-42 chapter. Therefore, only these data have recommended emission factor ratings. Since all of these tests are considered "A" quality, then the emission factor ranking becomes more of a function of the number of data points used for that compound. The following criteria, used in developing ratings in the 1997 AP-42 update (U.S. EPA, 1997b), were used to provide recommended default emission factor ratings. Statistical data graphs of several of the more prevalent speciated organic compounds and reduced sulfur compounds are presented in Appendix E.

TABLE 2-7. CRITERIA USED TO DETERMINE RECOMMENDED DEFAULT EMISSION FACTOR RATINGS

Factor Rating	# of Data Points
A	≥ 20
B	10-19
C	6-9
D	3-5
E	<3

Default emission factors for two compounds presented in Table 2-8 could not be calculated since the test values were all reported as BDL in the respective test reports. The data for acrylonitrile consisted of six BDL test values, and there was one BDL test value reported for hexachlorobutadiene. The acrylonitrile BDL data is consistent with information received from California Air Resources Board regarding testing for acrylonitrile at a San Diego landfill.

Appendix C presents the data summary for data that is not corrected for air infiltration. While this uncorrected data will not be presented in AP-42, it is shown here to document that it is available and was extracted from the test reports. If, in the future, some methodology for assuming a correction factor is available or more information from specific tests is received, then these data may be corrected and incorporated into the final default emission factors.

2.5 METHANE, CARBON DIOXIDE, CARBON MONOXIDE, OXYGEN AND NITROGEN

Table 2-9 presents a summary of the CH_4, CO_2, carbon monoxide (CO), O_2 and N_2 data. AP-42 presents CO data, but not the other compounds. However, as discussed above, CH_4, CO_2, O_2 and N_2 are used to correct for air infiltration, per Equation 3. CO measurements were performed using various methods, including EPA Method 10, Modified Method TO-14. Ten emission tests contained data for CO (TR-145, TR-147, TR-148, TR-175, TR-188, TR-189, TR-194, TR-209, TR-226, TR-241, and TR-266) and six of these data points were correctable for air infiltration. The average of the emissions tests results in a CO default emission factor of 21 ppmv (corrected for air infilteration). Since there are only six data points, the recommended emission factor rating for CO is C.

2.6 HYDROGEN CHLORIDE

One test report (TR-147) contained data for hydrogen chloride (HCl) present in the raw LFG. However, due to the lack of data for CH_4, CO_2, N_2, and O_2 the HCl data point could not be corrected for air infiltration.

TABLE 2-8. LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
1,1,1-Trichloroethane	33	5.15E-03	8.50E-01	2.43E-01	2.43E-01	8.30E-02	A
1,1,2,2-Tetrachloroethane	2	3.06E-02	1.04E+00	5.35E-01	7.14E-01	9.89E-01	E
1,1,2,3,4,4-Hexachloro-1,3-butadiene (Hexachlorobutadiene)	3	1.03E-03	7.91E-03	3.49E-03	3.83E-03	4.33E-03	D
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	9	2.06E-03	4.60E-01	6.72E-02	1.48E-01	9.64E-02	C
1,1,2-Trichloroethane	3	7.90E-03	4.08E-01	1.58E-01	2.18E-01	2.47E-01	D
1,1-Dichloroethane	36	2.56E-02	1.59E+01	2.08E+00	2.87E+00	9.38E-01	A
1,1-Dichloroethene (1,1-Dichloroethylene)	34	2.06E-03	1.28E+00	1.60E-01	2.60E-01	8.74E-02	A
1,2,3-Trimethylbenzene	3	2.69E-01	5.20E-01	3.59E-01	1.40E-01	1.58E-01	D
1,2,4-Trichlorobenzene	6	1.01E-03	7.71E-03	5.51E-03	2.70E-03	2.16E-03	C
1,2,4-Trimethylbenzene	13	1.95E-01	2.99E+00	1.37E+00	9.45E-01	5.14E-01	B
1,2-Dibromoethane (Ethylene dibromide)	11	1.37E-03	1.90E-02	4.80E-03	5.39E-03	3.18E-03	B
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12	7.90E-03	4.23E-01	1.06E-01	1.15E-01	6.51E-02	B
1,2-Dichloroethane (Ethylene dichloride)	34	1.03E-03	2.60E+00	1.59E-01	4.36E-01	1.46E-01	A
1,2-Dichloroethene	1			1.14E+01			E
1,2-Dichloropropane	4	7.35E-04	1.99E-01	5.20E-02	9.78E-02	9.58E-02	D
1,2-Diethylbenzene	3	1.38E-02	2.52E-02	1.99E-02	5.75E-03	6.51E-03	D

TABLE 2-8 (CONTINUED). LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
1,3,5-Trimethylbenzene	9	1.51E-01	1.09E+00	6.23E-01	3.59E-01	2.35E-01	C
1,3-Butadiene (Vinyl ethylene)	7	2.27E-02	5.89E-01	1.66E-01	2.07E-01	1.53E-01	C
1,3-Diethylbenzene	4	2.37E-02	1.30E-01	6.55E-02	4.53E-02	4.44E-02	D
1,4-Diethylbenzene	4	9.50E-02	5.49E-01	2.62E-01	2.03E-01	1.99E-01	D
1,4-Dioxane (1,4-Diethylene dioxide)	5	2.09E-03	1.39E-02	8.29E-03	4.50E-03	3.94E-03	D
1-Butene / 2-Methylbutene	3	8.57E-01	1.42E+00	1.22E+00	3.12E-01	3.53E-01	D
1-Butene / 2-Methylpropene	1			1.10E+00			E
1-Ethyl-4-methylbenzene (4-Ethyl toluene)	7	1.21E-01	2.85E+00	9.89E-01	1.21E+00	8.97E-01	C
1-Ethyl-4-methylbenzene (4-Ethyl toluene) + 1,3,5-Trimethylbenzene	4	8.17E-02	8.42E-01	5.79E-01	3.54E-01	3.46E-01	D
1-Heptene	2	4.48E-01	8.03E-01	6.25E-01	2.51E-01	3.48E-01	E
1-Hexene / 2-Methyl-1-pentene	3	1.26E-02	2.22E-01	8.88E-02	1.16E-01	1.31E-01	D
1-Methylcyclohexene	4	1.32E-02	3.89E-02	2.27E-02	1.16E-02	1.14E-02	D
1-Methylcyclopentene	4	1.55E-02	4.62E-02	2.52E-02	1.45E-02	1.42E-02	D
1-Pentene	4	3.23E-02	4.83E-01	2.20E-01	1.95E-01	1.91E-01	D
1-Propanethiol (n-Propyl mercaptan)	22	1.46E-04	4.86E-01	1.25E-01	1.22E-01	5.11E-02	A
2,2,3-Trimethylbutane	4	4.80E-03	1.41E-02	9.19E-03	3.86E-03	3.79E-03	D
2,2,4-Trimethylpentane	5	3.21E-01	8.12E-01	6.14E-01	2.27E-01	1.99E-01	D
2,2,5-Trimethylhexane	4	9.44E-02	2.50E-01	1.56E-01	7.29E-02	7.14E-02	D
2,2-Dimethylbutane	4	9.56E-02	2.28E-01	1.56E-01	5.49E-02	5.38E-02	D
2,2-Dimethylpentane	4	4.42E-02	7.30E-02	6.08E-02	1.27E-02	1.25E-02	D
2,2-Dimethylpropane	1			2.74E-02			E
2,3,4-Trimethylpentane	4	1.78E-01	4.73E-01	3.12E-01	1.35E-01	1.32E-01	D
2,3-Dimethylbutane	4	1.43E-01	2.21E-01	1.67E-01	3.59E-02	3.52E-02	D
2,3-Dimethylpentane	4	2.03E-01	3.76E-01	3.10E-01	7.70E-02	7.54E-02	D
2,4-Dimethylhexane	4	1.74E-01	2.61E-01	2.22E-01	3.62E-02	3.54E-02	D
2,4-Dimethylpentane	4	6.55E-02	1.21E-01	1.00E-01	2.42E-02	2.37E-02	D
2,5-Dimethylhexane	4	1.33E-01	1.96E-01	1.66E-01	2.62E-02	2.57E-02	D
2,5-Dimethylthiophene	1			6.44E-02			E
2-Butanone (Methyl ethyl ketone)	8	2.81E-01	9.54E+00	4.01E+00	3.07E+00	2.12E+00	C
2-Ethyl-1-butene	4	1.02E-02	2.68E-02	1.77E-02	6.98E-03	6.84E-03	D
2-Ethylthiophene	1			6.29E-02			E
2-Ethyltoluene	4	1.38E-01	6.53E-01	3.23E-01	2.29E-01	2.25E-01	D

TABLE 2-8 (CONTINUED). LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
2-Hexanone (Methyl butyl ketone)	2	5.73E-01	6.53E-01	6.13E-01	5.65E-02	7.83E-02	E
2-Methyl-1-butene	4	7.17E-02	3.47E-01	1.79E-01	1.18E-01	1.16E-01	D
2-Methyl-1-propanethiol (Isobutyl mercaptan)	1			1.70E-01			E
2-Methyl-2-butene	4	2.07E-01	4.12E-01	3.03E-01	1.03E-01	1.01E-01	D
2-Methyl-2-propanethiol (tert-Butylmercaptan)	1			3.25E-01			E
2-Methylbutane	4	2.80E-01	7.33E+00	2.26E+00	3.39E+00	3.32E+00	D
2-Methylheptane	4	6.01E-01	9.50E-01	7.16E-01	1.61E-01	1.57E-01	D
2-Methylhexane	4	5.58E-01	1.02E+00	8.16E-01	2.11E-01	2.07E-01	D
2-Methylpentane	4	5.51E-01	1.00E+00	6.88E-01	2.13E-01	2.09E-01	D
2-Propanol (Isopropyl alcohol)	6	1.17E-01	5.72E+00	1.80E+00	2.08E+00	1.66E+00	C
3,6-Dimethyloctane	4	5.38E-01	1.01E+00	7.85E-01	1.99E-01	1.95E-01	D
3-Ethyltoluene	4	3.55E-01	1.54E+00	7.80E-01	5.45E-01	5.34E-01	D
3-Methyl-1-pentene	3	4.33E-03	1.09E-02	6.99E-03	3.44E-03	3.89E-03	D
3-Methylheptane	4	6.25E-01	1.04E+00	7.63E-01	1.91E-01	1.87E-01	D
3-Methylhexane	4	7.44E-01	1.41E+00	1.13E+00	3.16E-01	3.10E-01	D
3-Methylpentane	4	5.72E-01	1.08E+00	7.40E-01	2.38E-01	2.34E-01	D
3-Methylthiophene	1			9.25E-02			E
4-Methyl-1-pentene	1			2.33E-02			E
4-Methyl-2-pentanone (MIBK)	7	7.77E-02	1.99E+00	8.83E-01	6.63E-01	4.91E-01	C
4-Methylheptane	4	1.90E-01	3.14E-01	2.49E-01	5.36E-02	5.25E-02	D
Acetaldehyde	5	2.19E-02	1.65E-01	7.74E-02	6.31E-02	5.53E-02	D
Acetone	9	3.38E-01	1.61E+01	6.70E+00	5.34E+00	3.49E+00	C
Acetonitrile	20	1.35E-01	2.56E+00	5.56E-01	5.19E-01	2.27E-01	A
Acrylonitrile	6			BDL[a]			C
Benzene	41	7.52E-02	2.20E+01	2.40E+00	3.69E+00	1.13E+00	A
Benzyl chloride	24	1.72E-03	2.96E-02	1.81E-02	8.16E-03	3.26E-03	A
Bromodichloromethane	2	2.75E-03	1.48E-02	8.78E-03	8.54E-03	1.18E-02	E
Bromomethane (Methyl bromide)	7	2.36E-03	6.77E-02	2.10E-02	2.32E-02	1.72E-02	C
Butane	9	4.31E-01	3.48E+01	6.22E+00	1.09E+01	7.10E+00	C
Carbon disulfide	34	2.92E-04	3.53E-01	1.47E-01	8.74E-02	2.94E-02	A
Carbon tetrachloride	30	8.55E-04	3.29E-02	7.98E-03	7.59E-03	2.72E-03	A
Carbon tetrafluoride (Freon 14)	1			1.51E-01			E
Carbonyl sulfide (Carbon oxysulfide)	29	1.04E-04	2.75E-01	1.22E-01	7.12E-02	2.59E-02	A

TABLE 2-8 (CONTINUED). LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
Chlorobenzene	37	1.79E-02	7.44E+00	4.84E-01	1.21E+00	3.89E-01	A
Chlorodifluoromethane (Freon 22)	4	2.06E-01	1.39E+00	7.96E-01	5.00E-01	4.90E-01	D
Chloroethane (Ethyl chloride)	10	9.69E-02	2.79E+01	3.95E+00	8.60E+00	5.33E+00	B
Chloromethane (Methyl chloride)	11	1.24E-02	1.16E+00	2.44E-01	3.28E-01	1.94E-01	B
cis-1,2-Dichloroethene	17	5.27E-02	6.69E+00	1.24E+00	1.56E+00	7.40E-01	B
cis-1,2-Dimethylcyclohexane	4	5.68E-02	1.03E-01	8.10E-02	1.90E-02	1.86E-02	D
cis-1,3-Dichloropropene	4	2.33E-04	6.68E-03	3.03E-03	2.72E-03	2.66E-03	D
cis-1,3-Dimethylcyclohexane	4	3.78E-01	6.36E-01	5.01E-01	1.25E-01	1.23E-01	D
cis-1,4-Dimethylcyclohexane / trans-1,3-Dimethylcyclohexane	4	2.00E-01	2.91E-01	2.48E-01	3.97E-02	3.89E-02	D
cis-2-Butene	4	7.08E-02	1.58E-01	1.05E-01	3.94E-02	3.86E-02	D
cis-2-Heptene	1			2.45E-02			E
cis-2-Hexene	4	8.54E-03	2.51E-02	1.72E-02	7.16E-03	7.02E-03	D
cis-2-Octene	4	1.67E-01	2.78E-01	2.20E-01	5.66E-02	5.55E-02	D
cis-2-Pentene	4	2.14E-02	7.47E-02	4.79E-02	2.37E-02	2.32E-02	D
cis-3-Methyl-2-pentene	4	1.18E-02	2.43E-02	1.79E-02	5.92E-03	5.80E-03	D
CO	6	4.75E+00	7.81E+01	2.44E+01	2.85E+01	2.28E+01	C
Cyclohexane	10	1.19E-01	3.03E+00	1.01E+00	8.97E-01	5.56E-01	B
Cyclohexene	4	1.43E-02	2.56E-02	1.84E-02	5.19E-03	5.09E-03	D
Cyclopentane	4	1.27E-02	3.34E-02	2.21E-02	8.55E-03	8.38E-03	D
Cyclopentene	4	5.13E-03	2.78E-02	1.21E-02	1.07E-02	1.05E-02	D
Decane	4	1.85E+00	6.38E+00	3.80E+00	1.94E+00	1.90E+00	D
Dibromochloromethane	3	7.95E-03	2.38E-02	1.51E-02	8.02E-03	9.08E-03	D
Dibromomethane (Methylene dibromide)	2	6.37E-04	1.03E-03	8.35E-04	2.81E-04	3.89E-04	E
Dichlorobenzene	58	4.84E-04	5.54E+00	9.40E-01	1.32E+00	3.40E-01	A
Dichlorodifluoromethane (Freon 12)	13	1.17E-01	6.56E+00	1.18E+00	1.72E+00	9.34E-01	B
Dichloromethane (Methylene chloride)	42	5.09E-03	4.12E+01	6.15E+00	8.23E+00	2.49E+00	A
Diethyl sulfide	1			8.62E-02			E
Dimethyl disulfide	25	2.29E-04	4.35E-01	1.37E-01	1.03E-01	4.02E-02	A
Dimethyl sulfide	29	7.51E-03	1.47E+01	5.66E+00	3.83E+00	1.39E+00	A
Dodecane (n-Dodecane)	4	6.79E-02	4.64E-01	2.21E-01	1.70E-01	1.66E-01	D
Ethane	5	4.83E+00	1.40E+01	9.05E+00	4.23E+00	3.71E+00	D
Ethanol	5	2.03E-02	3.40E-01	2.30E-01	1.39E-01	1.21E-01	D
Ethyl acetate	6	1.63E-01	3.97E+00	1.88E+00	1.54E+00	1.23E+00	C

TABLE 2-8 (CONTINUED). LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
Ethyl mercaptan (Ethanediol)	30	6.05E-05	8.35E-01	1.98E-01	1.97E-01	7.06E-02	A
Ethyl methyl sulfide	1			3.67E-02			E
Ethylbenzene	16	5.93E-01	8.80E+00	4.86E+00	2.58E+00	1.27E+00	B
Formaldehyde	5	3.40E-03	2.51E-02	1.17E-02	9.32E-03	8.17E-03	D
Heptane	10	1.29E-01	3.09E+00	1.34E+00	9.90E-01	6.14E-01	B
Hexane	17	1.19E-01	2.60E+01	3.10E+00	6.04E+00	2.87E+00	B
Hydrogen sulfide	36	1.02E-03	3.34E+02	3.20E+01	5.57E+01	1.82E+01	A
Indan (2,3-Dihydroindene)	4	2.38E-02	1.39E-01	6.66E-02	5.12E-02	5.02E-02	D
Isobutane (2-Methylpropane)	4	1.95E+00	1.66E+01	8.16E+00	6.73E+00	6.59E+00	D
Isobutylbenzene	4	1.66E-02	7.55E-02	4.07E-02	2.49E-02	2.44E-02	D
Isoprene (2-Methyl-1,3-butadiene)	3	1.16E-02	2.21E-02	1.65E-02	5.28E-03	5.97E-03	D
Isopropyl mercaptan	24	3.75E-05	1.22E+00	1.75E-01	2.60E-01	1.04E-01	A
Isopropylbenzene (Cumene)	5	7.61E-02	9.60E-01	4.30E-01	3.50E-01	3.07E-01	D
Methanethiol (Methyl mercaptan)	29	9.80E-04	4.05E+00	1.37E+00	9.55E-01	3.48E-01	A
Methyl tert-butyl ether (MTBE)	5	3.30E-03	2.61E-01	1.18E-01	1.21E-01	1.06E-01	D
Methylcyclohexane	4	1.00E+00	1.51E+00	1.29E+00	2.59E-01	2.54E-01	D
Methylcyclopentane	4	4.01E-01	8.17E-01	6.50E-01	1.77E-01	1.74E-01	D
Naphthalene	4	7.91E-03	2.65E-01	1.07E-01	1.19E-01	1.17E-01	D
n-Butylbenzene	4	2.24E-02	1.40E-01	6.80E-02	5.12E-02	5.02E-02	D
Nonane	4	1.62E+00	3.46E+00	2.37E+00	7.95E-01	7.79E-01	D
n-Propylbenzene (Propylbenzene)	5	1.32E-01	7.07E-01	4.13E-01	2.35E-01	2.06E-01	D
Octane	4	8.46E-01	1.38E+00	1.08E+00	2.73E-01	2.68E-01	D
p-Cymene (1-Methyl-4-lsopropylbenzene)	5	1.28E+00	8.16E+00	3.58E+00	3.10E+00	2.72E+00	D
Pentane	9	4.77E-01	2.44E+01	4.46E+00	7.56E+00	4.94E+00	C
Propane	9	4.79E+00	3.67E+01	1.55E+01	1.04E+01	6.80E+00	C
Propene	4	1.61E+00	4.80E+00	3.32E+00	1.41E+00	1.38E+00	D
Propyne	1			3.80E-02			E
sec-Butylbenzene	4	2.64E-02	1.21E-01	6.75E-02	4.04E-02	3.96E-02	D
Styrene (Vinylbenzene)	14	9.59E-03	1.21E+00	4.11E-01	4.49E-01	2.35E-01	B
Tetrachloroethylene (Perchloroethylene)	40	5.12E-03	8.28E+00	2.03E+00	1.89E+00	5.85E-01	A
Tetrahydrofuran (Diethylene oxide)	7	1.57E-01	1.78E+00	9.69E-01	5.63E-01	4.17E-01	C
Thiophene	2	1.25E-01	5.72E-01	3.49E-01	3.16E-01	4.38E-01	E
Toluene (Methyl benzene)	40	1.30E+00	9.08E+01	2.95E+01	2.30E+01	7.12E+00	A

TABLE 2-8 (CONTINUED). LANDFILL GAS CONSTITUENTS

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Interval (± ppm)	Recommended Emission Factor Rating
trans-1,2-Dichloroethene	8	3.09E-03	4.60E-02	2.87E-02	1.52E-02	1.05E-02	C
trans-1,2-Dimethylcyclohexane	4	3.19E-01	5.23E-01	4.04E-01	8.65E-02	8.47E-02	D
trans-1,3-Dichloropropene	5	3.30E-04	3.00E-02	9.43E-03	1.18E-02	1.03E-02	D
trans-1,4-Dimethylcyclohexane	4	1.68E-01	2.50E-01	2.05E-01	4.12E-02	4.04E-02	D
trans-2-Butene	4	5.41E-02	1.76E-01	1.04E-01	5.15E-02	5.05E-02	D
trans-2-Heptene	1			2.50E-03			E
trans-2-Hexene	4	1.11E-02	3.29E-02	2.06E-02	9.49E-03	9.30E-03	D
trans-2-Octene	4	1.69E-01	2.96E-01	2.41E-01	5.32E-02	5.21E-02	D
trans-2-Pentene	4	1.66E-02	5.09E-02	3.47E-02	1.41E-02	1.39E-02	D
trans-3-Methyl-2-pentene	4	9.91E-03	2.07E-02	1.55E-02	4.73E-03	4.63E-03	D
Tribromomethane (Bromoform)	4	4.36E-04	2.68E-02	1.24E-02	1.12E-02	1.09E-02	D
Trichloroethylene (Trichloroethene)	42	6.55E-03	3.18E+00	8.28E-01	6.88E-01	2.08E-01	A
Trichlorofluoromethane (Freon 11)	16	7.10E-03	7.14E-01	2.48E-01	2.22E-01	1.09E-01	B
Trichloromethane (Chloroform)	34	2.21E-03	6.82E-01	7.08E-02	1.46E-01	4.91E-02	A
Undecane	4	6.45E-01	3.10E+00	1.67E+00	1.04E+00	1.02E+00	D
Vinyl acetate	6	2.17E-02	1.02E+00	2.48E-01	3.86E-01	3.09E-01	C
Vinyl chloride (Chloroethene)	40	6.78E-03	1.72E+01	1.42E+00	2.88E+00	8.92E-01	A
Xylenes (*o*-, *m*-, *p*-, mixtures)	78	3.09E-01	3.56E+01	9.23E+00	8.84E+00	1.96E+00	A

[a] All tests below detection limit. Method detection limits are available for three tests, and are as follows: 2.00E-04, 4.00E-03, and 2.00E-02 ppm

TABLE 2-9. SUMMARY OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, AND OXYGEN CONCENTRATIONS OF RAW LANDFILL GAS

Test Report ID	CH_4		CO		CO_2		N_2		O_2	
	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)
TR-076	NR[a]	NR	NR	NR	NR	NR	160,500	16.1	16,700	1.7
TR-084	NR	NR	NR	NR	NR	NR	100,000	10.0	24,000	2.4
TR-086	NR	NR	NR	NR	NR	NR	21,700	2.2	10,000	1.0
TR-114	NR	NR	NR	NR	NR	NR	140,000	14.0	NR	NR
TR-134	NR	NR	NR	NR	NR	NR	27,850	2.8	2,500	0.3
TR-141	NR	NR	NR	NR	NR	NR	50,100	5.0	20,500	2.1
TR-145	50,600	51.0	13	0.0	407,400	40.7	71,400	7.1	11,100	1.1
TR-146	525,000	52.5	NR	NR	413,000	41.3	56,900	5.7	4,280	0.4
TR-147	NR	NR	2.7	0.0	NR	NR	NR	NR	NR	NR
TR-148	529,000	52.9	4.7	0.0	402,000	40.2	66,000	6.6	2,700	0.3
TR-153	547,000	54.7	NR	NR	380,000	38.0	80,000	8.0	6,000	0.6
TR-156	389,000	38.9	NR	NR	349,000	34.9	258,000	25.8	24,000	2.4
TR-157	581,000	58.1	NR	NR	386,000	38.6	27,000	2.7	2,800	0.3
TR-159	480,000	48.0	NR	NR	374,000	37.4	141,000	14.1	5,300	0.5
TR-165	443,000	44.3	NR	NR	356,000	35.6	180,000	18.0	15,200	1.5
TR-167	450,000	45.0	NR	NR	360,000	36.0	178,000	17.8	14,400	1.4
TR-168	335,000	33.5	NR	NR	326,000	32.6	324,000	32.4	21,000	2.1
TR-169	316,000	31.6	NR	NR	316,000	31.6	340,000	34.0	22,000	2.2
TR-171	359,000	35.9	NR	NR	405,000	40.5	209,000	20.9	22,000	2.2
TR-173	481,000	48.1	NR	NR	382,000	38.2	121,000	12.1	17,400	1.7
TR-175	379,000	37.9	5.2	0.0	301,000	30.1	235,000	23.5	62,100	6.2
TR-176	318,000	31.8	NR	NR	265,000	26.5	344,000	34.4	73,300	7.3
TR-178	200,000	20.0	NR	NR	247,000	24.7	519,000	51.9	34,000	3.4
TR-179	459,000	45.9	NR	NR	331,000	33.1	NR	NR	32,800	3.3
TR-181	335,500	33.6	NR	NR	324,000	32.4	306,000	30.6	23,800	2.4
TR-182	351,000	35.1	NR	NR	332,000	33.2	287,000	28.7	21,800	2.2
TR-183	326,000	32.6	NR	NR	309,000	30.9	341,000	34.1	24,000	2.4

TABLE 2-9 (CONTINUED). SUMMARY OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, AND OXYGEN CONCENTRATIONS OF RAW LANDFILL GAS

Test Report ID	CH_4		CO		CO_2		N_2		O_2	
	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)
TR-187	350,000	35.0	NR	NR	334,000	33.4	289,000	28.9	27,000	2.7
TR-188	435,000	43.5	77	0.0	355,000	35.5	196,000	19.6	13,700	1.4
TR-189	557,000	55.7	35	0.0	405,000	40.5	37,700	3.8	300	0.0
TR-190	502,000	50.2	NR	NR	395,000	39.5	103,000	10.3	200	0.0
TR-191	350,000	35.0	NR	NR	272,000	27.2	322,000	32.2	56,700	5.7
TR-194	611,000	61.1	65	0.0	389,000	38.9	NR	NR	1,000	0.1
TR-196	476,000	47.6	NR	NR	384,000	38.4	133,000	13.3	6,700	0.7
TR-199	275,000	27.5	NR	NR	212,000	21.2	427,000	42.7	86,000	8.6
TR-205	345,000	34.5	NR	NR	328,000	32.8	297,000	29.7	23,000	2.3
TR-207	183,000	18.3	NR	NR	219,500	22.0	506,000	50.6	91,800	9.2
TR-209	483,000	48.3	0.0	0.0	387,000	38.7	118,000	11.8	10,900	1.1
TR-220	350,000	35.0	NR	NR	295,000	29.5	304,000	30.4	50,500	5.1
TR-226	522,000	52.2	6.5	0.0	349,000	34.9	100,000	10.0	27,700	2.8
TR-229	309,000	30.9	NR	NR	250,000	25.0	374,000	37.4	72,200	7.2
TR-241	212,000	21.2	NR	NR	263,000	26.3	465,000	46.5	61,000	6.1
TR-251	410,000	41.0	NR	NR	366,000	36.6	190,000	19.0	35,000	3.5
TR-253	440,000	44.0	NR	NR	351,000	35.1	191,000	19.1	46,600	4.7
TR-255	445,000	44.5	NR	NR	375,000	37.5	164,000	16.4	16,000	1.6
TR-259	257,000	25.7	NR	NR	282,000	28.2	414,000	41.4	23,800	2.4
TR-260	260,000	26.0	NR	NR	284,000	28.4	415,000	41.5	24,000	2.4
TR-261	259,000	25.9	NR	NR	281,000	28.1	428,000	42.8	26,900	2.7
TR-264	446,000	44.6	NR	NR	374,000	37.4	154,000	15.4	26,500	2.7
TR-266	311,000	31.1	0.0	0.0	304,000	30.4	NR	NR	3,000	0.3
TR-272	467,000	46.7	NR	NR	374,000	37.4	131,000	13.1	17,000	1.7
TR-273	376,000	37.6	NR	NR	298,000	29.8	256,000	25.6	64,000	6.4
TR-284	520,000	52.0	NR	NR	411,000	41.1	159,000	15.9	16,000	1.6
TR-287	617,000	61.7	NR	NR	430,000	43.0	112,000	11.2	200	0.0

TABLE 2-9 (CONTINUED). SUMMARY OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, AND OXYGEN CONCENTRATIONS OF RAW LANDFILL GAS

Test Report ID	CH_4		CO		CO_2		N_2		O_2	
	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)	(ppmv)	(% v/v)
TR-290	213,000	21.3	NR	NR	348,000	34.8	420,000	42.0	8,800	0.9
TR-292	495,000	49.5	NR	NR	333,000	33.3	136,000	13.6	25,700	2.6
TR-293a	607,000	60.7	NR	NR	438,000	43.8	137,000	13.7	26,000	2.6
TR-293b	432,000	43.2	NR	NR	374,000	37.4	262,000	26.2	24,000	2.4
Minimum	183,000	18.3	-	-	212,000	21.2	21,700	2.2	200	0.0
Maximum	617,000	61.7	77.0	0.0	438,000	43.8	519,000	51.9	91,800	9.2
Mean	408,000	40.8	20.9	0.0	342,000	34.2	219,000	21.9	25,400	2.5
Standard Deviation	113,000	11.3	28.4	0.0	54,800	5.5	135,000	13.5	22,100	2.2
95% Confidence Interval (±)	31,100	3.1	17.6	0.0	15,000	1.5	35,900	3.6	5,790	0.6

[a] Not reported

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2.7 LANDFILL GAS CONSTITUENT DATA FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992

The prior Municipal Solid Waste (MSW) Landfills section of AP-42 (U.S. EPA, 1998) contained uncontrolled LFG constituent default emission factors derived from landfills with the majority of their waste in place prior to 1992. This data is retained in the AP-42 section as Table 2.4-2. The following discussion, adapted from the 1997 emission factor documentation report (U.S. EPA, 1997b), documents the prior activities and analysis performed to derive these emission factors. The supporting raw data tables from the 1997 report are provided in Appendix A.

2.7.1 Data Gathering and Review

Data gathering was undertaken in advance of the 1998 AP-42 section update. This data gathering effort included an extensive literature search, contacts to identify ongoing projects within EPA, and electronic database searches. MSW landfill source test reports were collected during these efforts. After the data gathering was completed, a review of the information obtained was undertaken to reduce and synthesize the information for emission factor development.

Reduction of the collected literature and data into a smaller, more pertinent subset for development of the MSW Landfill AP-42 section was governed by the following:

- Only primary references of emissions data were used.
- Test report source processes were clearly identified.
- Test reports specified whether emissions were controlled or uncontrolled.
- Reports referenced for controlled emissions specify the control devices.
- Data support (i.e., calculation sheets, sampling and analysis description) was supplied in most cases. One exception is that some industry responses to the NSPS surveys were deemed satisfactory for inclusion.
- Test report units were convertible to selected reporting units.
- Test reports that were positively biased to a particular situation (i.e., test studies involving PCB analysis because of a known historical problem associated with PCB disposal in a specific MSW landfill) were excluded.

As delineated by EPA's Emission Inventory Branch (EIB), the reduced subset of emissions data was ranked for quality. The ranking/rating of the data was used to identify questionable data. Each data set was ranked as follows:

A - When tests were performed by a sound methodology and reported in enough detail for adequate validation. These tests are not necessarily EPA reference method tests, although such reference methods were preferred.

B - When tests were performed by a generally sound methodology, but lack enough detail for adequate validation.

C - When tests were based on an untested or new methodology or are lacking a significant amount of background data.

D - When tests were based on a generally unacceptable method but the method may provide an order-of-magnitude value for the source (U.S. EPA, 1993).

The selected rankings were based on the following criteria:

- Source operation. The manner in which the source was operated is well documented in the report. The source was operating within typical parameters during the test.

- Sampling procedures. If actual procedures deviated from standard methods, the deviations are well documented. Procedural alterations are often made in testing an uncommon type of source. When this occurs an evaluation is made of how such alternative procedures could influence the test results.

- Sampling and process data. Many variations can occur without warning during testing, sometimes without being noticed. Such variations can induce wide deviation in sampling results. If a large spread between test results cannot be explained by information contained in the test report, the data are suspect and are given a lower rating.

- Analysis and calculations. The test reports contain original raw data sheets. The nomenclature and equations used are compared with those specified by the EPA, to establish equivalency. The depth of review of the calculations is dictated by the reviewers' confidence in the ability and conscientiousness of the tester, which in turn is based on factors such as consistency of results and completeness of other areas of the test report (U.S. EPA, 1993).

2.7.2 Development of Default Concentrations

After review, there were 110 data sources (identified in the references as BID-1 to BID-110) used to develop the default concentrations. Appendix A lists the compounds presented in each reference. The Appendix also reflects the co-disposal history of the landfill, if known. Landfills known to have accepted non-residential wastes (i.e., co-disposal) and those known to have never accepted non-residential wastes are delineated. For most of these landfills, the disposal history is unknown. The data for co-disposal and no co-disposal or unknown disposal history are separated for NMOC, benzene, and toluene. There was no statistical difference among disposal history for any of the other LFG constituents presented (U.S. EPA, 1997b). As mentioned before, RCRA subtitle D requirements resulted in eliminating the practice of co-disposal in municipal solid waste landfills, so that co-disposal data segregation is not an issue for the landfills with waste in place on or after 1992.

Table 2-11 presents default concentration values for the speciated organic compounds and reduced sulfur compounds that were corrected for air infiltration. As discussed earlier, these data were presented in the previous version of the AP-42 chapter (U.S. EPA, 1998), and will be presented in the AP-42 chapter as default concentrations for landfills with waste in place prior to 1992. The following criteria, used in developing ratings in the 1997 AP-42 update (U.S. EPA, 1997b), were used to provide recommended default emission factor ratings.

TABLE 2-10. CRITERIA USED TO DETERMINE RECOMMENDED DEFAULT EMISSION FACTOR RATINGS

Factor Rating	# of Data Points
A	≥ 20
B	10-19
C	6-9
D	3-5
E	<3

TABLE 2-11. DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992

Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
NMOC (as hexane)[e]	86.18		
Co-disposal (SCC 50300603)		2,420	D
No or Unknown co-disposal (SCC 50100402)		595	B
1,1,1-Trichloroethane (methyl chloroform)[a]	133.42	0.48	B
1,1,2,2-Tetrachloroethane[a]	167.85	1.11	C
1,1-Dichloroethane (ethylidene dichloride)[a]	98.95	2.35	B
1,1-Dichloroethene (vinylidene chloride)[a]	96.94	0.20	B
1,2-Dichloroethane (ethylene dichloride)[a]	98.96	0.41	B
1,2-Dichloropropane (propylene dichloride)[a]	112.98	0.18	D
2-Propanol (isopropyl alcohol)	60.11	50.1	E
Acetone	58.08	7.01	B
Acrylonitrile[a]	53.06	6.33	D
Benzene[a]	78.11		
Co-disposal (SCC 50300603)		11.1	D
No or Unknown co-disposal (SCC 50100402)		1.91	B
Bromodichloromethane	163.83	3.13	C
Butane	58.12	5.03	C
Carbon disulfide[a]	76.13	0.58	C
Carbon monoxide[b]	28.01	141	E
Carbon tetrachloride[a]	153.84	0.004	B
Carbonyl sulfide[a]	60.07	0.49	D
Chlorobenzene[a]	112.56	0.25	C
Chlorodifluoromethane	86.47	1.30	C
Chloroethane (ethyl chloride)[a]	64.52	1.25	B
Chloroform[a]	119.39	0.03	B
Chloromethane	50.49	1.21	B
Dichlorobenzene[c]	147	0.21	E
Dichlorodifluoromethane	120.91	15.7	A
Dichlorofluoromethane	102.92	2.62	D
Dichloromethane (methylene chloride)[a]	84.94	14.3	A
Dimethyl sulfide (methyl sulfide)	62.13	7.82	C
Ethane	30.07	889	C
Ethanol	46.08	27.2	E
Ethyl mercaptan (ethanethiol)	62.13	2.28	D
Ethylbenzene[a]	106.16	4.61	B
Ethylene dibromide	187.88	0.001	E
Fluorotrichloromethane	137.38	0.76	B

Table 2-11 (CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992

Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
Hexane[a]	86.18	6.57	B
Hydrogen sulfide	34.08	35.5	B
Mercury (total)[a,d]	200.61	$2.92x10^{-4}$	E
Methyl ethyl ketone[a]	72.11	7.09	A
Methyl isobutyl ketone[a]	100.16	1.87	B
Methyl mercaptan	48.11	2.49	C
Pentane	72.15	3.29	C
Perchloroethylene (tetrachloroethylene)[a]	165.83	3.73	B
Propane	44.09	11.1	B
t-1,2-dichloroethene	96.94	2.84	B
Toluene[a]	92.13		
Co-disposal (SCC 50300603)		165	D
No or Unknown co-disposal (SCC 50100402)		39.3	A
Trichloroethylene (trichloroethene)[a]	131.38	2.82	B
Vinyl chloride[a]	62.50	7.34	B
Xylenes[a]	106.16	12.1	B

NOTE: This is not an all-inclusive list of potential LFG constituents, only those for which test data were available at multiple sites.

[a] Hazardous Air Pollutants listed in Title III of the 1990 Clean Air Act Amendments.

[b] Carbon monoxide is not a typical constituent of LFG, but does exist in instances involving landfill (underground) combustion. Therefore, this default value should be used with caution. Of 18 sites where CO was measured, only 2 showed detectable levels of CO.

[c] Source tests did not indicate whether this compound was the para- or ortho- isomer. The para isomer is a Title III-listed HAP.

[d] No data were available to speciate total Hg into the elemental and organic forms.

[e] For NSPS/Emission Guideline compliance purposes, the default concentration for NMOC as specified in the final rule must be used. For purposes not associated with NSPS/Emission Guideline compliance, the default VOC content at co-disposal sites can be estimated by 85% by weight (2,060 ppmv as hexane); at No or Unknown sites can be estimated by 39% by weight (235 ppmv as hexane).

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3.0 CONTROLLED LANDFILL GAS DATA ANALYSIS RESULTS

Emission factors for control devices apply to landfills with waste in place both before and after 1992. Development of emission factors for each combustion control device type is discussed in the following sections.

3.1 FLARES

Landfill gas flare combustion by-product emissions data for a total of 35 landfills were submitted to EPA and utilized in emission factor development, comprising a total of 53flares contained in 41 test reports. Six of the test reports contained test data from two different landfills but represent six different flares (TR-181, TR-182, and TR-205 for one landfill, and TR-259, TR-260, and TR- 261 for another landfill). The manufacturer was specified for 23 of the flares (Table 3-1). These flares are assumed to be enclosed since sampling candle-stick flares is not typically done. Enclosed flares are designed to allow for performance testing to establish emission reduction capability and potential by-product emissions.

TABLE 3-1. SUMMARY OF NUMBER OF FLARES AND MANUFACTURERS FOR LANDFILL GAS FLARE COMBUSTION BY-PRODUCT EMISSIONS TEST DATA

Flare Manufacturer	Number of Emission Test Reports
Callidus	1
John Zink	14
LFG Specialties	1
McGill	2
Perennial Energy	3
SurLite	2
Not Specified	30
Total	53

Nitrogen oxides, carbon monoxide, and particulate matter emissions were sampled and reported in units of parts per million (ppm), pounds per hour (lb/hr), or pounds per day (lb/day). Total dioxin/furan emissions were reported in nanograms per dry standard cubic meter (ng/dscm). Twenty-five test reports contained emissions data for NO_X, CO, and PM. One test report contained data for NO_X, CO, and total dioxins/furans. Five test reports contained emissions data for both NO_X and CO, one test report contained only NO_X emission data, and five test reports contained only CO emissions data. Where possible, each of the emission data points were converted to kilograms per million dry standard cubic meters of CH_4 (kg/10^6 dscm CH_4) to result in comparable emissions for a variety of LFG flares (See Appendix G for sample calculation).

3.1.1 Nitrogen Oxides

The default NO_x emission factor was calculated from 36 test reports containing NO_X emissions data from a total of 48 flares.

The emission rate provided in TR-148 was excluded from the NO_X analysis because the flare inlet gas flow rate was reported in standard cubic feet per minute (scfm) and inlet gas moisture was not determined as part of the flare testing. Consequently, a NO_X emission factor could not be developed on the basis of dry standard cubic meters of inlet CH_4 for TR-148. The emission rate provided for TR-160 was excluded from the NO_X analysis because flare inlet gas composition data was not provided in the test report. As a result, an emission factor could not be calculated for TR-160.

One test report (TR-241) revealed NO_x emission rates below the method detection limit (<0.59 kg/hr or 392 kg/10^6 dscm CH_4) for all test runs. Based on guidance for detection limits contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the method detection limit was used to represent this flare's average emission rate. Since there are detect values greater than this non-detect, the value is used in emission factor determination calculations

Two of the 36 test reports (TR-145 and TR-146) contained NO_X test data obtained from operating the flare under two different operating temperatures. For both cases, the data associated with the set of test runs that most closely matched the average testing temperature from the other 34 test reports (1,552 ºF) was used for the development of the default NO_X emission factor.

Emission rates for the 46 flares (excluding the two flares from TR-148 and TR-160) included in the analysis range from 211 to 1,373 kg/10^6 dscm CH_4. The arithmetic mean emission rate for NO_X for these LFG flares is 631 kg/10^6 dscm CH_4. This average rate was selected as the default emission factor to represent flare NO_X in the AP-42 update with an A quality rating. The previous AP-42 default factor (U.S. EPA, 1998) was 650 kg/10^6 dscm CH_4 with a quality rating of "C."

3.1.2 Carbon Monoxide

The CO default emission factor was calculated from 40 test reports containing emissions data from 52 flares.

The emission rate provided in TR-148 was excluded from the CO analysis because the flare inlet gas flow rate was reported in standard cubic feet per minute (scfm) and inlet gas moisture was not determined as part of the flare testing. Consequently, a CO emission factor could not be developed on the basis of dry standard cubic meters of inlet CH_4 for TR-148. The emission rate provided for TR-160 was excluded from the CO analysis because flare inlet gas composition data was not provided in the test report. As a result, an emission factor could not be calculated for TR-160.

Four test reports (TR-157, TR-175, TR-179, and TR-251) revealed CO emission rates below the method detection limits. Based on guidance for detection limits contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the method detection limits were used to represent the average emission rate. Since there are detect values greater than the non-detect values, the values are used in emission factor determination calculations

Two of the 40 test reports (TR-145 and TR-146) contained CO test data obtained from operating the each flare under two different operating temperatures. For both cases, the data associated with the set of test runs that most closely matched the average testing temperature from the other 36 test reports (1,551 ºF) was used for the development of the default CO emission factor.

Carbon monoxide emission rates for the 50 flares (excluding the two flares from TR-148 and TR-160) included in the analysis range from 0 to 11,500 kg/10^6 dscm CH_4. The arithmetic mean emission rate for CO is 737 kg/10^6 dscm CH_4, which was selected as the default emission factor with an A quality rating for the AP-42 update. The prior default factor in AP-42 (U.S. EPA, 1998) was 12,000 kg/10^6 dscm CH_4 with a quality rating of "C." It is worth noting that the new default emission factor is based on over three times the amount of data as the previous emission factor, which may help explain the large difference between the default values.

3.1.3 Particulate Matter

The default PM emission factor was calculated from 28 test reports containing emissions data from 36 flares.

One of the test reports (TR-146) contained PM test data obtained from operating the flare under two different operating temperatures. The data associated with the set of test runs that most closely matched the average testing temperature from the other test reports (1,548 ºF) was used for the development of the default CO emission factor.

The emission rate provided in TR-148 was excluded from the PM analysis because the flare inlet gas flow rate was reported in standard cubic feet per minute (scfm) and inlet gas moisture was not determined as part of the flare testing. Consequently, a PM emission factor could not be developed on the basis of dry standard cubic meters of inlet CH_4.

The PM emission rates from the 35 flares (excluding the flare from TR-148) included in the analysis range between 84 and 735 kg/10^6 dscm CH_4. The arithmetic mean emission rate for PM is 238 kg/10^6 dscm CH_4 with an A quality rating. This average rate was selected as the default to represent PM in the AP-42 update. The prior version of the AP-42 section for MSW landfills (U.S. EPA, 1998) had a default PM emission factor of 270 kg/10^6 dscm CH_4 with a quality rating of "D."

3.1.4 Total Dioxin/Furan

One test report (TR-273) contained measurement data for dioxins/furans. The total dioxin/furan emission rate is 6.7 x 10^{-6} kg/10^6 dscm CH_4, which was selected as the default emission factor for the AP-42 update. The previous AP-42 section for MSW landfills (U.S. EPA, 1998) did not include dioxin/furan emission factors for LFG flares.

3.1.5 Flare Summary

Summaries of the NO_X, CO, PM, and total dioxin/furan combustion by-product data included in the LFG flare analysis for determining default emission factors for the update can be found in Tables 3-4, 3-5, and 3-6. In addition, the three tables provide the test methods used to measure these emissions data.

A data quality rating of A was assigned to each of the flare test reports listed in Tables 3-4, 3-5, and 3-6. All of the reports containing these data included adequate detail, the methodology appeared to be sound, and no problems were reported for the test runs. The following criteria, used in developing ratings in the 1998 AP-42 update, were used to provide recommended default emission factor ratings.

TABLE 3-2. CRITERIA USED TO DETERMINE RECOMMENDED DEFAULT EMISSION FACTOR RATINGS

Factor Rating	# of Data Points
A	≥ 20
B	10-19
C	6-9
D	3-5
E	<3

An overall data quality rating of A is recommended for the NO_X, CO, and PM combustion by-products from flares default emission factors. This rating exemplifies the fact that the default NO_X, CO, and PM emission factors were developed using A-rated test data and the emission factor ranking is more of a function of the number of data points used to develop the default emission factor. Furthermore, no specific bias is evident for the NO_X, CO, and PM emission factors. An overall data quality rating of E is recommended for the total dioxin/furan combustion by-product default emission factor since the emission factor was developed from a single facility which does not represent a random sample of LFG flares (Table 3-3).

TABLE 3-3. RECOMMENDED DEFAULT EMISSION FACTOR RATINGS FOR NO_X, CO, PM, AND TOTAL DIOXIN/FURAN LANDFILL FLARE COMBUSTION BY-PRODUCTS

Flare Combustion By-Product	# of Data Points	Recommended Emission Factor Rating
NOx	30	A
CO	34	A
PM	23	A
Total Dioxin/Furan	1	E

TABLE 3-4. LANDFILL GAS FLARE NO_x EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report	Test Method	Flare Combustion By-Product	Calculated Emission Factor ($kg/10^6$ dscm CH_4)
TR-145[a]	EPA Method 7E	NO_x	671
TR-146[a]	EPA Method 7E	NO_x	1,200
TR-159	EPA Method 7E	NO_x	634
TR-165	SCAQMD Method 100.1	NO_x	669
TR-168	SCAQMD Method 100.1	NO_x	341
TR-169	SCAQMD Method 100.1	NO_x	322
TR-171	SCAQMD Method 100.1	NO_x	608
TR-173	SCAQMD Method 100.1	NO_x	563
TR-175[b]	SCAQMD Method 100.1	NO_x	725
TR-176	SCAQMD Method 100.1	NO_x	656
TR-178	SCAQMD Method 100.1	NO_x	458
TR-179	SCAQMD Method 100.1	NO_x	502
TR-181, TR-182, TR-205[c]	SCAQMD Method 100.1	NO_x	320
TR-183	SCAQMD Method 100.1	NO_x	520
TR-187	SCAQMD Method 100.1	NO_x	430
TR-196	CARB Method 100/EPA Method 7E	NO_x	677
TR-199	SCAQMD Method 100.1	NO_x	449
TR-207	SCAQMD Method 100.1	NO_x	1,370
TR-209[d]	EPA Method 7E	NO_x	1,080
TR-229	SCAQMD Method 100.1	NO_x	823
TR-241[e]	EPA Method 7A	NO_x	392

TABLE 3-4 (CONTINUED). LANDFILL GAS FLARE NO_X EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report	Test Method	Flare Combustion By-Product	Calculated Emission Factor (kg/10^6 dscm CH_4)
TR-251	SCAQMD Method 100.1	NO_x	848
TR-253	SCAQMD Method 100.1	NO_x	846
TR-255	SCAQMD Method 100.1	NO_x	543
TR-258	CARB Method 100	NO_x	554
TR-259, TR-260, TR-261[c]	SCAQMD Method 100.1	NO_x	234
TR-264	SCAQMD Method 100.1	NO_x	939
TR-273	EPA Method 7E	NO_x	741
TR-287	EPA Method 7E	NO_x	596
TR-290	SCAQMD Method 100.1	NO_x	211
		NO_x Default Emission Factor	**631**
		1998 AP-42 NO_x Emission Factor[f]	**650**

[a] Average flare temperature for tests where the temperature was not varied is 1552ºF. For tests performed under multiple temperatures, the test where the operating temperature was closest to the average was included. See discussion for additional details.
[b] Emission factor calculated is based on the average emissions for three flares.
[c] Three test reports for three separate flares at the same landfill.
[d] Emission factor calculated is based on the average emissions for five flares.
[e] Based on guidance in EPA's Procedures for Preparing Emission Factor Documents for detection limits, half of the method detection limit was used to represent this landfill's average emission rate. Since there are detect values greater than this non-detect, the value is used in emission factor determination calculations.
[f] AP-42, Fifth Edition, Volume I, Section 2.4, Supplement E, November 1998.

TABLE 3-5. LANDFILL GAS FLARE CO EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report	Test Method	Flare Combustion By-Product	Calculated Emission Factor (kg/10^6 dscm CH_4)
TR-145[a]	EPA Method 10, 40 CFR 60, Appendix A	CO	533
TR-146[a]	EPA Method 10, 40 CFR 60, Appendix A	CO	23
TR-147	EPA Method 10, 40 CFR 60, Appendix A	CO	13
TR-153	EPA Method 10, 40 CFR 60, Appendix A	CO	105
TR-156	EPA Method 10, 40 CFR 60, Appendix A	CO	53
TR-157[b]	EPA Method 10, 40 CFR 60, Appendix A	CO	12
TR-159	EPA Method 10, 40 CFR 60, Appendix A	CO	911
TR-165	SCAQMD Method 100	CO	1,550
TR-168	SCAQMD Method 100	CO	11
TR-169	SCAQMD Method 100.1	CO	15
TR-171	SCAQMD Method 100.1	CO	319
TR-173	SCAQMD Method 100.1	CO	263

TABLE 3-5 (CONTINUED). LANDFILL GAS FLARE CO EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report	Test Method	Flare Combustion By-Product	Calculated Emission Factor ($kg/10^6$ dscm CH_4)
TR-175[b,d]	SCAQMD Method 100.1/SCAQMD Method 10.1 TCA/FID	CO	29
TR-176	SCAQMD Method 100.1	CO	13
TR-178	SCAQMD Method 100.1	CO	276
TR-179[b]	SCAQMD Method 100.1	CO	262
TR-181, TR-182, TR-205[e]	SCAQMD Method 100.1	CO	164
TR-183	SCAQMD Method 100.1	CO	541
TR-187	SCAQMD Method 100.1	CO	76
TR-196	CARB Method 100/EPA Method 10	CO	2,010
TR-199	SCAQMD Method 100.1	CO	11,500
TR-207	SCAQMD Method 100.1	CO	639
TR-209[c]	EPA Method 10, 40 CFR 60, Appendix A	CO	100
TR-226	EPA Method 10, 40 CFR 60, Appendix A	CO	67
TR-229	SCAQMD Method 100.1	CO	28
TR-251[b]	SCAQMD Method 25.1	CO	306
TR-253	SCAQMD Method 100.1	CO	13
TR-255	SCAQMD Method 100.1	CO	434
TR-258	CARB Method 100	CO	23
TR-259, TR-260, TR-261[e]	SCAQMD Method 100.1	CO	175
TR-264	SCAQMD Method 100.1	CO	780
TR-273	EPA Method 10, 40 CFR 60, Appendix A	CO	410
TR-287	EPA Method 10, 40 CFR 60, Appendix A	CO	3,420
TR-290	SCAQMD Method 100.1	CO	0
		CO Default Emission Factor	**737**
		1998 AP-42 CO Emission Factor[f]	**12,000**

[a] Average flare temperature for tests where the temperature was not varied is 1551ºF. For tests performed under multiple temperatures, the test where the operating temperature was closest to the average was included. See discussion for additional details.
[b] Based on guidance in EPA's Procedures for Preparing Emission Factor Documents for detection limits, half of the method detection limit was used to represent this landfill's average emission rate. Since there are detect values greater than this non-detect, the value is used in emission factor determination calculations.
[c] Emission factor calculated is based on the average emissions for five flares.
[d] Emission factor calculated is based on the average emissions for three flares.
[e] Three test reports for three separate flares at the same landfill.
[f] AP-42, Fifth Edition, Volume I, Section 2.4, Supplement E, November 1998.

TABLE 3-6. LANDFILL GAS FLARE PM AND TOTAL DIOXIN/FURAN EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report	Test Method	Flare Combustion By-Product	Calculated Emission Factor ($kg/10^6$ dscm CH_4)
TR-145	EPA Method 0050	PM	142
TR-146[a]	EPA Method 0050	PM	226
TR-165	SCAQMD Method 5.2	PM	187
TR-168	SCAQMD Method 5.1	PM	309
TR-171	SCAQMD Method 5.1	PM	735
TR-173	SCAQMD Method 5.1	PM	256
TR-175[b]	SCAQMD Method 5.1	PM	143
TR-176	SCAQMD Method 5.1	PM	165
TR-178	SCAQMD Method 5.1	PM	531
TR-179	SCAQMD Method 5.1	PM	251
TR-181, TR-182, TR-205[c]	SCAQMD Method 5.1	PM	84
TR-183	SCAQMD Method 5.1	PM	193
TR-187	SCAQMD Method 5.1	PM	249
TR-196	SCAQMD Method 5.1	PM	401
TR-199	SCAQMD Method 5.1	PM	184
TR-207	SCAQMD Method 5.2	PM	130
TR-229	SCAQMD Method 5.1	PM	313
TR-251	SCAQMD Method 5.1	PM	277
TR-253	SCAQMD Method 5.1	PM	131
TR-255	SCAQMD Method 5.1	PM	138
TR-259, TR-260, TR-261[c]	SCAQMD Method 5.1	PM	97
TR-264	SCAQMD Method 5.1	PM	205
TR-290	SCAQMD Method 5.1	PM	133
		PM Default Emission Factor	**238**
		1998 AP-42 PM Emission Factor[d]	**270**
TR-273	EPA Method 23	Dioxin/Furan	6.7E-06
		Dioxin/Furan Default Emission Factor[e]	**6.76E-06**

[a] Average flare temperature for tests where the temperature was not varied is 1548ºF. For tests performed under multiple temperatures, the test where the operating temperature was closest to the average was included. See discussion for additional details.
[b] Emission factor calculated is based on the average emissions for three flares.
[c] Three test reports for three separate flares at the same landfill.
[d] AP-42, Fifth Edition, Volume I, Section 2.4, Supplement E, November 1998.
[e] New default emission factor. No emission factor for dioxin/furan is in the latest AP-42 update.

References

TR-145. Compliance Testing of a Landfill Flare at Browning-Ferris Gas Services, Inc.'s Facility in Halifax, Massachusetts, BFI Waste Systems of North America, Inc., May 1996.

TR-146. Compliance Source Testing of a Landfill Flare at Northern Disposal, Inc. East Bridgewater Landfill, Northern Disposal, Inc., June 1994.

TR-147. Compliance Emissions Test Program for BFI of Ohio, Inc., BFI of Ohio, Inc., 6/26/98.

TR-148. Compliance Testing of Landfill Flare at Browning-Ferris Gas Services, Inc.'s Fall River Landfill Flare, BFI Waste Systems of North America, Inc., March 1995.

TR-153. Results of the Emission Compliance Test on the Enclosed Flare System at the Carbon Limestone Landfill, Browning-Ferris Industrial Gas Services, Inc., 8/8/96.

TR-156. Results of the Emission Compliance Test on the Enclosed Flare System at the Lorain County Landfill No. 2, Browning-Ferris Industrial Gas Services, Inc., 9/5/96.

TR-157. Emission Compliance Testing Browning-Ferris Gas Services, Inc. Willowcreek Landfill, BFI-Willowcreek, 2/2/98.

TR-159. Compliance Stack Sampling Report, Monmouth County Reclamation Center, SCS Engineers (Reston, VA), 9/8/95.

TR-160. Source Emission Testing of an Enclosed Landfill Gas Ground Flare, SCS Engineers (Reston, VA), September 1997.

TR-165. 1997 Annual Compliance Source Testing Results for the Coyote Canyon Landfill Gas Recovery Facility Flare No. 1, Laidlaw Gas Recovery Systems, January 1998.

TR-168. Colton Sanitary Landfill Gas Flare No. 2 (John Zink) 1998 Source Tests Results, Bryan A. Stirrat & Associates, 9/29/98.

TR-169. Colton Sanitary Landfill Gas Flare No. 1 (McGill) 1998 Source Tests Results, Bryan A. Stirrat & Associates, 9/29/98.

TR-171. High Landfill Gas Flow Rate Source Test Results from One Landfill Gas Flare at FRB Landfill in Orange County, California, Bryan A. Stirrat & Associates, July 1997.

TR-173. Annual Emissions Test of Landfill Gas Flare #3 Bradley Landfill, Waste Management Recycling and Disposal Services of California, Inc., 4/12/99.

TR-175. Emissions Tests on Flares #2, #4 and #6 at the Lopez Canyon Landfill, City of Los Angeles, August 1997.

TR-176. Emissions Test Results on Flares #1, #4 and #9 Calabasas Landfill, County Sanitation Districts of Los Angeles County, February 1998.

TR-178. Annual Emission Test of Landfill Gas Flare #3 Bradley Landfill, Waste Management Recycling and Disposal Services of California, Inc., 5/21/98.

TR-179. Annual Emissions Test of Landfill Gas Flare #1 Bradley Landfill, Waste Management Recycling and Disposal Services of California, Inc., 4/13/99.

TR-181. The Mid-Valley Sanitary Landfill Gas Flare No.1 (McGill) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

TR-182. The Mid-Valley Sanitary Landfill Gas Flare No.2 (SurLite) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

TR-183. Annual Emissions Test of Landfill Gas Flare #2 Bradley Landfill, Waste Management Recycling and Disposal Services of California, Inc., 4/13/99.

TR-187. Emissions Test of a Landfill Gas Flare - Lowry Landfill/Denver-Arapohoe Disposal Site, Sur-Lite Corporation, February 1997.

TR-196. Results of the Biennial Criteria and AB 2588 Air Toxics Source Test on the Simi Valley Landfill Flare, Simi Valley Landfill and Recycling Center, April 1997.

TR-199. Emission Compliance Test on a Landfill Flare, City of Los Angeles, January 1999.

TR-205. The Mid-Valley Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

TR-207. Compliance Source Test Report Landfill Gas-fired Flare Stations I-4 and F-2, BKK Landfill, 12/12/97.

TR-209. Emission Test Report Volumes I and II - Source/Compliance Emissions Testing for Cedar Hills Landfill, King County Solid Waste Division, 1/20/05.

TR-226. Methane and Nonmethane Organic Destruction Efficiency Tests of an Enclosed Landfill Gas Flare, Newco Waste Systems, April 1992.

TR-229. Scholl Canyon Landfill Gas Flares No. 9, 10 11 and 12 Emission Source Testing April 1999, South Coast Air Quality Management District, April 1999.

TR-241. Performance Evaluation, Enclosed Landfill Gas Flare, Valley Landfill, Waste Energy Technology, November 1991.

TR-251. Emission Compliance Test on a Landfill Gas Flare - Flare #1, Frank R. Bowerman Landfill, Orange County, 1/25/99.

TR-253. Emission Source Testing on Two Flares (Nos. 3 and 6) at the Spadra Landfill, Los Angeles County Sanitation Districts, 7/21/98.

TR-255. Emission Compliance Test on a Landfill Gas Flare -Olinda Alpha Landfill, Orange County Integrated Waste Management Department, No Report Date Given.

TR-258. Source Test Report, City of Sacramento Landfill Gas Flare, City of Sacramento, 6/26/96.

TR-259. The Millikan Sanitary Landfill Gas Flare No. 1 (Surlite) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

TR-260. The Millikan Sanitary Landfill Gas Flare No. 2 (John Zink) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

TR-261. The Millikan Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

TR-264. Emission Compliance Test on a Landfill Gas Flare, Orange County Integrated Waste Management Department, No Report Date Given.

TR-273. Source Testing Final Report - Landfill B, US EPA Air Pollution Prevention and Control Division, 10/6/05.

TR-287. Source Testing Final Report - Landfill D, US EPA Air Pollution Prevention and Control Division, 10/6/05.

TR-290. San Timoteo Sanitary Landfill 1998 Source Test Results, San Bernandino County Solid Waste Management, 9/29/98.

U.S. Environmental Protection Agency (1997a). Procedures for Preparing Emission Factor Documents ,EPA-454/R-95-015, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November 1997.

U.S. Environmental Protection Agency (1998). Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.4 Municipal Solid Waste Landfills, Research Triangle Park, NC, November 1998.

3.2 BOILERS, ENGINES AND TURBINES

3.2.1 Boiler Combustion By-Product Emissions – Source Characterization, Test Methods and Results

Combustion by-product emissions data for LFG-fired boilers were submitted to EPA for a total of seven landfills. However, one boiler test report (TR-163) was excluded from the analysis because the report provided to EPA is incomplete and does not contain any test method or sampling information. Nitrogen oxide and carbon monoxide emissions were sampled and reported in units of parts per million (ppm), pounds per hour (lb/hr), pounds per day (lb/day), or grams per cubic meter of CH_4 (g/m^3 CH_4) for six boilers. Four of the test reports also contain particulate matter emissions data, given in lb/hr, lb/day, or g/m^3 CH_4. Five boiler test reports have total dioxin/furan emissions in nanograms per dry standard cubic meter (ng/dscm), picograms in toxicity equivalents (TEQ) per cubic meter (pg TEQ/m^3), or lb/hr. Where possible, each of the emission data points were converted to kilograms per million dry standard cubic meters of CH_4 ($kg/10^6$ dscm CH_4) to result in comparable emissions for a variety of LFG-fired boilers.

Of the six boiler test reports used in the analysis, three boilers (TR-167, TR-220, TR-291) are Zurn steam boilers. One of these boilers is equipped with dual Coen burners such that the LFG may be supplemented with natural gas in order to maintain acceptable Btu levels. One boiler (TR-292) is a Combustion Engineering Model 33-7KT-10, A-type package base-load steam boiler. The remaining two boilers did not specify the type of boiler tested. There were no "A" or "B" quality test reports available for boilers from the prior AP-42 update that could be utilized in this analysis.

3.2.1.1 Nitrogen Oxides

Five of the six test reports (TR-167, TR-188, TR-220, TR-268, TR-291, TR-292) containing NO_X emissions data were included in the analysis to determine a default emission factor. The emission rate provided for TR-188 was excluded from the NO_X analysis because samples were collected and analyzed using a portable combustion gas analyzer, which is not considered an acceptable test method for the AP-42 analysis.

The two lowest emission rates are represented by boilers (TR-167, TR-220) equipped with flue gas recirculation to reduce NO_X formation, although the difference between these two rates and the next two highest rates is not a significant amount.

Emission rates for the six boilers included in the analysis range from 563 to 1,040 $kg/10^6$ dscm CH_4. The arithmetic mean emission rate for NO_X for these LFG-fired boilers is 677 $kg/10^6$ dscm CH_4. This average rate was selected as the default emission factor to represent boiler NO_X in the AP-42 update with a D quality rating. The 1998 default factor in AP-42 (U.S. EPA, 1998) is 530 with a D quality rating.

3.2.1.2 Carbon Monoxide

Four of the six test reports (TR-167, TR-188, TR-220, TR-268, TR-291, TR-292) containing CO emissions data were included in the analysis to determine a default emission factor. The emission rate provided for TR-188 was excluded from the CO analysis because samples were collected and analyzed using a portable combustion gas analyzer, which is not considered an acceptable test method for the AP-42 analysis. Another report (TR-291) reveals CO emission rates below the method detection limit (<0.03 kg/hr or 16 $kg/10^6$ dscm CH_4) for all test runs. Based on guidance for detection limits contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the detection limit (0.014 kg/hr or 8 $kg/10^6$ dscm CH_4) should be used to represent the average CO emission rate. However, the halved rate is greater than the detect value for the CO emission rate for another test report (TR-220). Therefore, as directed in the EPA procedures document, this halved emission rate was not used to determine a default CO emission factor.

Carbon monoxide emission rates range from 3 to 250 kg/10^6 dscm CH_4. The arithmetic mean emission rate for CO is 116 kg/10^6 dscm CH_4, which was selected as the default emission factor with a "D" quality rating for the AP-42 update. The prior default factor in AP-42 (U.S. EPA, 1998) is 90 kg/10^6 dscm CH_4 with a quality rating of "E."

3.2.1.3 Particulate Matter

Particulate matter emissions are provided in four boiler test reports (TR-167, TR-188, TR-220, TR-268). These four PM emission rates range between 10 and 71 kg/10^6 dscm CH_4. The arithmetic mean emission rate for PM is 41 kg/10^6 dscm CH_4. This average rate was selected as the default to represent PM in the AP-42 update, with a "D" quality rating. The previous AP-42 section for MSW landfills (U.S. EPA, 1998) has a default PM emission factor of 130 kg/10^6 dscm CH_4 with a quality rating of "D."

3.2.1.4 Total Dioxin/Furan

Five test reports (TR-188, TR-220, TR-268, TR-291, TR-292) contain measurement data for dioxins/furans. Emissions data for one boiler test report (TR-188) were excluded from the dioxin/furan analysis because data were only reported on a TEQ basis but total dioxin/furan on a mass basis was being used in the analysis to determine a default emission factor. Three test reports (TR-220, TR-268, TR-291) reveal total dioxin/furan emission rates below the method detection limit for all test runs. Based on guidance for detection limits contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the detection limit was used to represent the average emission rate of total dioxin/furan for these boilers.

Total dioxin/furan emission rates range from 1.4 x 10^{-6} to 1.5 x 10^{-5} kg/10^6 dscm CH_4. The arithmetic mean emission rate for total dioxin/furan is 5.1 x 10^{-6} kg/10^6 dscm CH_4, which was selected as the default emission factor with a "D" quality rating for the AP-42 update. The prior AP-42 section for MSW landfills (U.S. EPA, 1998) does not include dioxin/furan emission factors for LFG-fired boilers.

3.2.1.5 Boiler Summary

Table 3-7 contains a summary of the combustion by-product data included in the LFG-fired boiler analysis for determining default emission factors for the AP-42 update. In addition, Table 3-7 provides the test methods used to measure these emissions data.

A data quality rating of "A" was assigned to each of the boiler test reports listed in Table 3-7. All of the reports containing these data included adequate detail, the methodology appeared to be sound, and no problems were reported for the test runs. However, an overall data quality rating of "D" is recommended for each of the four default emission factors representing combustion by-products from boilers. This rating exemplifies the fact that the default factors were developed using "A"-rated test data from a small number of facilities. Although no specific bias is evident, it is not clear if the boilers tested represent a random sample of the existing LFG-fired boilers in the U.S. given that five or fewer data points were used to determine each default emission factor.

TABLE 3-7. LANDFILL GAS-FIRED BOILER EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report Reference	Test Method	Boiler Combustion By-Product	Emission Rate ($kg/10^6$ dscm CH_4)	Emission Rate ($lb/10^6$ dscf CH_4)
TR-167	SCAQMD Method 100.1 sampling with a CEMS	NO_X	591	37
TR-220	SCAQMD Method 100.1 sampling with a CEMS	NO_X	563	35
TR-268	ARB Method 1-100	NO_X	1,040	65
TR-291	SCAQMD Method 100.1 sampling with a CEMS	NO_X	593	37
TR-292	EPA Method 7E (CEM)	NO_X	593	37
		NO_X Default Emission Factor	**677**	**42**
		1998 NO_X Default Emission Factor[a]	**530**	**33**
TR-167	SCAQMD Method 100.1 sampling with a CEMS	CO	94	6
TR-220	SCAQMD Method 100.1 sampling with a CEMS	CO	3	0.2
TR-268	ARB Method 1-100	CO	116	7
TR-292	EPA Method 10 (CEM)	CO	250	16
		CO Default Emission Factor	**116**	**7**
		1998 CO Default Emission Factor[a]	**90**	**5.7**
TR-167	SCAQMD Method 5.2	PM	48	3
TR-188	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	36	2
TR-220	SCAQMD Method 5.1	PM	10	1
TR-268	EPA Method 5	PM	71	4
		PM Default Emission Factor	**41**	**3**
		1998 PM Default Emission Factor[a]	**130**	**8.2**
TR-220	CARB Method 428	Total dioxin/furan	$2.22x10^{-6}$	$1.38x10^{-7}$
TR-268	Modified EPA Method 5 (ASME Semi-VOST)	Total dioxin/furan	$1.36x10^{-6}$	$8.47x10^{-8}$
TR-291	CARB Method 428	Total dioxin/furan	$1.4x10^{-6}$	$8.93x10^{-8}$
TR-292	EPA Method 23 and EPA Method 8290	Total dioxin/furan	$1.53x10^{-5}$	$9.54x10^{-7}$
		Total Dioxin/Furan Default Emission Factor	**$5.1x10^{-6}$**	**$3.2x10^{-7}$**
		1998 Total Dioxin/Furan Default Emission Factor[a]	**Not available**	**Not available**

[a] – Default emission factor from the November 1998 AP-42 chapter 2.4.

3.2.2 Internal Combustion (IC) Engine Combustion By-Product Emissions – Source Characterization, Test Methods and Results

Combustion by-product emissions data for LFG-fired IC engines were submitted to EPA for a total of six landfills. Nitrogen oxide and carbon monoxide emissions were sampled and reported in units of ppm, lb/hr, or g/m^3 CH_4 for all six engines. Three of the test reports also contain particulate matter emissions data, given in g/m^3 CH_4. Five engine test reports have total dioxin/furan emissions in pg TEQ/m^3, or grams per hour (g/hr). Where possible, each of the emission data points was converted to kilograms per million dry standard cubic meters of CH_4 ($kg/10^6$ dscm CH_4) to result in comparable emissions for a variety of LFG-fired engines.

Of the six engine test reports used in the analysis, five engines (TR-189, TR-190, TR-266, TR-272, TR-284) are Caterpillar gas engines. The remaining engine (TR-194) is a Waukesha gas engine.

In addition to the newly-submitted test reports described above, there were data from six engine test reports used in the prior AP-42 update that were "A" or "B" quality that were also used in this analysis. Six data points for NO_x, five for CO, and one for PM were used from the prior AP-42 update information.

3.2.2.1 Nitrogen Oxides

Three of the six test reports (TR-266, TR-272, TR-284) containing NO_X emissions data were included in the analysis to determine a default emission factor. The emission rates provided for TR-189, TR-190, and TR-194 were excluded from the NO_X analysis because samples were collected and analyzed using a portable combustion gas analyzer, which is not considered an acceptable test method.

The maximum emission rate of 60,600 kg/10^6 dscm CH_4 for one engine (TR-284) is a suspected outlier when compared to the other emission rates. However, this test was witnessed by EPA staff and was thoroughly audited. Therefore, this potential outlier was included in the analysis because no datum should be rejected solely on the basis of statistical tests since there is a risk of rejecting an emission rate that represents actual emissions.

Emission rates for the three engines included in the analysis, plus the six engines from the previous AP-42 update (BID-64, -67, -68, -98, -99, -101) range from 2,440 to 60,600 kg/10^6 dscm CH_4. The arithmetic mean emission rate for NO_X for these LFG-fired engines is 11,600 kg/10^6 dscm CH_4. This average rate was selected as the default emission factor to represent engine NO_X in the AP-42 update, with a quality rating of "C." However, the user should consider the impact of the individual data point that is influencing this average when applying the default emission factor. For comparison, the median value of the engine NOx data points results in a value of 4,740 kg/10^6 dscm CH_4, which compares more closely with the previous default factor in AP-42 (U.S. EPA, 1998). The previous default emission factor was 4,000 kg/10^6 dscm CH_4 with a quality rating of "D."

3.2.2.2 Carbon Monoxide

Three of the six engine test reports (TR-266, TR-272, TR-284) containing CO emissions data were included in the analysis to determine a default emission factor. The emission rates provided for TR-189, TR-190, and TR-194 were excluded from the CO analysis because samples were collected and analyzed using a portable combustion gas analyzer, which is not considered an acceptable test method for the AP-42 analysis. There are five emission data points from the prior AP-42 update that are included in this analysis (BID-64, -67, -98, -99, -101).

Carbon monoxide emission rates range from 6,400 to 11,700 kg/10^6 dscm CH_4. The arithmetic mean emission rate for CO is 8,460 kg/10^6 dscm CH_4, which was selected as the default emission factor with a "C" quality rating for the AP-42 update. The prior default factor in AP-42 (U.S. EPA, 1998) is 7,500 kg/10^6 dscm CH_4 with a quality rating of "C."

3.2.2.3 Particulate Matter

Particulate matter emissions are provided in three engine test reports (TR-189, TR-190, TR-194) and one data point from the prior AP-42 update (BID-98). These four PM emission rates range between

43 and 772 kg/10^6 dscm CH_4. The arithmetic mean emission rate for PM is 232 kg/10^6 dscm CH_4. This average rate was selected as the default to represent PM in the AP-42 update, with a quality rating of "D." The 1998 AP-42 section for MSW landfills (U.S. EPA, 1998) has a default PM emission factor of 770 kg/10^6 dscm CH_4 with a quality rating of "E."

3.2.2.4 Total Dioxin/Furan

Five test reports (TR-189, TR-190, TR-194, TR-272, TR-284) contain measurement data for dioxins/furans. Emissions data for three engine test reports (TR-189, TR-190, TR-194) were excluded from the dioxin/furan analysis because data were only reported on a TEQ basis but total dioxin/furan on a mass basis was being used in the analysis to determine a default emission factor. Emission rates for the remaining two test reports (TR-272, TR-284) are below the method detection limit for all test runs using EPA Method 23. The emission rates for each of these reports are $<2.15 \times 10^{-10}$ kg/hr (1.73×10^{-6} kg/10^6 dscm CH_4) for TR-272 and $<1.12 \times 10^{-10}$ kg/hr (3.92×10^{-7} kg/10^6 dscm CH_4) for TR-284. Therefore, a proper analysis cannot be conducted for total dioxin/furan emissions from LFG-fired engines until additional data become available. The prior version of the AP-42 section for MSW landfills (U.S. EPA, 1998) does not include dioxin/furan emission factors for engines.

3.2.2.5 IC Engine Summary

Table 3-8 contains a summary of the combustion by-product data included in the LFG-fired IC engine analysis for determining default emission factors for the AP-42 update. In addition, Table 3-8 provides the test methods used to measure these emissions data.

A data quality rating of "A" (except for BID-99 and PM for BID-98, which have "B" ratings) was assigned to each of the IC engine test reports listed in Table B. All of the reports containing these data included adequate detail, the methodology appeared to be sound, and no problems were reported for the test runs. However, overall data quality ratings of "C" for NOx and CO, and "D" for PM, are recommended for default emission factors representing combustion by-products from engines. These ratings exemplify the fact that the default factors were developed using "A" and "B"-rated test data from a reasonable to small number of facilities. Although no specific bias is evident, it is not clear if the engines tested represent a random sample of the existing LFG-fired engines in the U.S. given that between four (PM) to nine (NO_x) data points were used to determine each default emission factor.

TABLE 3-8. LANDFILL GAS-FIRED IC ENGINE EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report Reference	Test Method	IC Engine Combustion By-Product	Emission Rate (kg/10^6 dscm CH_4)	Emission Rate (lb/10^6 dscf CH_4)
TR-266	SCAQMD Method 100.1 and EPA Methods 6C and 7E	NO_X	8,170	510
TR-272	EPA Method 7E (CEM)	NO_X	5,680	355
TR-284	EPA Method 7E (CEM)	NO_X	60,600	3,780
BID-64	EPA Method 10 (CEM)	NO_X	2,470	154
BID-67	EPA Method 10 (CEM)	NO_X	2,500	156
BID-68	EPA Method 7E (CEM)	NO_X	2,440	152
BID-98	CARB Method 1-100	NO_X	4,540	283
BID-99	Unspecified	NO_X	4,740	296
BID-101	Phenoldisulfonic Acid (PDSA) method	NO_X	13,400	839

TABLE 3-8 (CONTINUED). LANDFILL GAS-FIRED IC ENGINE EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS

Test Report Reference	Test Method	IC Engine Combustion By-Product	Emission Rate ($kg/10^6$ dscm CH_4)	Emission Rate ($lb/10^6$ dscf CH_4)
		NO_X Default Emission Factor	**11,600**	**725**
		1998 NO_X Default Emission Factor[a]	**4,000**	**250**
TR-266	SCAQMD Method 100.1 and EPA Methods 6C and 7E	CO	11,100	693
TR-272	EPA Method 10 (CEM)	CO	11,700	728
TR-284	EPA Method 10 (CEM)	CO	7,680	479
BID-64	EPA Method 7E (CEM)	CO	8,150	508
BID-67	EPA Method 7E (CEM)	CO	9,280	579
BID-98	CARB Method 1-100	CO	6,810	425
BID-99	Unspecified	CO	6,400	399
BID-101	TCA method	CO	6,610	413
		CO Default Emission Factor	**8,460**	**528**
		1998 CO Default Emission Factor[a]	**7,500**	**470**
TR-189	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	56.6	3.5
TR-190	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	54.8	3.4
TR-194	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	43.1	2.7
BID-98	EPA Method 5	PM	772	48
		PM Default Emission Factor	**232**	**14.5**
		1998 PM Default Emission Factor[a]	**770**	**48**

[a] – Default emission factor from the November 1998 AP-42 chapter 2.4.

3.2.2.6 Emission Factors in Alternate Units of Measure

The preceding tables present the emission factors in the units used for updating the MSW Landfills section of AP-42 (U.S. EPA, 1998). However, EPA's Landfill Methane Outreach Program (LMOP) and other organizations may require emission factors presented in units more convenient to the LFG energy project or combustion device being studied. Therefore, Table 3-9 presents the boiler data in units of lb/MMBtu heat input and lb/MWh of electricity produced, and Table 3-10 presents the engine data in lb/MMBtu heat input, and lb/MWh and g/brake horsepower-hour (bhph). The heat rate assumed in these conversions is 10,700 Btu/kWh for boilers, and 11,100 Btu/kWh for engines. These are consistent with factors used by the LMOP program and are based on engine manufacturer's literature and other information provided to LMOP by manufacturers and distributors. The heat content of CH_4 is 1,012 Btu/dscf (Perry, 1963).

TABLE 3-9. LANDFILL GAS-FIRED BOILER EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS (ALTERNATE UNIT FACTORS)

Test Report Reference	Test Method	Boiler Combustion By-Product	Emission Rate (lb/MMBtu) (fuel input)	Emission Rate (lb/MWh)
TR-167	SCAQMD Method 100.1 sampling with a CEMS	NO_X	0.04	0.4
TR-220	SCAQMD Method 100.1 sampling with a CEMS	NO_X	0.03	0.4
TR-268	ARB Method 1-100	NO_X	0.06	0.7
TR-291	SCAQMD Method 100.1 sampling with a CEMS	NO_X	0.04	0.4
TR-292	EPA Method 7E (CEM)	NO_X	0.04	0.4
		NO_X Default Emission Factor	**0.04**	**0.4**
		1998 NO_X Default Emission Factor[a]	**0.03**	**0.3**
TR-167	SCAQMD Method 100.1 sampling with a CEMS	CO	0.01	0.1
TR-220	SCAQMD Method 100.1 sampling with a CEMS	CO	2.0×10^{-4}	2.1×10^{-3}
TR-268	ARB Method 1-100	CO	0.01	0.1
TR-292	EPA Method 10 (CEM)	CO	0.02	0.2
		CO Default Emission Factor	**0.01**	**0.1**
		1998 CO Default Emission Factor[a]	**0.01**	**0.1**
TR-167	SCAQMD Method 5.2	PM	3.0×10^{-3}	0.03
TR-188	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	2.2×10^{-3}	0.02
TR-220	SCAQMD Method 5.1	PM	6.0×10^{-4}	0.01
TR-268	EPA Method 5	PM	4.4×10^{-3}	0.05
		PM Default Emission Factor	**2.5×10^{-3}**	**0.03**
		1998 PM Default Emission Factor[a]	**8.1×10^{-3}**	**0.09**
TR-220	CARB Method 428	Total dioxin/furan	1.4×10^{-10}	1.5×10^{-9}
TR-268	Modified EPA Method 5 (ASME Semi-VOST)	Total dioxin/furan	8.4×10^{-11}	9.0×10^{-10}
TR-291	CARB Method 428	Total dioxin/furan	8.8×10^{-11}	9.4×10^{-10}
TR-292	EPA Method 23 and EPA Method 8290	Total dioxin/furan	9.4×10^{-10}	1.0×10^{-8}
		Total Dioxin/Furan Default Emission Factor	**3.1×10^{-10}**	**3.3×10^{-9}**
		1998 Dioxin/Furan Default Emission Factor[a]	**Not available**	**Not available**

[a] – Default emission factor from the November 1998 AP-42 chapter 2.4, but converted to lb/MMBtu and lb/kWh units using 1,012 Btu/dscf CH_4 and 10,700 Btu/kWh, as discussed above.

TABLE 3-10. LANDFILL GAS-FIRED IC ENGINE EMISSIONS DATA USED TO DEVELOP COMBUSTION BY-PRODUCT EMISSION FACTORS (ALTERNATE UNIT FACTORS)

Test Report Reference	Test Method	IC Engine Combustion By-Product	Emission Rate (lb/MMBtu) (fuel input)	Emission Rate (lb/MWh)	Emission Rate (g/bhph)[a]
TR-266	SCAQMD Method 100.1 and EPA Methods 6C and 7E	NO_X	0.5	5.6	2.0
TR-272	EPA Method 7E (CEM)	NO_X	0.4	3.9	1.4
TR-284	EPA Method 7E (CEM)	NO_X	3.7	41	15
BID-64	EPA Method 10 (CEM)	NO_X	0.2	1.7	0.6
BID-67	EPA Method 10 (CEM)	NO_X	0.2	1.7	0.6
BID-68	EPA Method 7E (CEM)	NO_X	0.2	1.7	0.6
BID-98	CARB Method 1-100	NO_X	0.3	3.1	1.1
BID-99	Unspecified	NO_X	0.3	3.2	1.2
BID-101	Phenoldisulfonic Acid (PDSA) method	NO_X	0.8	9.2	3.3
NO_X Default Emission Factor			**0.7**	**8.0**	**2.8**
1998 NO_X Default Emission Factor[b]			**0.2**	**2.7**	**1.0**
TR-266	SCAQMD Method 100.1 and EPA Methods 6C and 7E	CO	0.7	7.6	2.7
TR-272	EPA Method 10 (CEM)	CO	0.7	8.0	2.8
TR-284	EPA Method 10 (CEM)	CO	0.5	5.3	1.9
BID-64	EPA Method 7E (CEM)	CO	0.5	5.6	2.0
BID-67	EPA Method 7E (CEM)	CO	0.6	6.4	2.3
BID-98	CARB Method 1-100	CO	0.4	4.7	1.7
BID-99	Unspecified	CO	0.4	4.4	1.6
BID-101	TCA method	CO	0.4	4.5	1.6
CO Default Emission Factor			**0.5**	**5.8**	**2.1**
1998 CO Default Emission Factor[b]			**0.5**	**5.2**	**1.8**
TR-189	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	$3.5x10^{-3}$	$3.9x10^{-2}$	$1.4x10^{-2}$
TR-190	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	$3.4x10^{-3}$	$3.8x10^{-2}$	$1.3x10^{-2}$
TR-194	Environment Canada Report EPS 1/RM/8 "*Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources*"	PM	$2.7x10^{-3}$	$3.0x10^{-2}$	$1.1x10^{-2}$
BID-98	EPA Method 5	PM	$4.7 x10^{-2}$	$5.3x10^{-1}$	$1.9x10^{-1}$
PM Default Emission Factor			**$1.4x10^{-2}$**	**$1.6x10^{-1}$**	**$5.6x10^{-2}$**
1998 PM Default Emission Factor[b]			**$4.7 x10^{-2}$**	**$5.3 x10^{-1}$**	**$1.9x10^{-1}$**

[a] – Per common practice, assumes a 5% energy loss from engine output in converting shaft energy to electricity.
[b] – Default emission factor from the November 1998 AP-42 chapter 2.4, but converted to lb/MMBtu and lb/kWh units using 1,012 Btu/dscf CH_4 and 11,100 Btu/kWh, as discussed above.

3.2.3 Gas Turbine Data Summary

Since the last update of the MSW Landfills section of AP-42 (U.S. EPA, 1998), no additional test data for LFG turbines has been received by EPA. Therefore, these emission factors remain the same as in the previous update. Supporting background information from the 1997 background information document for turbines is included in Appendix F to this document.

References

BID-64. Report of Emission Levels and Fuel Economics for Eight Waukesha 12V-AT25GL Units Located at the Johnston, Rhode Island Central Landfill, Waukesha Pearce Industries, Inc. Houston, TX , July 19, 1991.

BID-67. Final Report for Emissions Compliance Testing of One Waukesha Engine Generator, Browning-Ferris Gas Services, Inc., Chicopee, MA, February 1994.

BID-68. Final Report for Emissions Compliance Testing of Three Waukesha Engine Generators, Browning-Ferris Gas Services, Inc., Richmond, VA, February 1994.

BID-98. Landfill Gas Engine Exhaust Emissions Test Report in Support of Modification to Existing IC Engine Permit at Bakersfield Landfill Unit #1, Pacific Energy Services, December 4, 1990.

BID-99. Addendum to Source Test Report for Superior Engine #1 at Otay Landfill, Pacific Energy Services, April 2, 1991.

BID-101. Source Test Report 88-0096 of Emissions from an Internal Combustion Engine Fueled by Landfill Gas, Toyon Canyon Landfill, Pacific Energy Lighting Systems, South Coast Air Quality Management District, March 8, 1988.

Perry, John H., ed. *Chemical Engineers Handbook*. McGraw-Hill Book Company: NY, 1963, Page 9-9.

TR-163. Compliance Testing for SPADRA Landfill Gas-to-Energy Plant, Ebasco Constructors, Inc., November 1990.

TR-167. 1997 Annual Compliance Source Testing Results for the Coyote Canyon Landfill Gas Recovery Facility Boiler, Laidlaw Gas Recovery Systems, January 1998.

TR-188. Characterization of Emissions from a Power Boiler Fired with Landfill Gas, Environment Canada, Emissions Research and Measurement Division, March 2000.

TR-189. Characterization of Emissions from 925 kWe Reciprocating Engine Fired with Landfill Gas, Environment Canada, Emissions Research and Measurement Division, December 2000.

TR-190. Characterization of Emissions from 812 kWe Reciprocating Engine Fired with Landfill Gas, Environment Canada, Emissions Research and Measurement Division, December 1999.

TR-194. Characterization of Emissions from 1 Mwe Reciprocating Engine Fired with Landfill Gas, Environment Canada, Emissions Research and Measurement Division, January 2002.

TR-220. SCAQMD Performance Tests on the Spadra Energy Recovery from Landfill Gas (SPERG) Facility, County Sanitation Districts of Los Angeles County, April 1992.

TR-266. Compliance Source Test Report – Landfill Gas-Fired Engine, Minnesota Methane, March 3, 1998.

TR-268. Emission Testing at PERG – Maximum Boiler Load, County Sanitation Districts of Los Angeles County, December 1986.

TR-272. Source Testing Final Report – Landfill A, U.S. Environmental Protection Agency, Air Pollution Prevention and Control Division, October 6, 2005.

TR-284. Source Testing Final Report – Landfill C, U.S. Environmental Protection Agency, Air Pollution Prevention and Control Division, October 6, 2005.

TR-291. PCDD/PCDF Emissions Tests on the Palos Verdes Energy Recovery from Landfill Gas (PVERG) Facility, Unit 2, County Sanitation Districts of Los Angeles County, February 1994.

TR-292. Source Testing Final Report – Landfill E, U.S. Environmental Protection Agency, Air Pollution Prevention and Control Division, October 2005.

U.S. Environmental Protection Agency (1997a). Procedures for Preparing Emission Factor Documents ,EPA-454/R-95-015, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November 1997.

U.S. Environmental Protection Agency (1998). Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.4 Municipal Solid Waste Landfills, Research Triangle Park, NC, November 1998.

3.3 CONTROL DEVICE EFFICENCY DATA

NMOC data was compiled for the various control devices and analyzed. This data consists of "A" and "B" data from the prior Municipal Solid Waste (MSW) Landfills section of AP-42 (U.S. EPA, 1998), along with the data available from this update, all of which were rated as "A" quality. The following table (Table 3-11) summarizes the data, which is also found in Table 2.4-3 of the AP-42 section. Appendix F contains the supporting data and calculations used to determine the control device efficiencies.

Please note that the Landfill NSPS requirements are in 40 CFR 60.752(b)(2)(iii) for enclosed combustion devices (e.g., enclosed flares, boilers, engines, turbines) burning untreated LFG require reduction of NMOC by 98 weight % or reduce the outlet NMOC concentration to less than 20 ppmv, dry basis as hexane at 3% oxygen. Therefore, although some of the data show that observed control efficiencies may sometimes be less than 98%, the control device may still meet the regulatory requirements by meeting the 20 ppmv limit of NMOC (dry basis as hexane at 3% oxygen).

Following the same criteria as described for the emission factors, the control device efficiency rankings were assigned as follows: Boiler – "D;" Flare – "A;" Engine – "D;" and Turbine – "E."

TABLE 3-11. NMOC CONTROL EFFICIENCY DATA ANALYSIS SUMMARY

	Number of Data Points	Min (%)	Max (%)	Mean (%)	Standard Deviation (%)	95% Confidence Interval (± %)
Boiler	5	95.9	99.6	98.6	1.6	1.4
Flare	25	85.8	100.0	97.7	3.4	1.3
Engine	3	94.6	99.7	97.2	2.6	2.9
Avg of Boiler, Engine, Flare				**97.8**		
Turbine	2	91.5	97.3	94.4	4.1	134.8

Historically, controlled emissions have been calculated with Equation 6. In this equation it is assumed that the LFG collection and control system operates 100 percent of the time. Minor durations of system downtime associated with routine maintenance and repair (i.e., 5 to 7 percent) will not appreciably affect emission estimates. The first term in Equation 6 accounts for emissions from uncollected LFG, while the second term accounts for emissions of the pollutant that were collected but not fully combusted in the control or utilization device:

$$CM_P = \left[UM_P \text{ x } \left(1 - \frac{\eta_{col}}{100}\right)\right] + \left[UM_P \text{ x } \frac{\eta_{col}}{100} \text{ x } \left(1 - \frac{\eta_{cnt}}{100}\right)\right] \quad (6)$$

where:

CM_P = Controlled mass emissions of pollutant P, kg/yr;
UM_P = Uncontrolled mass emissions of P, kg/yr (from Equation 5);
η_{col} = Efficiency of the LFG collection system, % (recommended default is 75%); and
η_{cnt} = Efficiency of the LFG control or utilization device, %.

3.4 CONTROL DEVICE CARBON DIOXIDE, SULFUR DIOXIDE, AND HYDROGEN CHLORIDE EMISSIONS

Controlled emissions of CO_2 and sulfur dioxide (SO_2) are best estimated using site-specific LFG constituent concentrations and mass balance methods (Nesbitt, 1996). If site-specific data are not available, the data in Tables 2-7, 2-8 and 2-9 can be used with the mass balance methods that follow.

Controlled CO_2 emissions include emissions from the CO_2 component of LFG and additional CO_2 formed during the combustion of LFG. The bulk of the CO_2 formed during LFG combustion comes from the combustion of the CH_4 fraction. Small quantities will be formed during the combustion of the NMOC fraction. However, this typically amounts to less than one percent of total CO_2 emissions by weight. This contribution to the overall mass balance picture is also very small and does not have a significant impact on overall CO_2 emissions (Nesbitt, 1996).

The following equation which assumes a 100% combustion efficiency for CH_4 can be used to estimate CO_2 emissions from controlled landfills:

$$CM_{CO2} = UM_{CO2} + \left(UM_{CH4} \text{ x } \frac{\eta_{col}}{100} \text{ x } 2.75 \right) \qquad (7)$$

where:

CM_{CO_2} = Controlled mass emissions of CO_2, kg/yr (from Equation 5);
UM_{CO_2} = Uncontrolled mass emissions of CO_2, kg/yr (from Equation 5);
UM_{CH_4} = Uncontrolled mass emissions of CH_4, kg/yr;
η_{col} = Efficiency of the LFG collection system, % (recommended default is 75%); and
2.75 = Ratio of the molecular weight of CO_2 to the molecular weight of CH_4.

To prepare estimates of SO_2 emissions, data on the concentration of reduced sulfur compounds within the LFG are needed. The best way to prepare this estimate is with site-specific information on the total reduced sulfur content of the LFG. Often these data are expressed in ppmv as sulfur (S). Equations 4 and 5 should be used first to determine the uncontrolled mass emission rate of reduced sulfur compounds as sulfur. Then, the following equation can be used to estimate SO_2 emissions:

$$CM_{SO2} = UM_S \text{ x } \frac{\eta_{col}}{100} \text{ x } 2.0 \qquad (8)$$

where:

CM_{SO_2} = Controlled mass emissions of SO_2, kg/yr;
UM_S = Uncontrolled emissions of reduced sulfur compounds as sulfur, kg/yr;
η_{col} = Efficiency of the LFG collection system, %; and
2.0 = Ratio of the molecular weight of SO_2 to the molecular weight of S.

The next best method to estimate SO_2 concentrations, if site-specific data for total reduced sulfur compounds as sulfur are not available, is to use site-specific data for speciated reduced sulfur compound concentrations. These data can be converted to ppmv as S with Equation 9. After the total reduced sulfur as S has been obtained from Equation 9, then Equations 4, 5, and 8 can be used to derive SO_2 emissions.

$$C_S = \sum_{i=1}^{n} C_P \times S_P \qquad (9)$$

where:

C_S = Concentration of total reduced sulfur compounds, ppmv as S (for use in Equation 4);
C_P = Concentration of each reduced sulfur compound, ppmv;
S_P = Number of moles of S produced from the combustion of each reduced sulfur compound (i.e., 1 for sulfides, 2 for disulfides); and
n = Number of reduced sulfur compounds available for summation.

If no site-specific data are available, values of 47 and 33 ppmv can be used for C_S in the gas from landfills having a majority of the waste in place before 1992 and from landfills having a majority of the waste in place after 1992, respectively. These values were obtained by using the default concentrations presented in Tables 2-9 and 2-7 for reduced sulfur compounds and Equation 9.

Hydrochloric acid [hydrogen chloride (HCl)] emissions are formed when chlorinated compounds in LFG are combusted in control equipment. The best methods to estimate HCl emissions are mass balance methods that are analogous to those presented above for estimating SO_2 emissions. Hence, the best source of data to estimate HCl emissions is site-specific LFG data on total chloride [expressed in ppmv as the chloride ion (Cl^-)]. However, emission estimates may be underestimated, since not every chlorinated compound in the LFG will be represented in the site test report (i.e., only those that the analytical method specifies). If these data are not available, then total chloride can be estimated from data on individual chlorinated species using Equation 10 below.

$$C_{Cl} = \sum_{i=1}^{n} C_P \times Cl_P \qquad (10)$$

where:

C_{Cl} = Concentration of total chloride, ppmv as Cl^- (for use in Equation 4);
C_P = Concentration of each chlorinated compound, ppmv;
Cl_P = Number of moles of Cl^- produced from the combustion of each mole of chlorinated compound (i.e., 3 for 1,1,1-trichloroethane); and
n = Number of chlorinated compounds available for summation.

After the total chloride concentration (C_{Cl}) has been estimated, Equations 4 and 5 should be used to determine the total uncontrolled mass emission rate of chlorinated compounds as chloride ion (UM_{Cl}). This value is then used in Equation 11, below, to derive HCl emission estimates:

$$CM_{HCl} = UM_{Cl} \times \frac{\eta_{col}}{100} \times 1.03 \times \frac{\eta_{cnt}}{100} \qquad (11)$$

where:

CM_{HCl} = Controlled mass emissions of HCl, kg/yr;

UM_{Cl} = Uncontrolled mass emissions of chlorinated compounds as chloride, kg/yr (from Equations 4 and 5);

η_{col} = Efficiency of the LFG collection system, percent;

1.03 = Ratio of the molecular weight of HCl to the molecular weight of Cl^-; and

η_{cnt} = Control efficiency of the LFG control or utilization device, percent.

In estimating HCl emissions, it is assumed that all of the chloride ion from the combustion of chlorinated LFG constituents is converted to HCl. If an estimate of the control efficiency, η_{cnt}, is not available, then the control efficiency for the equipment listed in Table 3-11 should be used. This assumption is recommended to assume that HCl emissions are not under-estimated.

If site-specific data on total chloride or speciated chlorinated compounds are not available, then default values of 42 and 74 ppmv can be used for C_{Cl} in the gas from landfills having a majority of the waste in place before 1992 and from landfills having a majority of the waste in place after 1992, respectively. These values were derived from the default LFG constituent concentrations presented in Tables 2-11 and 2-8. As mentioned above, use of this default may produce underestimates of HCl emissions since it is based only on those compounds for which analyses have been performed. The constituents listed in Table 2-11 and 2-8 are likely not all of the chlorinated compounds present in LFG.

References

Letter and attached documents from C. Nesbitt, Los Angeles County Sanitation Districts, to K. Brust, E.H. Pechan and Associates, Inc., December 6, 1996.

4.0 MERCURY EMISSIONS DATA ANALYSIS

4.1 MERCURY IN RAW LANDFILL GAS

Mercury concentration data for raw LFG were submitted to EPA for a total of 17 landfills. These landfills are represented by nine emissions test reports because one test report (TR-211) contains mercury data for eight landfills in the state of Washington and another (TR-293) contains data for two landfills. This Washington report includes multiple measurements for two of the landfills sampled (TR-211a, TR-211f) because the LFG streams are split between the flare and the energy recovery facility at each landfill. A single average concentration for each of these landfills was calculated to represent each landfill so as not to disproportionately affect the overall average concentration being determined to estimate mercury emissions for an average landfill.

Total mercury, elemental mercury, monomethyl mercury, and dimethyl mercury are the four forms of mercury sampled and analyzed at these 17 landfills. Mercury concentrations are reported in either nanograms per cubic meter (ng/m^3) or milligrams per dry standard cubic foot (mg/dscf). These concentrations were converted to common units of parts per million by volume (ppmv), assuming standard conditions of 20 °C and one atmosphere.

4.1.1 Total Mercury

All nine of the test reports (TR-196, TR-211, TR-212, TR-272, TR-273, TR-284, TR-287, TR-292, TR-293), representing 17 landfills, contain measurement data for total mercury. Concentrations for two landfills were excluded from the total mercury analysis because samples were collected from a leachate well open to the atmosphere for one landfill (TR-211c) and from a passive gas well, with ambient air present, for another landfill (TR-211d).

Total mercury was sampled and analyzed using EPA Method 1631 for 14 of the 17 landfills. The test report for the landfill (TR-196) used CARB Draft Method 436 (adopted as CARB Method 436 in July 1997), Determination of Multiple Metals Emissions from Stationary Sources, to determine total mercury concentration. This test report reveals total mercury concentrations below the method detection limit ($<4.08 \times 10^{-6}$ ppmv) for all three test runs. Based on guidance for detection limits contained in EPA's Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the detection limit (2.04×10^{-6} ppmv) was used to represent the average concentration of total mercury for this landfill. This concentration represents the minimum concentration used in the analysis. Another test report (TR-293) used method SW-846 Method 7473, "Mercury in Solids and Solutions by Thermal Decomposition, Mercury Amalgamation, and Atomic Adsorption Spectroscopy" and CFR Part 60 Method 30B, "Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Tubes" to determine total mercury.

Total mercury concentrations for the 15 landfills included in the analysis range from 2.04×10^{-6} to 9.61×10^{-4} ppmv. The maximum concentration of 9.61×10^{-4} ppmv for one landfill (TR-211g) is a suspected outlier when compared to the other concentrations. However, the maximum concentration was included in the analysis because no datum should be rejected solely on the basis of statistical tests since there is a risk of rejecting a concentration that represents actual emissions. The test report containing this suspected outlier (TR-211) is for eight landfills in the state of Washington. This report states that total mercury levels observed at these Washington landfills are in the range of 25 to 8,000 ng/m^3 (3.0×10^{-6} to 9.6×10^{-4} ppmv) which generally agrees with concentrations previously reported by Lindberg et al., 2001.

The arithmetic mean concentration for total mercury for the 13 landfills is 1.2×10^{-4} ppmv. This average concentration was selected as the default to represent total mercury in the AP-42 update. The previous default concentration in AP-42 (U.S. EPA, 1998) is 2.92 x 10^{-4} ppmv with a quality rating of "E."

4.1.2 Elemental Mercury

Six test reports (TR-272, TR-273, TR-284, TR-287, TR-292, TR-293), representing seven landfills, include elemental mercury concentrations that were measured by the LUMEX Instrument. Elemental mercury concentrations range from 7.0 x 10^{-6} to 3.9 x 10^{-4} ppmv. The arithmetic mean concentration for elemental mercury is 7.7 x 10^{-5} ppmv, which was selected as the default concentration for the AP-42 update. The previous version of the AP-42 section for MSW landfills (U.S. EPA, 1998) does not include elemental mercury because no data were available to speciate total mercury into the elemental form.

4.1.3 Monomethyl Mercury

Monomethyl mercury concentrations are contained in seven test reports (TR-212, TR-272, TR-273, TR-284, TR-287, TR-292, TR-293) representing eight landfills. Five of these were sampled and analyzed using EPA draft method 1630. One test report (TR-293) used cold-vapor atomic fluorescence spectroscopy (CVAFS). The overall range of concentrations is 4.5 x 10^{-8} to 2.0 x 10^{-6} ppmv. The arithmetic mean concentration for monomethyl mercury for the six landfills is 3.8 x 10^{-7} ppmv. This average concentration was selected as the default to represent total mercury in the AP-42 update. The prior AP-42 section for MSW landfills (U.S. EPA, 1998) does not include monomethyl mercury because no data were available to speciate total mercury into the organic forms.

4.1.4 Dimethyl Mercury

Eight test reports (TR-211, TR-212, TR-272, TR-273, TR-284, TR-287, TR-292, TR-293), representing 16 landfills, contain measurement data for dimethyl mercury. Concentrations for two landfills were excluded from the dimethyl mercury analysis because samples were collected from a leachate well open to the atmosphere for one landfill (TR-211c) and from a passive gas well, with ambient air present, for another landfill (TR-211d). Concentrations thought to be biased low were excluded for two additional landfills (TR-272, TR-273) because spike recoveries are well below normally acceptable levels.

Dimethyl mercury was sampled and analyzed using EPA Method 1630 Appendix A for five test reports. The remaining test report, representing two landfills, used CVAFS.

Dimethyl mercury concentrations range from 2.3 x 10^{-7} to 5.5 x 10^{-6} ppmv. The arithmetic mean concentration for dimethyl mercury is 2.5 x 10^{-6} ppmv, which was selected as the default concentration for the AP-42 update. The prior version of the AP-42 section for MSW landfills (U.S. EPA, 1998) does not include dimethyl mercury because no data were available to speciate total mercury into the organic forms.

4.1.5 Mercury Data Summary

Table 4-1 contains a summary of the mercury data included in the raw LFG analysis for determining default concentrations for the AP-42 update. Appendix E presents statistical data graphs of the mercury data.

A data quality rating of "A" was assigned to each of the individual mercury test data contained in Table 4-1. All of the reports containing these data included adequate detail, the methodology appeared to be sound, and no problems were reported for the valid test runs. An overall data quality rating of "B" for each of the four default concentrations representing each mercury compound is recommended. This rating exemplifies the fact that the default concentrations were developed from "A"-rated test data from a moderate number of facilities. Although no specific bias is evident, is not clear if the landfills tested represent a random sample of landfills in the U.S. In addition, less than 20 data points were used to determine each default concentration.

TABLE 4-1. RAW LANDFILL GAS MERCURY DATA USED TO DETERMINE AP-42 DEFAULT CONCENTRATIONS

Test Report Reference	Mercury Test Method	Mercury Compound	Concentration (ppmv)
TR-211a	EPA Method 1630 Appendix A	Dimethyl	1.9×10^{-6}
TR-211b	EPA Method 1630 Appendix A	Dimethyl	1.10×10^{-6}
TR-211e	EPA Method 1630 Appendix A	Dimethyl	7.4×10^{-7}
TR-211f	EPA Method 1630 Appendix A	Dimethyl	2.59×10^{-6}
TR-211g	EPA Method 1630 Appendix A	Dimethyl	4.81×10^{-6}
TR-211h	EPA Method 1630 Appendix A	Dimethyl	3.00×10^{-6}
TR-212	EPA Method 1630 Appendix A	Dimethyl	3.97×10^{-6}
TR-284	EPA Method 1630 Appendix A	Dimethyl	1.54×10^{-6}
TR-287	EPA Method 1630 Appendix A	Dimethyl	5.32×10^{-6}
TR-292	EPA Method 1630 Appendix A	Dimethyl	5.48×10^{-6}
TR-293a	CVAFS	Dimethyl	2.3×10^{-7}
TR-293b	CVAFS	Dimethyl	6.8×10^{-7}
		Dimethyl Mercury Default Concentration	**2.5×10^{-6}**
TR-272	LUMEX Instrument	Elemental	3.69×10^{-5}
TR-273	LUMEX Instrument	Elemental	7.0×10^{-6}
TR-284	LUMEX Instrument	Elemental	1.2×10^{-5}
TR-287	LUMEX Instrument	Elemental	3.33×10^{-5}
TR-292	LUMEX Instrument	Elemental	5.28×10^{-5}
TR-293a	LUMEX Instrument	Elemental	3.9×10^{-4}
TR-293b	LUMEX Instrument	Elemental	5.6×10^{-6}
		Elemental Mercury Default Concentration	**7.7×10^{-5}**
TR-212	EPA Draft Method 1631	Monomethyl	1.446×10^{-7}
TR-272	EPA Draft Method 1630	Monomethyl	4×10^{-8}
TR-273	EPA Draft Method 1630	Monomethyl	1.3×10^{-7}
TR-284	EPA Draft Method 1630	Monomethyl	4.4×10^{-7}
TR-287	EPA Draft Method 1630	Monomethyl	2.76×10^{-7}
TR-292	EPA Draft Method 1630	Monomethyl	6.0×10^{-7}
TR-293a	CVAFS	Monomethyl	1.4×10^{-6}
TR-293b	CVAFS	Monomethyl	2.0×10^{-6}
		Monomethyl Mercury Default Concentration	**3.8×10^{-7}**

TABLE 4-1 (CONTINUED). RAW LANDFILL GAS MERCURY DATA USED TO DETERMINE AP-42 DEFAULT CONCENTRATIONS

Test Report Reference	Mercury Test Method	Mercury Compound	Concentration (ppmv)
TR-196	CARB Draft Method 436	Total	2.04×10^{-6}
TR-211a	EPA Method 1631	Total	5.41×10^{-6}
TR-211b	EPA Method 1631	Total	1.4098×10^{-4}
TR-211e	EPA Method 1631	Total	1.13×10^{-5}
TR-211f	EPA Method 1631	Total	2.767×10^{-5}
TR-211g	EPA Method 1631	Total	9.6083×10^{-4}
TR-211h	EPA Method 1631	Total	3.029×10^{-5}
TR-212	EPA Method 1631	Total	4.89×10^{-5}
TR-272	EPA Method 1631	Total	7.58×10^{-5}
TR-273	EPA Method 1631	Total	2.45×10^{-5}
TR-284	EPA Method 1631	Total	5.10×10^{-5}
TR-287	EPA Method 1631	Total	8.87×10^{-5}
TR-292	EPA Method 1631	Total	1.751×10^{-4}
TR-293a	SW-846 Method 7473 / CFR Part 60 Method 30B	Total	6.0×10^{-4}
TR-293b	SW-846 Method 7473 / CFR Part 60 Method 30B	Total	5.2×10^{-6}
		Total Mercury Default Concentration	**1.2×10^{-4}**

4.2 POST-COMBUSTION MERCURY EMISSIONS

Burning LFG in combustion devices (control devices), including flares, engines, turbines, and boilers, may change the chemical species of mercury originally in the raw LFG but does not reduce the total quantity of mercury released. The amount of total mercury released from any combustion outlet is directly related to the amount of total mercury contained in the raw LFG. In other words, mercury emissions from landfills will be released to the atmosphere regardless of whether the LFG is combusted. However, combustion of LFG can convert organic forms of mercury, such as dimethyl mercury and monomethyl mercury, to less toxic inorganic forms, such as elemental mercury (Lindberg et al., 2001). The previous version of the AP-42 section for MSW landfills (U.S. EPA, 1998) has the following footnote for Table 2.4-3. Control Efficiencies for LFG Constituents: “For any equipment, the control efficiency for mercury should be assumed to be 0.” However, we note that this statement pertains only to the use of combustion devices to control LFG emissions, and does not pertain to the use of activated carbon injection technology, which is sometimes employed for mercury control in large combustion sources. We are uncertain whether this particular technology is feasible for LFG combustion applications.

Total mercury concentrations from combustion outlets were provided for five landfills (TR-272, TR-273, TR-284, TR-287, TR-292), representing outlet emissions from two flares, two engines, and one boiler. Total mercury was measured using EPA Method 29 for all five landfills. Concentrations for four of these landfills (TR-272, TR-273, TR-284, TR-287) are below the method detection limit for all three test runs. Based on guidance for detection limits contained in EPA’s Procedures for Preparing Emission Factor Documents (U.S. EPA, 1997a), half of the detection limit should be used to represent the average concentration of total mercury for each of these four landfills. However, these halved concentrations are greater than the detect value for the total mercury concentration from the remaining landfill tested (TR-292). Therefore, as directed in the EPA procedures document, these four halved concentrations should not be used in determining a default concentration for post-combustion total mercury emissions. In addition, elemental mercury concentrations were provided for post-combustion engine emissions from two landfills (TR-272, TR-284), using the LUMEX Instrument.

Due to the limited post-combustion mercury data provided and the knowledge that mercury in raw LFG is not destroyed through combustion but rather converted from organic to inorganic forms, it is recommended that default concentrations for post-combustion mercury emissions not be developed at this time. If additional data become available, then these factors may be explored further.

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5.0 AP-42 SECTION 2.4

Section 2.4 of AP-42 is presented in the following pages as it would appear in the AP-42 update. Please note that until this is formally released through EPA's Technology Transfer Network (TTN) Clearinghouse for Inventories & Emissions (http://www.epa.gov/ttn/chief/ap42/), the factors and information contained in this report are regarded as draft.

2.4 MUNICIPAL SOLID WASTE LANDFILLS

2.4.1 General [1-4]

A municipal solid waste (MSW) landfill unit is a discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile. An MSW landfill unit may also receive other types of wastes, such as commercial solid waste, nonhazardous sludge, and industrial solid waste. In addition to household and commercial wastes, the other waste types potentially accepted by MSW landfills include (most landfills accept only a few of the following categories):

- Municipal sludge,
- Municipal waste combustion ash,
- Infectious waste,
- Small-quantity generated hazardous waste;
- Waste tires,
- Industrial non-hazardous waste,
- Conditionally exempt small quantity generator (CESQG) hazardous waste,
- Construction and demolition waste,
- Agricultural wastes,
- Oil and gas wastes, and
- Mining wastes.

The information presented in this section applies only to landfills which receive primarily MSW. This information is not intended to be used to estimate emissions from landfills which receive large quantities of other waste types such as industrial waste, or construction and demolition wastes. These other wastes exhibit emissions unique to the waste being landfilled.

In the United States in 2006, approximately 55 percent of solid waste was landfilled, 13 percent was incinerated, and 32 percent was recycled or composted. There were an estimated 1,754 active MSW landfills in the United States in 2006. These landfills were estimated to receive 138 million tons of waste annually, with 55 to 60 percent reported as household waste, and 35 to 45 percent reported as commercial waste.[79]

2.4.2 Process Description [2,5]

The majority of landfills currently use the "area fill" method which involves placing waste on a landfill liner, spreading it in layers, and compacting it with heavy equipment. A daily soil cover is spread over the compacted waste to prevent wind-blown trash and to protect the trash from scavengers and vectors. The landfill liners are constructed of soil (i.e., recompacted clay) and synthetics (i.e., high density polyethylene) to provide an impermeable barrier to leachate (i.e., water that has passed through the landfill) and gas migration from the landfill. Once an area of the landfill is completed, it is covered with a "cap" or "final cover" composed of various combinations of clay, synthetics, soil and cover vegetation to control the incursion of precipitation, the erosion of the cover, and the release of gases and odors from the landfill.

2.4.3 Control Technology[2,5,6]

The New Source Performance Standards (NSPS) and Emission Guidelines for air emissions from MSW landfills for certain new and existing landfills were published in the Federal Register on March 1, 1996. Current versions of the NSPS and Emission Guidelines can be found at 40 CFR 60 subparts WWW and Cb, respectively. The regulation requires that Best Demonstrated Technology (BDT) be used to reduce MSW landfill emissions from affected new and existing MSW landfills if (1) the landfill has a design capacity of 2.5 million Mg (2.75 million tons) and 2.5 million cubic meters or more, and (2) the calculated uncontrolled emissions from the landfill are greater than or equal to 50 Mg/yr (55 tons/yr) of nonmethane organic compounds (NMOCs). The MSW landfills that are affected by the NSPS/Emission Guidelines are each new MSW landfill, and each existing MSW landfill that has accepted waste since November 8, 1987 or that has capacity available for future use. Control systems require: (1) a well-designed and well-operated gas collection system, and (2) a control device capable of reducing non-methane organic compounds (NMOCs) in the collected gas by 98 weight-percent (or to 20 ppmv, dry basis as hexane at 3% oxygen for an enclosed combustion device). Other compliance options include use of a flare that meets specified design and operating requirements or treatment of landfill gas (LFG) for use as a fuel. The National Emission Standards for Hazardous Air Pollutants (NESHAP) for MSW landfills was published in the Federal Register on January 16, 2003. It requires control of the same landfills, and the same types of gas collection and control systems as the NSPS. The NESHAP also requires earlier control of bioreactor landfills and contains a few additional reporting requirements for MSW landfills.

Landfill gas collection systems consist of a series of vertical or horizontal perforated pipes that penetrate the waste mass and collect the gases produced by the decaying waste. These collection systems are classified as either active or passive systems. Active collection systems use mechanical blowers or compressors to create a vacuum in the collection piping to optimize the collection of LFG. Passive systems use the natural pressure gradient established between the encapsulated waste and the atmosphere to move the gas through the collection system.

LFG control and treatment options include: (1) combustion of the LFG, and (2) treatment of the LFG for subsequent sale or use. Combustion techniques include techniques that do not recover energy (i.e., flares and thermal incinerators), and techniques that recover energy and generate electricity from the combustion of the LFG (i.e., gas turbines and reciprocating engines). Boilers can also be employed to recover energy from LFG in the form of steam. Flares combust the LFG without the recovery of energy, and are classified by their burner design as being either open or enclosed. Purification techniques are used to process raw LFG to either a medium-BTU gas using dehydration and filtration or as a higher-BTU gas by removal of inert constituents using adsorption, absorption, and membranes.

2.4.4 Emissions[2,7]

Methane (CH_4) and carbon dioxide (CO_2) are the primary constituents of LFG, and are produced by microorganisms within the landfill under anaerobic conditions. Transformations of CH_4 and CO_2 are mediated by microbial populations that are adapted to the cycling of materials in anaerobic environments. Landfill gas generation proceeds through four phases. The first phase is aerobic [i.e., with oxygen (O_2) available from air trapped in the waste] and the primary gas produced is CO_2. The second phase is characterized by O_2 depletion, resulting in an anaerobic environment, where large amounts of CO_2 and some hydrogen (H_2) are produced. In the third phase, CH_4 production begins, with an accompanying reduction in the amount of CO_2 produced. Nitrogen (N_2) content is initially high in LFG in the first phase, and declines sharply as the landfill proceeds through the second and third phases. In the fourth phase, gas production of CH_4, CO_2, and N_2 becomes fairly steady. The duration of each phase and the total time of gas generation vary with landfill conditions (i.e., waste composition, design management, and anaerobic state).

Typically, LFG also contains NMOC and volatile organic compounds (VOC). NMOC result from either decomposition by-products or volatilization of biodegradable wastes. Although NMOC are considered trace constituents in LFG, the NMOC and VOC emission rates could be "major" with respect to Prevention of Significant Deterioration (PSD) and New Source Review (NSR) requirements. This NMOC fraction often contains various organic hazardous air pollutants (HAP), greenhouse gases (GHG), compounds associated with stratospheric ozone depletion and volatile organic compounds (VOC). However, in MSW landfills where contaminated soils from storage tank cleanups are used as daily cover, much higher levels of NMOC have been observed. As LFG migrates through the contaminated soil, it adsorbs the organics, resulting in the higher concentrations of NMOC and any other contaminant in the soil. In one landfill where contaminated soil was used as daily cover, the NMOC concentration in the LFG was 5,870 ppm as compared to the AP-42 average value of 838 ppm. While there is insufficient data to develop a factor or algorithm for estimating NMOC from contaminated daily cover, the emissions inventory developer should be aware to expect elevated NMOC concentrations from these landfills.

Other emissions associated with MSW landfills include combustion products from LFG control and utilization equipment (i.e., flares, engines, turbines, and boilers). These include carbon monoxide (CO), oxides of nitrogen (NO_X), sulfur dioxide (SO_2), hydrogen chloride (HCl), particulate matter (PM) and other combustion products (including HAPs). PM emissions can also be generated in the form of fugitive dust created by mobile sources (i.e., garbage trucks) traveling along paved and unpaved surfaces. The reader should consult AP-42 Volume I Sections 13.2.1 and 13.2.2 for information on estimating fugitive dust emissions from paved and unpaved roads.

One pollutant that can very greatly between landfills is hydrogen sulfide (H_2S). H_2S is normally present in LFG at levels ranging from 0 to 90 ppm, with an average concentration of 33 ppm. However, a recent trend at some landfills has been the use of construction and demolition waste (C&D) as daily cover. Under certain conditions that are not well understood, some microorganisms will convert the sulfur in the wall-board of C&D waste to H_2S. At these landfills, H_2S concentrations can be significantly higher than at landfills that do not use C&D waste as daily cover. While H_2S measurements are not available for landfills using C&D for daily cover, the State of New Hampshire among others have noted elevated H_2S odor problems at these landfills and have assumed that H_2S concentrations have increased, similarly. In a series of studies at 10 landfills in Florida where a majority of the waste is composed of C&D material, the concentration of H_2S concentration spanned a range from less than the detection limit of the instrument (0.003 ppmv) up to 12,000 ppmv.[8] Another study that was conducted used flux boxes to measure uncontrolled emissions of H_2S at five landfills in Florida. This study reported a range of H_2S emissions between 0.192 and 1.76 mg/(m^2-d).[9] At any MSW landfill where C&D waste was used as daily cover or was comingled with the MSW, it is recommended that direct H_2S measurements be used to develop specific H_2S emissions for the landfill.

The rate of emissions from a landfill is governed by gas production and transport mechanisms. Production mechanisms involve the production of the emission constituent in its vapor phase through vaporization, biological decomposition, or chemical reaction. Transport mechanisms involve the transportation of a volatile constituent in its vapor phase to the surface of the landfill, through the air boundary layer above the landfill, and into the atmosphere. The three major transport mechanisms that enable transport of a volatile constituent in its vapor phase are diffusion, convection, and displacement.

Although relatively uncommon, fires can occur on the surface of the landfill or underground. The smoke from a landfill fire frequently contains many dangerous chemical compounds, including: carbon monoxide, particulate matter and hazardous gases that are the products of incomplete combustion, and very elevated concentrations of the many gaseous constituents normally occurring in LFG. Of particular concern in landfill fires is the emission of dioxins/furans. Accidental fires at landfills and the uncontrolled burning of residential waste are considered the largest sources of dioxin emissions in the United States.[10] The composition of the gases from landfill fires is highly variable and dependent on numerous site specific factors, including: the composition of the material burning, the composition of the surrounding waste, the temperature of the burning waste, and the presence of oxygen. The only reliable method for estimating the emissions from a landfill fire involves testing the emissions directly. More information is available on landfill fires and their emissions from reference 11.

2.4.4.1 Uncontrolled Emissions — Several methods have been developed by EPA to determine the uncontrolled emissions of the various compounds present in LFG. The newest measurement method is optical remote sensing with radial plume mapping (ORS-RPM). This method uses an optical emission detector such as open-path Fourier transform infrared spectroscopy (FTIR), ultraviolet differential absorption spectroscopy (UV-DOAS), or open-path tunable diode laser absorption spectroscopy (OP-TDLAS); coupled with radial plume mapping software that processes path-integrated emission concentration data and meteorological data to yield an estimate of uncontrolled emissions. More information on this newest method is described in *Evaluation of Fugitive Emissions Using Ground-Based Optical Remote Sensing Technology* (EPA/600/R-07/032).[12] Additional research is ongoing to provide additional guidance on the use of optical remote sensing for application at landfills. Evaluating uncontrolled emissions from landfills can be a challenge. This is due to the changing nature of landfills, scale and complexity of the site, topography, and spatial and temporal variability in emissions. Additional guidance is being developed for application of EPA's test method for area sources emissions. This is expected to be released by the spring of 2009. For more information, refer to the Emission Measurement Center of EPA's Technology Transfer Network (http://www.epa.gov/ttn/emc/tmethods.html). Additional information on ORS technology can also be found on EPA's website for Measurement and Monitoring Technologies for 21st Century ($21M^2$) which provided funding to identify improved technologies for quantifying area source emissions (http://www.clu-in.org/programs/21m2/openpath/).

Often flux data are used to evaluate LFG collection efficiency. The concern with the use of this data is that it does not capture emission losses from header pipes or extraction wells. The other concern is that depending upon the design of the study, the emission variability across a landfill surface is not captured. Emission losses can occur from cracks and fissures or difference in landfill cover material. Often, alternative cover material is used to help promote infiltration, particularly for wet landfill operation. This can result in larger loss of fugitive emissions. Another loss of landfill gas is through the leachate collection pumps and wells. For many of these potential losses, a flux box is not considered adequate to capture the total loss of fugitive gas. The use of ORS technology is considered more reliable.

When direct measurement data are not available, the most commonly used EPA method to estimate the uncontrolled emissions associated with LFG is based on a biological decay model. In this method, the generation of CH_4 must first be estimated by using a theoretical first-order kinetic model of CH_4 production developed by the EPA[13]:

$$Q_{CH_4} = 1.3 L_o R (e^{-kc} - e^{-kt}) \qquad (1)$$

where:

Q_{CH_4} = Methane generation rate at time t, m^3/yr;
L_o = Methane generation potential, m^3 CH_4/Mg of "wet" or "as received" refuse;
R = Average annual refuse acceptance rate during active life, Mg of "wet" or "as received" refuse /yr;
e = Base log, unitless;
k = Methane generation rate constant, yr^{-1};
c = Time since landfill closure, yrs (c = 0 for active landfills); and
t = Time since the initial refuse placement, yrs.

When annual refuse acceptance data is available, the following form of Equation (1) is used. This is the general form of the equation that is used in EPA's Landfill Gas Emissions Model (LandGEM). Due to the complexity of the double summation, Equation (1alt) is normally implemented within a computer model. Equation (1 alt.) is more accurate because it accounts for the varying annual refuse flows and it calculates each year's gas flow in $^1/_{10th}$ year increments.

$$Q_{CH_4} = 1.3 \sum_{i=1}^{n} \sum_{j=0.1}^{1} k\, L_o \frac{R_i}{10} e^{-kt_{ij}} \qquad \text{(1 alternate)}$$

where:

Q_{CH_4} = Methane generation rate at time t, m^3/yr;
L_o = Methane generation potential, m^3 CH_4/Mg of "wet" or "as received" refuse;
R_i = Annual refuse acceptance rate for year i, Mg of "wet" or "as received" refuse /yr;
e = Base log, unitless;
k = Methane generation rate constant, yr^{-1};
c = Time since landfill closure, yrs (c = 0 for active landfills); and
t = Time since the initial refuse placement, yrs.
i = year in life of the landfill
j = $^1/_{10th}$ year increment in the calculation.

It should be noted that Equation (1) is provided for estimating CH_4 emissions to the atmosphere. Other fates may exist for the gas generated in a landfill, including capture and subsequent microbial degradation within the landfill's surface layer. Currently, there are no data that adequately address this fate. It is generally accepted that the bulk of the CH_4 generated will be emitted through cracks or other openings in the landfill surface and that Equation (1) can be used to approximate CH_4 emissions from an uncontrolled landfill. It should also be noted that Equation (1) is different from the equation used in other models such as LandGEM by the addition of the constant 1.3 at the front of the equation. This constant is included to compensate for L_O which is typically determined by the amount of gas collected by LFG collection systems. The design of these systems will typically result in a gas capture efficiency of only 75%. Therefore, 25% of the gas generated by the landfill is not captured and included in the development of L_O. The ratio of total gas to captured gas is a ratio of 100/75 or equivalent to 1.3.

Site-specific landfill information is generally available for variables R, c, and t. When refuse acceptance rate information is scant or unknown, R can be determined by dividing the refuse in place by the age of the landfill. If a facility has documentation that a certain segment (cell) of a landfill received *only* nondegradable refuse, then the waste from this segment of the landfill can be excluded from the calculation of R. Nondegradable refuse includes concrete, brick, stone, glass, plaster, wallboard, piping, plastics, and metal objects. The average annual acceptance rate should only be estimated by this method when there is inadequate information available on the actual average acceptance rate. The time variable, t, includes the total number of years that the refuse has been in place (including the number of years that the landfill has accepted waste and, if applicable, has been closed).

Values for variables L_o and k are normally estimated. Estimation of the potential CH_4 generation capacity of refuse (L_o) is generally treated as a function of the moisture and organic content of the refuse. Estimation of the CH_4 generation constant (k) is a function of a variety of factors, including moisture, pH, temperature, and other environmental factors, and landfill operating conditions.

Recommended AP-42 defaults for k are:

k Value	Landfill Conditions
0.02	**Areas receiving <25 inches/yr rainfall**
0.04	**Areas receiving >25 inches/yr rainfall**
0.3	**Wet landfills[14]**

For the purpose of the above table, wet landfills are defined as landfills which add large amounts of water to the waste. This added water may be recycled landfill leachates and condensates, or may be other sources of water such as treated wastewater.

The CH_4 generation potential, $L_{o,}$ has been observed to vary from 6 to 270 m^3/Mg (200 to 8670 ft3/ton), depending on the organic content of the waste material. A higher organic content results in a higher L_o. Food, textiles, paper, wood, and horticultural waste have the highest L_o value on a dry basis, while inert materials such as glass, metal and plastic have no L_o value.[2] Since moisture does not contribute to the value of L_o, a high moisture content waste, such as food or organic sludge, will have a lower L_o on an “as received” basis. When using Equation 1 to estimate emissions for typical MSW landfills in the U.S., a mean L_o value of 100 m^3/Mg refuse (3,530 ft^3 /ton, “as received” basis) is recommended.

There is a significant level of uncertainty in Equation 2 and its recommended defaults values for k and $L_{o.}$ The recommended defaults k and L_o for conventional landfills, based upon the best fit to 40 different landfills, yielded predicted CH_4 emissions that ranged from ~30 to 400% of measured values and had a relative standard deviation of 0.73 (Table 2-2). The default values for wet landfills were based on a more limited set of data and are expected to contain even greater uncertainty.

When gas generation reaches steady state conditions, LFG consists of approximately equal volumes of CO_2 and CH_4. LFG also typically contains as much as five percent N_2 and other gases, and trace amounts of NMOCs. Since the flow of CO_2 is approximately equal to the flow of CH_4, the estimate derived for CH_4 generation using Equation (1) can also be used to estimate CO_2 generation. Addition of the CH_4 and CO_2 emissions will yield an estimate of total LFG emissions. If site-specific information is available on the actual CH_4 and CO_2 contents of the LFG, then the site-specific information should be used.

Most of the NMOC emissions from landfills result from the volatilization of organic compounds contained in the landfilled waste. Small amounts may also be created by biological processes and chemical reactions within the landfill. Available data show that the range of values for total NMOC in LFG is from 31 ppmv to over 5,387 ppmv, and averages 838 ppmv. The proposed regulatory default of 4,000 ppmv for NMOC concentration was developed for regulatory compliance purposes and is considered more conservative. For emissions inventory purposes, site-specific information should be taken into account when determining the total NMOC concentration, whenever available. Measured pollutant concentrations (i.e., as measured by EPA Reference Method 25C), must be corrected for air infiltration which can occur by two different mechanisms: LFG sample dilution and air intrusion into the landfill. These corrections require site-specific data for the LFG CH_4, CO_2, N_2, and O_2 content. If the ratio of N_2 to O_2 is less than or equal to 4.0 (as found in ambient air), then the total pollutant concentration is adjusted for sample dilution by assuming that CO_2 and CH_2 are the primary constituents of LFG (assumed to account for 100% of the LGF), and the following equation is used:

$$C_P \text{ (corrected for air infiltration)} = \frac{C_P \text{ x } (1 \text{x} 10^6)}{C_{CO_2} + C_{CH_4}} \tag{2}$$

where:

C_P = Concentration of pollutant P in LFG (i.e., NMOC as hexane), ppmv;
C_{CO2} = CO_2 concentration in LFG, ppmv;
Q_{CH4} = CH_4 Concentration in LFG, ppmv; and
$1 \text{ x } 10^6$ = Constant used to correct concentration of P to units of ppmv.

If the ratio of N_2 to O_2 concentrations (i.e., C_{N2}, C_{O2}) is greater than 4.0, then the total pollutant concentration should be adjusted for air intrusion into the landfill by using Equation (2) and adding the concentration of N_2 (i.e., C_{N2}) to the denominator. Values for C_{CO2}, C_{CH4}, C_{N2}, C_{O2}, can usually be found in the source test report for the particular landfill along with the total pollutant concentration data.

To estimate uncontrolled emissions of NMOC or other LFG constituents, the following equation should be used:

$$Q_P = \frac{Q_{CH4} \text{ x } C_P}{C_{CH_4} \text{ x } (1 \text{x} 10^6)} \tag{3}$$

where:

Q_P = Emission rate of pollutant P (i.e., NMOC), m^3/yr;
Q_{CH4} = CH_4 generation rate, m^3/yr (from Equation 1);
C_P = Concentration of pollutant P in LFG, ppmv; and
C_{CH4} = Concentration of CH_4 in the LFG (assumed to be 50% expressed as 0.5)

Uncontrolled mass emissions per year of total NMOC (as hexane) and speciated organic and inorganic compounds can be estimated by the following equation:

$$UM_P = Q_P \text{ x } \frac{MW_P \text{ x} 1 \text{ atm}}{(8.205\text{x}10^{-5} \text{ m}^3 - \text{atm/gmol} - {}^{o}\text{K}) \text{ x } (1000\text{g/kg}) \text{ x } (273 + T)} \tag{4}$$

where:

UM_P = Uncontrolled mass emissions of pollutant P (i.e., NMOC), kg/yr;
MW_P = Molecular weight of P, g/gmol (i.e., 86.18 for NMOC as hexane);
Q_P = Emission rate of pollutant P, m^3/yr; and
T = Temperature of LFG, ^oC.

This equation assumes that the operating pressure of the system is approximately 1 atmosphere. If the temperature of the LFG is not known, a temperature of 25 ^oC (77 ^oF) is recommended.

Uncontrolled default concentrations of VOC, NMOC and speciated compounds are presented in Table 2.4-1 for landfills having a majority of the waste in place on or after 1992 and in Table 2.4-2 for landfills having a majority of the waste in place before 1992. These default concentrations have already been corrected for air infiltration and can be used as input parameters to Equation (3) for estimating emissions from landfills when site-specific data are not available. An analysis of the data, based on the co-disposal history (with non-residential wastes) of the individual landfills from which the concentration data were derived, indicates that for benzene, NMOC, and toluene, there is a difference in the uncontrolled concentrations.

It is important to note that the compounds listed in Tables 2.4-1 and 2.4-2 are not the only compounds likely to be present in LFG. The listed compounds are those that were identified through a review of the available landfill test reports. The reader should be aware that additional compounds are likely present, such as those associated with consumer or industrial products. Given this information, extreme caution should be exercised in the use of the default emission concentrations given in Tables 2.4-1 and 2.4-2. Available data have shown that there is a range of over two orders of magnitude in many of the pollutant concentrations among gases from various MSW landfills.

2.4.4.2 Controlled Emissions — Emissions from landfills are typically controlled by installing a gas collection system, and either combusting the collected gas through the use of internal combustion engines, flares, or turbines, or by purifying the gas for direct use in place of a fuel such as natural gas. Gas collection systems are not 100% efficient in collecting LFG, so emissions of CH_4 and NMOC at a landfill with a gas recovery system still occur. To estimate controlled emissions of CH_4, NMOC, and other constituents in LFG, the collection efficiency of the system must first be estimated. Reported collection efficiencies typically range from 50 to 95%, with a default efficiency of 75% recommended by EPA for inventory purposes. The lower collection efficiencies are experienced at landfills with a large number of open cells, no liners, shallow soil covers, poor collection system and cap maintenance programs and/or a large number of cells without gas collection. The higher collection efficiencies may be achieved at closed sites employing good liners, extensive geomembrane-clay composite caps in conjunction with well engineered gas collection systems, and aggressive operation and maintenance of the cap and collection system. If documented site-specific collection efficiencies are available (i.e., through a comprehensive surface sampling program), then they may be used instead of the 75% average. An analysis showing a range in the gas collection system taking into account delays from gas collection from initial waste placement is provided in Section 2.0.

Estimates of controlled emissions may also need to account for the control efficiency of the control device. Control efficiencies for NMOC and VOC based on test data for the combustion of LFG with differing control devices are presented in Table 2.4-3. As noted in the table, these control efficiencies may also be applied to other LFG constituents. Emissions from the control devices need to be added to the uncollected emissions to estimate total controlled emissions.

Controlled CH_4, NMOC, VOC, and speciated emissions can be determined by either of two methods developed by EPA. The newest method is the optical remote sensing with radial plume mapping (ORS-RPM). This method uses an optical emission detector such as open-path Fourier transform infrared spectroscopy (FTIR), ultraviolet differential absorption spectroscopy (UV-DOAS), or open-path tunable diode laser absorption spectroscopy (OP-TDLAS); coupled with radial plume mapping software that processes path-integrated emission concentration data and meteorological data to yield an estimate of uncontrolled emissions. More information on this newest method is described in *Evaluation of Fugitive Emissions Using Ground-Based Optical Remote Sensing Technology* (EPA/600/R-07/032).[12]

Historically, controlled emissions have been calculated with Equation 5. In this equation it is assumed that the LFG collection and control system operates 100 percent of the time. Minor durations of system downtime associated with routine maintenance and repair (i.e., 5 to 7 percent) will not appreciably effect emission estimates. The first term in Equation 5 accounts for emissions from uncollected LFG, while the second term accounts for emissions of the pollutant that were collected but not fully combusted in the control or utilization device:

$$CM_P = \left[UM_P \text{ x } \left(1 - \frac{\eta_{col}}{100}\right)\right] + \left[UM_P \text{ x } \frac{\eta_{col}}{100} \text{ x } \left(1 - \frac{\eta_{cnt}}{100}\right)\right] \tag{5}$$

where:

CM_P = Controlled mass emissions of pollutant P, kg/yr;
UM_P = Uncontrolled mass emissions of P, kg/yr (from Equation 4);
η_{col} = Efficiency of the LFG collection system, % (recommended default is 75%); and
η_{cnt} = Efficiency of the LFG control or utilization device, %.

Emission factors for the secondary compounds, CO, PM, NO_x and dioxins/furans exiting the control device are presented in Table 2.4-4. These emission factors should be used when equipment vendor emission guarantees are not available.

Controlled emissions of CO_2 and sulfur dioxide (SO_2) are best estimated using site-specific LFG constituent concentrations and mass balance methods.[15] If site-specific data are not available, the data in Tables 2.4-1 and 2.4-2 can be used with the mass balance methods that follow.

Controlled CO_2 emissions include emissions from the CO_2 component of LFG and additional CO_2 formed during the combustion of LFG. The bulk of the CO_2 formed during LFG combustion comes from the combustion of the CH_4 fraction. Small quantities will be formed during the combustion of the NMOC fraction. However, this typically amounts to less than 1 percent of total CO_2 emissions by weight. Also, the formation of CO through incomplete combustion of LFG will result in small quantities of CO_2 not being formed. This contribution to the overall mass balance picture is also very small and does not have a significant impact on overall CO_2 emissions.[15]

The following equation which assumes a 100% combustion efficiency for CH_4 can be used to estimate CO_2 emissions from controlled landfills:

$$CM_{CO2} = UM_{CO2} + \left(UM_{CH4} \text{ x } \frac{\eta_{col}}{100} \text{ x } 2.75 \right) \tag{6}$$

where:

CM_{CO_2} = Controlled mass emissions of CO_2, kg/yr;
UM_{CO_2} = Uncontrolled mass emissions of CO_2, kg/yr (from Equation 4);
UM_{CH_4} = Uncontrolled mass emissions of CH_4, kg/yr (from Equation 4);
η_{col} = Efficiency of the LFG collection system, % (recommended default is 75%); and
2.75 = Ratio of the molecular weight of CO_2 to the molecular weight of CH_4.

To prepare estimates of SO_2 emissions, data on the concentration of reduced sulfur compounds within the LFG are needed. The best way to prepare this estimate is with site-specific information on the total reduced sulfur content of the LFG. Often these data are expressed in ppmv as sulfur (S). Equations 3 and 4 should be used first to determine the uncontrolled mass emission rate of reduced sulfur compounds as sulfur. Then, the following equation can be used to estimate SO_2 emissions:

$$CM_{SO_2} = UM_S \times \frac{\eta_{col}}{100} \times 2.0 \qquad (7)$$

where:

CM_{SO_2} = Controlled mass emissions of SO_2, kg/yr;
UM_S = Uncontrolled emissions of reduced sulfur compounds as sulfur, kg/yr (from Equations 3 and 4);
η_{col} = Efficiency of the LFG collection system, %; and
2.0 = Ratio of the molecular weight of SO_2 to the molecular weight of S.

The next best method to estimate SO_2 concentrations, if site-specific data for total reduced sulfur compounds as sulfur are not available, is to use site-specific data for speciated reduced sulfur compound concentrations. These data can be converted to ppmv as S with Equation 8. After the total reduced sulfur as S has been obtained from Equation 8, then Equations 3, 4, and 7 can be used to derive SO_2 emissions.

$$C_S = \sum_{i=1}^{n} C_P \times S_P \qquad (8)$$

where:

C_S = Concentration of total reduced sulfur compounds, ppmv as S (for use in Equation 3);
C_P = Concentration of each reduced sulfur compound, ppmv;
S_P = Number of moles of S produced from the combustion of each reduced sulfur compound (i.e., 1 for sulfides, 2 for disulfides); and
n = Number of reduced sulfur compounds available for summation.

If no site-specific data are available, values of 47 and 33 ppmv can be used for C_S in the gas from landfills having a majority of the waste in place before 1992 and from landfills having a majority of the waste in place after 1992, respectively. These values were obtained by using the default concentrations presented in Tables 2.4-1 and 2.4-2 for reduced sulfur compounds and Equation 8.

Hydrochloric acid [Hydrogen Chloride (HCl)] emissions are formed when chlorinated compounds in LFG are combusted in control equipment. The best methods to estimate HCl emissions are mass balance methods that are analogous to those presented above for estimating SO_2 emissions. Hence, the best source of data to estimate HCl emissions is site-specific LFG data on total chloride [expressed in ppmv as the chloride ion (Cl^-)]. However, emission estimates may be underestimated, since not every chlorinated compound in the LFG will be represented in the site test report (i.e., only those that the analytical method specifies). If these data are not available, then total chloride can be estimated from data on individual chlorinated species using Equation 9 below.

$$C_{Cl} = \sum_{i=1}^{n} C_P \text{ x } Cl_P \qquad (9)$$

where:

- C_{Cl} = Concentration of total chloride, ppmv as Cl^- (for use in Equation 3);
- C_P = Concentration of each chlorinated compound, ppmv;
- Cl_P = Number of moles of Cl^- produced from the combustion of each mole of chlorinated compound (i.e., 3 for 1,1,1-trichloroethane); and
- n = Number of chlorinated compounds available for summation.

After the total chloride concentration (C_{Cl}) has been estimated, Equations 3 and 4 should be used to determine the total uncontrolled mass emission rate of chlorinated compounds as chloride ion (UM_{Cl}). This value is then used in Equation 10, below, to derive HCl emission estimates:

$$CM_{HCl} = UM_{Cl} \text{ x } \frac{\eta_{col}}{100} \text{ x } 1.03 \text{ x } \frac{\eta_{cnt}}{100} \qquad (10)$$

where:

- CM_{HCl} = Controlled mass emissions of HCl, kg/yr;
- UM_{Cl} = Uncontrolled mass emissions of chlorinated compounds as chloride, kg/yr (from Equations 3 and 4);
- η_{col} = Efficiency of the LFG collection system, percent;
- 1.03 = Ratio of the molecular weight of HCl to the molecular weight of Cl^-; and
- η_{cnt} = Control efficiency of the LFG control or utilization device, percent.

In estimating HCl emissions, it is assumed that all of the chloride ion from the combustion of chlorinated LFG constituents is converted to HCl. If an estimate of the control efficiency, η_{cnt}, is not available, then the control efficiency for the equipment listed in Table 2.4-3 should be used. This assumption is recommended to assume that HCl emissions are not under-estimated.

If site-specific data on total chloride or speciated chlorinated compounds are not available, then default values of 42 and 74 ppmv can be used for C_{Cl} in the gas from landfills having a majority of the waste in place before 1992 and from landfills having a majority of the waste in place after 1992, respectively. These values were derived from the default LFG constituent concentrations presented in Tables 2.4-1 and 2.4-2. As mentioned above, use of this default may produce underestimates of HCl emissions since it is based only on those compounds for which analyses have been performed. The constituents listed in Table 2.4-1 and 2.4-2 are likely not all of the chlorinated compounds present in LFG.

The reader is referred to AP-42 Volume I, Sections 13.2.1 and 13.2.2 for information on estimating fugitive dust emissions from paved and unpaved roads, and to Section 13.2.3 for information on estimating fugitive dust emissions from heavy construction operations; and to AP-42 Volume II Section II-7 for estimating exhaust emissions from construction equipment.

2.4.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. The November 1998 revision includes major revisions of the text and recommended emission factors contained in the section. The most significant revisions to this section since publication in the Fifth Edition are summarized below.

- The equations to calculate the CH_4, CO_2 and other constituents were simplified.
- The default L_0 and k were revised based upon an expanded base of gas generation data.
- The default ratio of CO_2 to CH_4 was revised based upon averages observed in available source test reports.
- The default concentrations of LFG constituents were revised based upon additional data. References 16-148 are the emission test reports from which data were obtained for this section.
- Additional control efficiencies were included and existing efficiencies were revised based upon additional emission test data.
- Revised and expanded the recommended emission factors for secondary compounds emitted from typical control devices.

The current (i.e., 2008) update includes text revisions and additional discussion, as well as revised recommended emission factors contained within the section. The more significant revisions are summarized below:

- Default concentrations of LFG constituents were developed for landfills with the majority of their waste in place on or after 1992 (proposal of RCRA Subtitle D). The LFG constituent list from the last update reflects data from landfills with waste in place prior to 1992, so Table 2.4-2 was renamed to reflect this.
- Control efficiencies were updated to incorporate additional emission test data and the table was revised to show the NMOC and VOC control efficiencies.
- Revised and expanded the recommended emission factors for secondary compounds emitted from typical control devices.
- The description of modern landfills and statistics about waste disposition in the U.S. were updated with 2006 information.
- EPA's newest measurement method for determining landfill emissions, Optical Remote Sensing with Radial Plume Mapping (ORS-RPM), was added to the discussion of available options for measuring landfill emissions.

- A factor of 1.3 was added to Equation (1) to account for the fact that L_0 is typically determined by the amount of CH_4 collected at landfills using equipment that typically has a capture efficiency of only 75%.

- A k value of 0.3 was added to the list of recommended k values for use in Equation (1) to more accurately model landfill gas emissions from wet landfills.

Table 2.4-1. DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE ON OR AFTER 1992

Compound	CAS Number	Molecular Weight	Default Concentration (ppmv)	Recommended Emission Factor Rating
NMOC (as hexane)[a]		86.18	8.38E+02	A
VOC[b]		NA	8.35E+02	A
1,1,1-Trichloroethane[c]	71556	133.40	2.43E-01	A
1,1,2,2-Tetrachloroethane[c]	79345	167.85	5.35E-01	E
1,1,2,3,4,4-Hexachloro-1,3-butadiene (Hexachlorobutadiene)[c]	87683	260.76	3.49E-03	D
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	76131	187.37	6.72E-02	C
1,1,2-Trichloroethane[c]	79005	133.40	1.58E-01	D
1,1-Dichloroethane[c]	75343	98.96	2.08E+00	A
1,1-Dichloroethene (1,1-Dichloroethylene)[c]	75354	96.94	1.60E-01	A
1,2,3-Trimethylbenzene	526738	120.19	3.59E-01	D
1,2,4-Trichlorobenzene[c]	120821	181.45	5.51E-03	C
1,2,4-Trimethylbenzene	95636	120.19	1.37E+00	B

Table 2.4-1(CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE ON OR AFTER 1992				
Compound	CAS Number	Molecular Weight	Default Concentration (ppmv)	Recommended Emission Factor Rating
1,2-Dibromoethane (Ethylene dibromide)[c]	106934	187.86	4.80E-03	B
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	76142	170.92	1.06E-01	B
1,2-Dichloroethane (Ethylene dichloride)[c]	107062	98.96	1.59E-01	A
1,2-Dichloroethene	540590	96.94	1.14E+01	E
1,2-Dichloropropane[c]	78875	112.99	5.20E-02	D
1,2-Diethylbenzene	135013	134.22	1.99E-02	D
1,3,5-Trimethylbenzene	108678	120.19	6.23E-01	C
1,3-Butadiene (Vinyl ethylene)[c]	106990	54.09	1.66E-01	C
1,3-Diethylbenzene	141935	134.22	6.55E-02	D
1,4-Diethylbenzene	105055	134.22	2.62E-01	D
1,4-Dioxane (1,4-Diethylene dioxide)[c]	123911	88.11	8.29E-03	D
1-Butene / 2-Methylbutene	106989 / 513359	56.11 / 70.13	1.22E+00	D
1-Butene / 2-Methylpropene	106989 / 115117	56.11	1.10E+00	E
1-Ethyl-4-methylbenzene (4-Ethyl toluene)	622968	120.19	9.89E-01	C
1-Ethyl-4-methylbenzene (4-Ethyl toluene) + 1,3,5-Trimethylbenzene	622968 / 108678	120.19	5.79E-01	D
1-Heptene	592767	98.19	6.25E-01	E
1-Hexene / 2-Methyl-1-pentene	592416 / 763291	84.16	8.88E-02	D
1-Methylcyclohexene	591491	96.17	2.27E-02	D
1-Methylcyclopentene	693890	82.14	2.52E-02	D
1-Pentene	109671	70.13	2.20E-01	D
1-Propanethiol (n-Propyl mercaptan)	107039	76.16	1.25E-01	A
2,2,3-Trimethylbutane	464062	100.20	9.19E-03	D
2,2,4-Trimethylpentane[c]	540841	114.23	6.14E-01	D
2,2,5-Trimethylhexane	3522949	128.26	1.56E-01	D
2,2-Dimethylbutane	75832	86.18	1.56E-01	D
2,2-Dimethylpentane	590352	100.20	6.08E-02	D
2,2-Dimethylpropane	463821	72.15	2.74E-02	E
2,3,4-Trimethylpentane	565753	114.23	3.12E-01	D
2,3-Dimethylbutane	79298	86.18	1.67E-01	D
2,3-Dimethylpentane	565593	100.20	3.10E-01	D
2,4-Dimethylhexane	589435	114.23	2.22E-01	D
2,4-Dimethylpentane	108087	100.20	1.00E-01	D
2,5-Dimethylhexane	592132	114.23	1.66E-01	D
2,5-Dimethylthiophene	638028	112.19	6.44E-02	E
2-Butanone (Methyl ethyl ketone)[c]	78933	72.11	4.01E+00	C
2-Ethyl-1-butene	760214	84.16	1.77E-02	D
2-Ethylthiophene	872559	112.19	6.29E-02	E
2-Ethyltoluene	611143	120.19	3.23E-01	D
2-Hexanone (Methyl butyl ketone)	591786	100.16	6.13E-01	E
2-Methyl-1-butene	563462	70.13	1.79E-01	D
2-Methyl-1-propanethiol (Isobutyl mercaptan)	513440	90.19	1.70E-01	E
2-Methyl-2-butene	513359	70.13	3.03E-01	D

Table 2.4-1(CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE ON OR AFTER 1992				
Compound	CAS Number	Molecular Weight	Default Concentration (ppmv)	Recommended Emission Factor Rating
2-Methyl-2-propanethiol (tert-Butylmercaptan)	75661	90.19	3.25E-01	E
2-Methylbutane	78784	72.15	2.26E+00	D
2-Methylheptane	592278	114.23	7.16E-01	D
2-Methylhexane	591764	100.20	8.16E-01	D
2-Methylpentane	107835	86.18	6.88E-01	D
2-Propanol (Isopropyl alcohol)	67630	60.10	1.80E+00	C
3,6-Dimethyloctane	15869940	142.28	7.85E-01	D
3-Ethyltoluene	620144	120.19	7.80E-01	D
3-Methyl-1-pentene	760203	84.16	6.99E-03	D
3-Methylheptane	589811	114.23	7.63E-01	D
3-Methylhexane	589344	100.20	1.13E+00	D
3-Methylpentane	96140	86.18	7.40E-01	D
3-Methylthiophene	616444	98.17	9.25E-02	E
4-Methyl-1-pentene	691372	84.16	2.33E-02	E
4-Methyl-2-pentanone (MIBK)[c]	108101	100.16	8.83E-01	C
4-Methylheptane	589537	114.23	2.49E-01	D
Acetaldehyde[c]	75070	44.05	7.74E-02	D
Acetone	67641	58.08	6.70E+00	C
Acetonitrile[c]	75058	41.05	5.56E-01	A
Acrylonitrile[c,d]	107131	53.06	BDL	
Benzene[c]	71432	78.11	2.40E+00	A
Benzyl chloride[c]	100447	126.58	1.81E-02	A
Bromodichloromethane	75274	163.83	8.78E-03	E
Bromomethane (Methyl bromide)[c]	74839	94.94	2.10E-02	C
Butane	106978	58.12	6.22E+00	C
Carbon disulfide[c]	75150	76.14	1.47E-01	A
Carbon monoxide	630080	28.01	2.44E+01	C
Carbon tetrachloride[c]	56235	153.82	7.98E-03	A
Carbon tetrafluoride (Freon 14)	75730	88.00	1.51E-01	E
Carbonyl sulfide (Carbon oxysulfide)[c]	463581	60.08	1.22E-01	A
Chlorobenzene	108907	112.56	4.84E-01	A
Chlorodifluoromethane (Freon 22)[c]	75456	86.47	7.96E-01	D
Chloroethane (Ethyl chloride)[c]	75003	64.51	3.95E+00	B
Chloromethane (Methyl chloride)[c]	74873	50.49	2.44E-01	B
cis-1,2-Dichloroethene	156592	96.94	1.24E+00	B
cis-1,2-Dimethylcyclohexane	2207014	112.21	8.10E-02	D
cis-1,3-Dichloropropene	10061015	110.97	3.03E-03	D
cis-1,3-Dimethylcyclohexane	638040	112.21	5.01E-01	D
cis-1,4-Dimethylcyclohexane / trans-1,3-Dimethylcyclohexane	624293 / 2207036	112.21	2.48E-01	D
cis-2-Butene	590181	56.11	1.05E-01	D
cis-2-Heptene	6443921	98.19	2.45E-02	E
cis-2-Hexene	7688213	84.16	1.72E-02	D
cis-2-Octene	7642048	112.21	2.20E-01	D
cis-2-Pentene	627203	70.13	4.79E-02	D
cis-3-Methyl-2-pentene	922623	84.16	1.79E-02	D
Cyclohexane	110827	84.16	1.01E+00	B
Cyclohexene	110838	82.14	1.84E-02	D

Table 2.4-1(CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE ON OR AFTER 1992				
Compound	CAS Number	Molecular Weight	Default Concentration (ppmv)	Recommended Emission Factor Rating
Cyclopentane	287923	70.13	2.21E-02	D
Cyclopentene	142290	68.12	1.21E-02	D
Decane	124185	142.28	3.80E+00	D
Dibromochloromethane	124481	208.28	1.51E-02	D
Dibromomethane (Methylene dibromide)	74953	173.84	8.35E-04	E
Dichlorobenzene[c,e]	106467	147.00	9.40E-01	A
Dichlorodifluoromethane (Freon 12)	75718	120.91	1.18E+00	B
Dichloromethane (Methylene chloride)[c]	75092	84.93	6.15E+00	A
Diethyl sulfide	352932	90.19	8.62E-02	E
Dimethyl disulfide	624920	94.20	1.37E-01	A
Dimethyl sulfide	75183	62.14	5.66E+00	A
Dodecane (n-Dodecane)	112403	170.33	2.21E-01	D
Ethane	74840	30.07	9.05E+00	D
Ethanol	64175	46.07	2.30E-01	D
Ethyl acetate	141786	88.11	1.88E+00	C
Ethyl mercaptan (Ethanediol)	75081	62.14	1.98E-01	A
Ethyl methyl sulfide	624895	76.16	3.67E-02	E
Ethylbenzene[c]	100414	106.17	4.86E+00	B
Formaldehyde[c]	50000	30.03	1.17E-02	D
Heptane	142825	100.20	1.34E+00	B
Hexane[c]	110543	86.18	3.10E+00	B
Hydrogen sulfide	7783064	34.08	3.20E+01	A
Indane (2,3-Dihydroindene)	496117	34.08	6.66E-02	D
Isobutane (2-Methylpropane)	75285	58.12	8.16E+00	D
Isobutylbenzene	538932	134.22	4.07E-02	D
Isoprene (2-Methyl-1,3-butadiene)	78795	68.12	1.65E-02	D
Isopropyl mercaptan	75332	76.16	1.75E-01	A
Isopropylbenzene (Cumene)[c]	98828	120.19	4.30E-01	D
Mercury (total)[c]	7439976	200.59	1.22E-04	B
Mercury (elemental)[c]	7439976	200.59	7.70E-05	C
Mercury (monomethyl)[c]	51176126	216.63	3.84E-07	C
Mercury (dimethyl)[c]	627441	258.71	2.53E-06	B
Methanethiol (Methyl mercaptan)	74931	48.11	1.37E+00	A
Methyl tert-butyl ether (MTBE)[c]	1634044	88.15	1.18E-01	D
Methylcyclohexane	108872	98.19	1.29E+00	D
Methylcyclopentane	96377	84.16	6.50E-01	D
Naphthalene[c]	91203	128.17	1.07E-01	D
n-Butylbenzene	104518	134.22	6.80E-02	D
Nonane	111842	128.26	2.37E+00	D
n-Propylbenzene (Propylbenzene)	103651	120.19	4.13E-01	D
Octane	111659	114.23	1.08E+00	D
p-Cymene (1-Methyl-4-lsopropylbenzene)	99876	134.22	3.58E+00	D
Pentane	109660	72.15	4.46E+00	C
Propane	74986	44.10	1.55E+01	C
Propene	115071	42.08	3.32E+00	D
Propyne	74997	40.06	3.80E-02	E
sec-Butylbenzene	135988	134.22	6.75E-02	D

Table 2.4-1(CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE ON OR AFTER 1992				
Compound	CAS Number	Molecular Weight	Default Concentration (ppmv)	Recommended Emission Factor Rating
Styrene (Vinylbenzene)[c]	100425	104.15	4.11E-01	B
Tetrachloroethylene (Perchloroethylene)[c]	127184	165.83	2.03E+00	A
Tetrahydrofuran (Diethylene oxide)	109999	72.11	9.69E-01	C
Thiophene	110021	84.14	3.49E-01	E
Toluene (Methyl benzene)[c]	108883	92.14	2.95E+01	A
trans-1,2-Dichloroethene	156605	96.94	2.87E-02	C
trans-1,2-Dimethylcyclohexane	6876239	112.21	4.04E-01	D
trans-1,3-Dichloropropene	10061026	110.97	9.43E-03	D
trans-1,4-Dimethylcyclohexane	2207047	112.21	2.05E-01	D
trans-2-Butene	624646	56.11	1.04E-01	D
trans-2-Heptene	14686136	98.19	2.50E-03	E
trans-2-Hexene	4050457	84.16	2.06E-02	D
trans-2-Octene	13389429	112.21	2.41E-01	D
trans-2-Pentene	646048	70.13	3.47E-02	D
trans-3-Methyl-2-pentene	616126	84.16	1.55E-02	D
Tribromomethane (Bromoform)[c]	75252	252.73	1.24E-02	D
Trichloroethylene (Trichloroethene)[c]	79016	131.39	8.28E-01	A
Trichlorofluoromethane (Freon 11)	91315616	137.37	2.48E-01	B
Trichloromethane (Chloroform)[c]	8013545	119.38	7.08E-02	A
Undecane	1120214	156.31	1.67E+00	D
Vinyl acetate[c]	85306269	86.09	2.48E-01	C
Vinyl chloride (Chloroethene)[c]	75014	62.50	1.42E+00	A
Xylenes (o-, m-, p-, mixtures)	8026093	106.17	9.23E+00	A

NOTE: This is not an all-inclusive list of potential LFG constituents, only those for which test data were available at multiple sites. References 83-148.

[a] For NSPS/Emission Guideline compliance purposes, the default concentration for NMOC as specified in the final rule must be used.

[b] Calculated as 99.7% of NMOC, based on speciated emission test data.

[c] Hazardous Air Pollutant listed in Title III of the 1990 Clean Air Act Amendments.

[d] All tests below detection limit. Method detection limits are available for three tests, and are as follows: MDL = 2.00E-04, 4.00E-03, and 2.00E-02 ppm

[e] Many source tests did not indicate whether this compound was the ortho-, meta-, or para- isomer. The para isomer is a Title III listed HAP.

Table 2.4-2. DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992 (SCC 50100402, 50300603)			
Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
NMOC (as hexane)[e]	86.18		
Co-disposal (SCC 50300603)		2,420	D
No or Unknown co-disposal (SCC 50100402)		595	B
1,1,1-Trichloroethane (methyl chloroform)[a]	133.42	0.48	B
1,1,2,2-Tetrachloroethane[a]	167.85	1.11	C
1,1-Dichloroethane (ethylidene dichloride)[a]	98.95	2.35	B
1,1-Dichloroethene (vinylidene chloride)[a]	96.94	0.20	B

Table 2.4-2 (CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992 (SCC 50100402, 50300603)			
Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
1,2-Dichloroethane (ethylene dichloride)[a]	98.96	0.41	B
1,2-Dichloropropane (propylene dichloride)[a]	112.98	0.18	D
2-Propanol (isopropyl alcohol)	60.11	50.1	E
Acetone	58.08	7.01	B
Acrylonitrile[a]	53.06	6.33	D
Benzene[a]	78.11		
Co-disposal (SCC 50300603)		11.1	D
No or Unknown co-disposal (SCC 50100402)		1.91	B
Bromodichloromethane	163.83	3.13	C
Butane	58.12	5.03	C
Carbon disulfide[a]	76.13	0.58	C
Carbon monoxide[b]	28.01	141	E
Carbon tetrachloride[a]	153.84	0.004	B
Carbonyl sulfide[a]	60.07	0.49	D
Chlorobenzene[a]	112.56	0.25	C
Chlorodifluoromethane	86.47	1.30	C
Chloroethane (ethyl chloride)[a]	64.52	1.25	B
Chloroform[a]	119.39	0.03	B
Chloromethane	50.49	1.21	B
Dichlorobenzene[c]	147	0.21	E
Dichlorodifluoromethane	120.91	15.7	A
Dichlorofluoromethane	102.92	2.62	D
Dichloromethane (methylene chloride)[a]	84.94	14.3	A
Dimethyl sulfide (methyl sulfide)	62.13	7.82	C
Ethane	30.07	889	C
Ethanol	46.08	27.2	E
Ethyl mercaptan (ethanethiol)	62.13	2.28	D
Ethylbenzene[a]	106.16	4.61	B
Ethylene dibromide	187.88	0.001	E
Fluorotrichloromethane	137.38	0.76	B
Hexane[a]	86.18	6.57	B
Hydrogen sulfide	34.08	35.5	B
Mercury (total)[a,d]	200.61	2.92×10^{-4}	E
Methyl ethyl ketone[a]	72.11	7.09	A
Methyl isobutyl ketone[a]	100.16	1.87	B
Methyl mercaptan	48.11	2.49	C

Table 2.4-2 (CONTINUED). DEFAULT CONCENTRATIONS FOR LFG CONSTITUENTS FOR LANDFILLS WITH WASTE IN PLACE PRIOR TO 1992

(SCC 50100402, 50300603)

Compound	Molecular Weight	Default Concentration (ppmv)	Emission Factor Rating
Pentane	72.15	3.29	C
Perchloroethylene (tetrachloroethylene)[a]	165.83	3.73	B
Propane	44.09	11.1	B
t-1,2-dichloroethene	96.94	2.84	B
Toluene[a]	92.13		
Co-disposal (SCC 50300603)		165	D
No or Unknown co-disposal (SCC 50100402)		39.3	A
Trichloroethylene (trichloroethene)[a]	131.38	2.82	B
Vinyl chloride[a]	62.50	7.34	B
Xylenes[a]	106.16	12.1	B

NOTE: This is not an all-inclusive list of potential LFG constituents, only those for which test data were available at multiple sites. References 16-82. Source Classification Codes in parentheses.
[a] Hazardous Air Pollutants listed in Title III of the 1990 Clean Air Act Amendments.
[b] Carbon monoxide is not a typical constituent of LFG, but does exist in instances involving landfill (underground) combustion. Therefore, this default value should be used with caution. Of 18 sites where CO was measured, only 2 showed detectable levels of CO.
[c] Source tests did not indicate whether this compound was the para- or ortho- isomer. The para isomer is a Title III-listed HAP.
[d] No data were available to speciate total Hg into the elemental and organic forms.
[e] For NSPS/Emission Guideline compliance purposes, the default concentration for NMOC as specified in the final rule must be used. For purposes not associated with NSPS/Emission Guideline compliance, the default VOC content at co-disposal sites can be estimated by 85 percent by weight (2,060 ppmv as hexane); at No or Unknown sites can be estimated by 39 percent by weight 235 ppmv as hexane).

Table 2.4-3. CONTROL EFFICIENCIES FOR LFG NMOC and VOC[a]

Control Device	Control Efficiency (%)[b]		
	Typical	Range	Rating
Boiler/Steam Turbine (50100423)	98.6	96-99+	D
Flare[c] (50100410) (50300601)	97.7	86-99+	A
Gas Turbine (50100420)	94.4	92-97	E
IC Engine (50100421)	97.2	95-99+	D

[a] References 16-148. Source Classification Codes in parentheses.

[b] Control efficiency may also be applied to LFG constituents in Tables 2-4.1 and 2.4-2, except for mercury. For any combustion equipment, the control efficiency for mercury should be assumed to be 0.
[c] Where information on equipment was given in the reference, test data were taken from enclosed flares. Control efficiencies are assumed to be equally representative of open flares.

Table 2.4-4. EMISSION FACTORS FOR SECONDARY COMPOUNDS EXITING CONTROL DEVICES[a]

Control Device	Pollutant[b]	Typical Rate, kg/10^6 dscm CH_4	Typical Rate, lb/10^6 dscf CH_4	Emission Factor Rating
Flare[c]	Nitrogen dioxide	631	39	A
(50100410)	Carbon monoxide	737	46	A
(50300601)	Particulate matter	238	15	A
	Dioxin/Furan	6.7×10^{-6}	4.2×10^{-7}	E
IC Engine	Nitrogen dioxide	11,620	725	C
(50100421)	Carbon monoxide	8,462	528	C
	Particulate matter	232	15	D
Boiler/Steam Turbine[d]	Nitrogen dioxide	677	42	D
(50100423)	Carbon monoxide	116	7	D
	Particulate matter	41	3	D
	Dioxin/Furan	5.1×10^{-6}	3.2×10^{-7}	D
Gas Turbine	Nitrogen dioxide	1,400	87	D
(50100420)	Carbon monoxide	3,600	230	E
	Particulate matter	350	22	E

[a] Source Classification Codes in parentheses.
[b] No data on PM size distributions were available, however for other gas-fired combustion sources, most of the particulate matter is less than 2.5 microns in diameter. Hence, this emission factor can be used to provide estimates of PM-10 or PM-2.5 emissions. See section 2.4.4.2 for methods to estimate CO_2, SO_2, and HCl.
[c] Where information on equipment was given in the reference, test data were taken from enclosed flares. Control efficiencies are assumed to be equally representative of open flares.
[d] All source tests were conducted on boilers, however emission factors should also be representative of steam turbines. Emission factors are representative of boilers equipped with low-NO_x burners and flue gas recirculation. No data were available for uncontrolled NO_x emissions.

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110. TR-181. The Mid-Valley Sanitary Landfill Gas Flare No.1 (McGill) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

111. TR-182. The Mid-Valley Sanitary Landfill Gas Flare No.2 (SurLite) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

112. TR-183. Annual Emissions Test of Landfill Gas Flare #2 Bradley Landfill, Waste Management Recycling and Disposal Services of California, Inc., 4/13/99.

113. TR-187. Emissions Test of a Landfill Gas Flare - Lowry Landfill/Denver-Arapohoe Disposal Site, Sur-Lite Corporation, February 1997.

114. TR-188. Characterization of Emissions from a Power Boiler Fired with Landfill Gas, Environment Canada Emissions Research and Measurement Division, March 2000.

115. TR-189. Characterization of Emissions from 925 kWe Reciprocating Engine Fired with Landfill Gas, Environment Canada Emissions Research and Measurement Division, December 2000.

116. TR-190. Characterization of Emissions from 812 kWe Reciprocating Engine Fired with Landfill Gas, Environment Canada Emissions Research and Measurement Division, December 1999.

117. TR-191. Characterization of Emissions from Enclosed Flare - Trail Road Landfill, Environment Canada Emissions Research and Measurement Division, August 2000.

118. TR-194. Characterization of Emissions from 1 MWe Reciprocating Engine Fired with Landfill Gas, Environment Canada Emissions Research and Measurement Division, January 2002.

119. TR-195. Characteristics of Semi-volatile Organic Compounds from Vented Landfills, Environment Canada Environmental Technology Advancement Directorate, August 1996.

120. TR-196. Results of the Biennial Criteria and AB 2588 Air Toxics Source Test on the Simi Valley Landfill Flare, Simi Valley Landfill and Recycling Center, April 1997.

121. TR-199. Emission Compliance Test on a Landfill Flare, City of Los Angeles, January 1999.

122. TR-205. The Mid-Valley Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results, Bryan A. Stirrat & Associates, 9/29/98.

123. TR-207. Compliance Source Test Report Landfill Gas-fired Flare Stations I-4 and F-2, BKK Landfill, 12/12/97.

124. TR-209. Emission Test Report Volumes I and II - Source/Compliance Emissions Testing for Cedar Hills Landfill, King County Solid Waste Division, 1/20/05.

125. TR-211. Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills, Washington State Department of Ecology, July 2003.

126. TR-212. Determination of Total, and Monomethyl Mercury in Raw Landfill Gas at the Central Solid Waste Management Center, Delaware Solid Waste Authority, February 2003.

127. TR-220. SCAQMD Performance Tests on the Spadra Energy Recovery from Landfill Gas (SPERG) Facility, County Sanitation Districts of Los Angeles County, April 1992.

128. TR-226. Methane and Nonmethane Organic Destruction Efficiency Tests of an Enclosed Landfill Gas Flare, Newco Waste Systems, April 1992.

129. TR-229. Scholl Canyon Landfill Gas Flares No. 9, 10 11 and 12 Emission Source Testing April 1999, South Coast Air Quality Management District, April 1999.

130. TR-236. Landfill Gas Flare Hydrogen Chloride Emissons Atascocita Landfill, Waste Management of Houston, 4/20/99.

131. TR-241. Performance Evaluation, Enclosed Landfill Gas Flare, Valley Landfill, Waste Energy Technology, November 1991.

132. TR-251. Emission Compliance Test on a Landfill Gas Flare - Flare #1, Frank R. Bowerman Landfill, Orange County, 1/25/99.

133. TR-253. Emission Source Testing on Two Flares (Nos. 3 and 6) at the Spadra Landfill, Los Angeles County Sanitation Districts, 7/21/98.

134. TR-255. Emission Compliance Test on a Landfill Gas Flare -Olinda Alpha Landfill, Orange County Integrated Waste Management Department, No Report Date Given.

135. TR-258. Source Test Report, City of Sacramento Landfill Gas Flare, City of Sacramento, 6/26/96.

136. TR-259. The Millikan Sanitary Landfill Gas Flare No. 1 (Surlite) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

137. TR-260. The Millikan Sanitary Landfill Gas Flare No. 2 (John Zink) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

138. TR-261. The Millikan Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results, South Coast Air Quality Management District, 9/29/98.

139. TR-264. Emission Compliance Test on a Landfill Gas Flare, Orange County Integrated Waste Management Department, No Report Date Given.

140. TR-266. Compliance Source Test Report - Landfill Gas-Fired Engine, Minnesota Methane, 3/3/98.

141. TR-268. Emission Testing at PERG - Maximum Boiler Load, County Sanitation Districts of Los Angeles County, December 1986.

142. TR-272. Source Testing Final Report - Landfill A, US EPA Air Pollution Prevention and Control Division, 10/6/05.

143. TR-273. Source Testing Final Report - Landfill B, US EPA Air Pollution Prevention and Control Division, 10/6/05.

144. TR-284. Source Testing Final Report - Landfill C, US EPA Air Pollution Prevention and Control Division, 10/6/05.

145. TR-287. Source Testing Final Report - Landfill D, US EPA Air Pollution Prevention and Control Division, 10/6/05.

146. TR-290. San Timoteo Sanitary Landfill 1998 Source Test Results, San Bernandino County Solid Waste Management, 9/29/98.TR-291. PCDD/PCDF Emissions Tests on the Palos Verdes Energy Recovery from Landfill Gas (PVERG) Facility, Unit 2, County Sanitation Districts of Los Angeles County, February 1994.

147. TR-292. Source Testing Final Report - Landfill E, US EPA Air Pollution Prevention and Control Division, October 2005

148. TR-293. *Quantifying Uncontrolled Air Emissions From Two Florida Landfills* – Draft Final Report. U.S. EPA Air Pollution Prevention and Control Division, March 26, 2008.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
1	Scholl Canyon	California	Benzene Carbon dioxide Carbon tetrachloride Chloroform Methane PCE TCA TNMHC Toluene Vinyl chloride	Flare	Benzene Carbon dioxide Carbon tetrachloride Chloroform Methane PCE TCA TNMHC Toluene Vinyl chloride	Test date 8/1/86. 2 of 4 flares operating day of test.
3	Palos Verdes	California		Turbine/flare	1,1-Dichloroethene 1,2-Dichloroethane Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbonyl sulfide Dimethyl sulfide Ethyl mercaptan Hydrogen sulfide Methane Methyl mercaptan Nitrogen oxides PCE TCA TCE Toluene Vinyl chloride	Test date 3/6/84. CO determined by TCA Method.
4	Puente Hills	California	Carbon dioxide Methane Oxygen TNMHC	Turbine	Carbon dioxide Carbon monoxide Nitrogen oxide Oxygen Sulfur dioxide THC Total particulate	Test dates 7/31/84 and 8/3/84; results from two turbines.
5	Mountaingate	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride	Flare		Test date 10/15/84. Flare not operative day of testing.
6	Bradley Pit	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Chloroform Dimethyl sulfide Hydrogen sulfide Methane Methyl mercaptan PCE t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride	Boiler/flare		Test date 2/15/85. Gas (and test results) from active and inactive sections of landfill.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
7	Calabasas	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride	Flare	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride	Test dates 7/31/85, 9/4/84. 6 flares operating, station #1 sampled both dates.
8	Operating Industries	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCA TCE Toluene Vinyl chloride	Flare	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCA TCE Toluene Vinyl chloride	Test date 9/11/85. 82 wells, 3 flares. Tested 1 flare. CO determined by TCA Method.
9	Sheldon Street	California	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCA TCE Toluene Vinyl chloride	Flare	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCA TCE Toluene Vinyl chloride	Test date 11/5/85. Landfill inactive for 10 years; two gas collection and flare stations. One flare tested. CO determined by TCA Method.
10	Mission Canyon	California	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE TCA TCE Toluene Vinyl chloride	Flare	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE TCA TCE Toluene Vinyl chloride	Test date 12/6/85. Inactive landfill. CO determined by TCA Method.
12	BKK Corporation	California	TCA 1,2-Dichloroethane Benzene Carbon monoxide Carbon tetrachloride Chloroform Furans Methylene chloride Nitrogen oxides PCE TCE Toluene Vinyl chloride	Flare	TCA 1,2-Dichloroethane Benzene Carbon monoxide Carbon tetrachloride Chloroform Dioxins Furans HCl Methylene chloride Nitrogen oxides PCE Toluene	Test dates 3/3/86 through 3/7/86; tested Flare #6. CO determined by TCA Method.
13	Syufy Enterprises	California	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE TCA TCE Toluene Vinyl chloride	Flare	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE TCA TCE Toluene Vinyl chloride	Test date 7/10/86. Lines from peripheral and interior wells combined. Inactive landfill.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
15	Azusa Land Reclamation	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon disulfide Carbon tetrachloride Carbonyl sulfide Chloroform Dimethyl sulfide Hydrogen sulfide Methane Methyl mercaptan PCE TCA TCE Toluene Vinyl chloride	Flare	TCA Benzene Carbon tetrachloride Chloroform PCE TCE Toluene Vinyl chloride	Test dates 6/17/83, 8/29/84, 11/1/84, 7/12/85, 5/7/86. Sales gas results combined with raw gas results as uncontrolled.
17	Bradley Pit	California	1,1-Dichloroethene 1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Methane PCE TCA TCE Toluene Vinyl chloride	Boiler/flare		Test date 3/20/84. Active and inactive landfill sections. Flare not operating.
18	Puente Hills	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform PCE t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride	Flare/turbine	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE TCA TCE Toluene Vinyl chloride	Test date 2/6/85. Active landfill; two gas collection systems and stations. Test conducted at West flaring station (18 flares and 2 turbines). CO determined by TCA Method.
19	Bradley Pit	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Dimethyl sulfide Methane Methyl mercaptan PCE	Boiler/flare		Test date 12/14/84. Active and inactive landfill sections. Flare not operating.
19 cont.	Bradley Pit	California	Sulfur dioxide t-1,2-Dichloroethene TCA TCE Toluene Vinyl chloride			
20	Penrose	California	TCA 1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane PCE t-1,2-Dichloroethene TCE Toluene Vinyl chloride	Boiler/flare		Test date 7/11/84. Inactive landfill; 5 gas collection lines and flares. Flares not sampled due to upcoming modifications.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
22	Palos Verdes	California	TCA 1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCE Toluene Vinyl chloride	Flare	TCA 1,2-Dichloroethane Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Methane Oxygen PCE TCE Toluene Vinyl chloride	Test date 8/14/85. Inactive landfill, 3 flare stations and one turbine. CO determined by TCA Method.
23	Toyon Canyon	California	TCA Benzene Carbon dioxide Carbon tetrachloride Chloroform Methane PCE TCE TNMHC Toluene Vinyl chloride	ICE	Benzene Carbon dioxide Carbon disulfide Carbon tetrachloride Chloroform Dimethyl sulfide Hydrogen sulfide Methane Methyl mercaptan Nitrogen dioxide PCE	Test date 5/16/86. Inactive landfill, 5 ICE's.
24	Puente Hills	California	TCA Benzene Carbon monoxide Carbon tetrachloride Chloroform Dioxins	Flare	TCA Benzene Carbon monoxide Carbon tetrachloride Chloroform Dioxins	Test dates 2/18/86 through 2/21/86. Flare operating at steady state.
24 cont.	Puente Hills	California	Furans PCE TCE Toluene Vinyl chloride		Furans HCl Nitrogen oxide PCE Sulfur dioxide TCE Toluene Vinyl chloride	
26	Confidential	Wisconsin	Carbon dioxide Methane Nitrogen Oxygen TNMOC	Turbine		Test date 8/6/90. U.S. EPA Office of Research and Development.
26	Confidential	Illinois	Carbon dioxide Methane Nitrogen Oxygen TNMOC	Turbine		Test date 8/7/90. U.S. EPA Office of Research and Development.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
26	Confidential	Pennsylvania	Carbon dioxide Methane Nitrogen Oxygen TNMOC	Turbine		Test date 8/8/90. U.S. EPA Office of Research and Development.
26	Confidential	Florida	Carbon dioxide Methane Nitrogen Oxygen TNMOC	Turbine		Test date 8/20/90. U.S. EPA Office of Research and Development.
26	Confidential	California	Carbon dioxide Methane Nitrogen Oxygen TNMOC	Flare		Test date 8/23/90. U.S. EPA Office of Research and Development.
26	Confidential	California	Carbon dioxide Methane Nitrogen Oxygen TNMOC	ICE		Test date 8/24/90. U.S. EPA Office of Research and Development.
27	Lyon Development	Michigan	TCA 1,1-Dichloroethane 1,2-Dichloroethane Benzene Carbon disulfide Carbon tetrachloride Carbonyl sulfide Chlorobenzene Chloroform Dimethyl disulfide Dimethyl sulfide	None		Test date 8/21/90. Two wells sampled by canister.
27 cont.	Lyon Development	Michigan	Ethylbenzene Hydrogen sulfide m+p-Xylene Methyl mercaptan Methylene chloride o-Xylene PCE t-1,2-Dichloroethene TCE Toluene Vinyl chloride			

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
41	Bradley Pit	California	TCA	Boiler/flare	TCA	Test dates 10/2/85 and 1/24/86.
			Benzene		Benzene	Questionnaire response.
			Butane		Butane	Scrubber operative 10/2/85.
			Carbon dioxide		Carbon dioxide	Flare operativewith no visible
			Carbon monoxide		Carbon monoxide	flame 1/24/86 test. CO
			Carbon tetrachloride		Carbon tetrachloride	determined by TCA Method.
			Chloroform		Chloroform	
			Ethane		Ethane	
			Heptanes		Heptanes	
			Hexanes		Hexanes	
			Methane		Methane	
			Nitrogen		Nitrogen	
			Nonanes		Nonanes	
			Octanes		Octanes	
			Oxygen		Oxygen	
			PCE		PCE	
			Pentane		Pentane	
			Propane		Propane	
			TCE		TCE	
			TNMHC		TNMHC	
			Toluene		Toluene	
			Vinyl chloride		Vinyl chloride	
41	Guadalupe Landfill		1,1-Dichloroethene	ICE	1,1-Dichloroethene	Test date 7/25/84.
			1,2 Dimethyl cyclohexane		1,2 Dimethyl cyclohexane	Questionnaire response.
			1,3 Dimethyl cyclohexane		1,2,4-Trimethyl cyclopentane	
			1-Butanol		1,3 Dimethyl cyclohexane	
			1-Propanol		1-Butanol	
			2,4 Dimethyl heptane		1-Propanol	
			2-Butanol		2,4 dimethyl heptane	
			2-Butanone		2-Butanol	
			2-Methyl-methylester		2-Butanone	
			2-Methyl heptane		2-Methyl-methylester	
			2-Methyl propane		2-Methyl heptane	
			2-Propanol		2-Methyl propane	
			3-Carene		2-Propanol	
			Butylester butanoic acid		3-Carene	
			Carbon dioxide		Butane	
			Chloroethene		Butylester butanoic acid	
41 cont.	Guadalupe Landfill		Dichloromethane		Carbon dioxide	
			Ethanol		Chlorodifluoromethane	
			Ethyl benzene		Chloroethene	
			Ethylester acetic acid		Dichloromethane	
			Ethylester propanoic acid		Ethanol	
			Hydrogen		Ethyl benzene	
			Isooctanol		Ethylester acetic acid	
			Methane		Ethylester propanoic acid	
			Methylester acetic acid		Furan	
			Methylester butanoic acid		Hydrogen	
			Nitrogen		Isooctanol	
			Oxygen		Methane	
			Propane		Methylester acetic acid	
			Propanoic acid		Methylester butanoic acid	
			Propylester acetic acid		Nitrogen	
			Propylester butanoic acid		Oxygen	
			Tetrachloroethene		Propane	
			Tetrahydrofuran		Propanoic acid	
			Thiobismethane		Propylester acetic acid	
			TNMHC		Propylester butanoic acid	
			Toluene		Tetrachloroethene	
			Trichloroethene		Tetrahydrofuran	
			Xylene		Thiobismethane	
					TNMHC	
					Toluene	
					Trichloroethene	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
43	34- Confidential	Confidential	TCA	Varies--		
			1,1,2,2-Tetra-chloroethane	uncontrolled		
			1,1,2-Trichloroethane	data only.		
			1,1-Dichloroethane			
			1,1-Dichloroethene			
			1,2-Dichlorobenzene			
			1,2-Dichloroethane			
			1,2-Dichloropropane			
			1,3-Dichlorobenzene			
			1,3-Dichloropropane			
			1,4-Dichlorobenzene			
			2-Chloroethylvinyl ether			
			Acetone			
			Acrolein			
			Acrylonitrile			
			Benzene			
			Bromodichloromethane			
			Bromoform			
			Bromomethane			
			Butane			
			Carbon dioxide			
			Carbon tetrachloride			
			Chlorobenzene			
43 cont.	34- Confidential	Confidential	Chlorodibromomethane			
			Chlorodifluoromethane			
			Chloroethane			
			Chloroform			
			Chloromethane			
			Dichlorodifluoromethane			
			Ethanol			
			Ethylbenzene			
			Flurotrichloromethane			
			Hexane			
			Methane			
			Methyl ethyl ketone			
			Methyl isobutyl ketone			
			Methylene chloride			
			Pentane			
			Propane			
			t-1,2-Dichloroethene			
			Tetrachloroethene			
			Toluene			
			Trichloroethene			
			Vinyl chloride			
			Xylene			
48	Calabasas Landfill	California	TCA	Flare	TCA	Test date 10/9/87. Active landfill; 6 flares, 3 operational day of testing.
			Benzene		Benzene	
			Carbon dioxide		Carbon dioxide	
			Carbon disulfide		Carbon disulfide	
			Carbon monoxide		Carbon monoxide	
			Carbon tetrachloride		Carbon tetrachloride	
			Carbonyl sulfide		Carbonyl sulfide	
			Chloroform		Chloroform	
			Dimethyl sulfide		Dimethyl sulfide	
			Hydrogen sulfide		Hydrogen sulfide	
			Methane		Methane	
			Methyl mercaptan		Methyl mercaptan	
			PCE		PCE	
			TCE		TCE	
			TNMHC		TNMHC	
			Toluene		Toluene	
			Vinyl chloride		Vinyl chloride	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
49	Scholl Canyon	California	TCA Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chloroform Dimethyl sulfide Hydrogen sulfide Methane	Flare	TCA Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chloroform Dimethyl sulfide Hydrogen sulfide Methane	Test date 10/15/87. Active landfill, 4 operational flares and 2 standbys. Flare #2 tested.
49 cont.	Scholl Canyon	California	PCE TCE TNMHC Toluene Vinyl chloride Xylene		PCE TCE TNMHC Toluene Vinyl chloride Xylene	
50	Puente Hills	California	TCA 1,2 Dichloroethane Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chloroform Dimethyl sulfide Hydrogen sulfide Methane Methyl mercaptan PCE t-1,2 Dichloroethene TCE TNMHC Toluene Trichloroethane Vinyl chloride Xylene	Turbine/flare	TCA 1,2 Dichloroethane Benzene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chloroform Dimethyl sulfide Hydrogen sulfide Methane Methyl mercaptan PCE t-1,2 Dichloroethene TCE TNMHC Toluene Trichloroethane Vinyl chloride Xylene	Test date 12/1/87. Active landfill, tested flare #23 and solar turbine tested.
51	Palos Verdes	California	TCA Benzene Carbon tetrachloride Chloroform Hydrogen sulfide Methane PCE TCE TNMHC Toluene Vinyl chloride Xylene	Flare	TCA Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Hydrogen sulfide Methane PCE TCE TNMHC Toluene Vinyl chloride Xylene	Test date 11/16/87. Inactive landfill, 3 flare stations (flare station 1 not operating day of testing). Flare stations 2 and 3 tested.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
53	Altamont	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon tetrachloride Chloroform Ethylene dibromide Methane Methyl chloroform Methylene chloride	Flare	Carbon dioxide Carbon monoxide NOx Oxygen THC TNMOC	Test date: 4/7/88. O_2 determined by BAAQMD Method ST-14. CO_2 determined by BAAQMD Method ST-5. NOx determined by BAAQMD Method ST-13A. THC and THMOC determined by BAAQMD Method ST-7.
53 cont.	Altamont	California	Nitrogen Oxygen PCE TCA TCE Vinyl chloride			CO determined by BAAQMD Method ST-C.
54	Arbor Hills	Michigan	1,1-Dichloroethane 1,2-Dichloroethane Benzene Carbon disulfide Carbon tetrachloride Carbonyl sulfide Chlorobenzene Chloroform Dimethyl disulfide Dimethyl sulfide Ethylbenzene Ethylene dibromide Hydrogen sulfide Methyl chloroform Methyl mercaptan Methylene chloride PCE TCE Toluene Vinyl chloride Vinylidene chloride Xylenes	Flare	1,1-Dichloroethane 1,2-Dichloroethane Benzene Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chlorobenzene Chloroform Dimethyl disulfide Dimethyl sulfide Ethylbenzene Ethylene dibromide HCL Hydrogen sulfide Methyl chloroform Methyl mercaptan Methylene chloride NOx PCB PCE Quartz TCE TNMOC Toluene Vinyl chloride Vinylidene chloride Xylenes Zinc	
55	BFI Facility,	MA	1,1-Dichloroethane 1,2-Dichloroethane Benzene Benzyl chloride Carbon tetrachloride Chlorobenzene Chloroform Dichlorobenzene Dichloromethane Dimethyl sulfide Ethyl mercaptan Hydrogen sulfide Methyl chloroform Methyl mercaptan PCE TCE Toluene	Flare	1,1-Dichloroethane 1,2-Dichloroethane Benzene Benzyl chloride Carbon monoxide Carbon tetrachloride Chlorobenzene Chloroform Dichlorobenzene Dichloromethane Dimethyl sulfide Ethyl mercaptan HCl Hydrogen sulfide Methyl chloroform Methyl mercaptan NOx	Test date: 7/15/90. NOx determined by EPA Method 7A.
55 cont.	BFI Facility,	MA	Vinyl chloride Vinylidene chloride Xylene		PCE TCE Toluene Vinyl chloride Vinylidene chloride Xylene	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
56	Coyote Canyon	California	1,1-Dichloroethane 1,1-Dichloroethylene 1,2-Dichloroethane Acetonitrile Benzene Benzyl chloride Carbon disulfide Carbon tetrachloride Chlorobenzene Chloroform Dichlorobenzene Dichloromethane Dimethyl disulfide Dimethyl sulfide Ethyl mercaptan Hydrogen sulfide Methane Methyl chloroform Methyl mercaptan PCE Sulfur TCA TCE TGNMO Toluene Vinyl chloride Xylenes	Boiler/Flare	1,1-Dichloroethane 1,1-Dichloroethylene 1,2-Dichloroethane Acetonitrile Arsenic Benzene Benzyl chloride Beryllium Cadmium Carbon disulfide Carbon monoxide Carbon tetrachloride Chlorobenzene Chloroform Chromium Copper Dichlorobenzene Dichloromethane Dimethyl disulfide Dimethyl sulfide Ethyl mercaptan Formaldehyde HCl Hydrogen sulfide Manganese Mercury Methane Methyl chloroform Napthalene Nickel Nitrogen NOx Oxygen PAH Particulate matter PCE Selenium Sulfur dioxide TCE TGNMO Toluene Total chromium Vinyl chloride Xylenes	Test date: 6/6 -14/91. Tested flare #1. Test results were evaluated seperately for Low flow & High flow rate runs. NOx & CO were analyzed using CARB Method 100 (Chamilum & GFC NDIR).
57	Durham Rd.	California	1,2-Dichloroethane Benzene Carbon dioxide Carbon tetrachloride Chloroform Ethylene dibromide Methane Methyl chloroform Methylene chloride Nitrogen Oxygen PCE TCE Vinyl chloride	Flare	1,2-Dichloroethane Benzene Carbon dioxide Carbon tetrachloride Chloroform Ethylene dibromide Methane Methyl chloroform Methylene chloride Nitrogen Oxygen PCE TCE Vinyl chloride	Test date: 9/1/88. O_2 and CO_2 determined by BAAQMD Method ST-24.
58	Otay	California	Benzene Carbon tetrachloride Chloroform Ethylene dibromide Ethylene dichloride Methyl chloroform Methylene chloride PCE TCE Vinyl chloride	Engine	Benzene Carbon tetrachloride Chloroform Ethylene dibromide Ethylene dichloride Methyl chloroform Methylene chloride PCE TCE Vinyl chloride	Test date: June 87.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
59	Rockingham	Vermont	1,1,2.2-Tetrachloroethane 1,1-Dichloroethane 1,2-Dichloroethane Acetone Acrylonitrile Benzene Carbon tetrachloride Chlorobenzene Chloroform Dichlorobenzene Ethyl benzene Methyl chloroform Methyl ethyl ketone Methylene chloride PCE Sulfur dioxide TCE Toluene Vinyl chloride Xylenes	Flare	1,1,2.2-Tetrachloroethane 1,1-Dichloroethane 1,2-Dichloroethane Acetone Acrylonitrile Benzene Carbon tetrachloride Chlorobenzene Chloroform Dichlorobenzene Ethyl benzene HCl HF Methyl chloroform Methyl ethyl ketone Methylene chloride NMO PCE Sulfur dioxide TCE TNMOC Toluene Vinyl chloride Xylenes	Test date: 8/9-10/90. SO_2 determined by EPA Method 8.
60	Sunshine Canyon	California	2-Propanol benzene Butane Dimethyl sulfide Ethanol Ethyl benzene Ethyl mercaptan Hydrogen sulfide Methane Methyl mercaptan PCE Phenol Propyl mercaptan TCE Toluene Xylenes	Flare	2-Propanol Butane Carbon monoxide Dimethyl sulfide Ethanol Ethyl benzene Ethyl mercaptan HCl Hydrogen sulfide Methane Methyl mercaptan Nitrogen NOx Oxygen PCE Perticulates Phenol Propyl mercaptan SOx TCE TNMOC Toluene Xylenes	Test date: 5/21-22/90. NOx & CO were analyzed using CARB Method 100.
61	Pinelands	New Jersey	Methane	Flare	Carbon dioxide Carbon monoxide Methane Oxygen THC TNMOC	Test date: 2/28/92. CO analyzed by EPA Method 10.
62	Greentree	Pennsylvania		Flare	TNMHC Methane NOx	Test date: 4/22-23/92. NOx determined by EPA Method. 7D. CH_4 content estimated.
63	Kappaa Quarry	Hawaii		Gas Turbine	Carbon monoxide NOx Sulfur dioxide	Test date: 12/28/93. NOx & CO were analyzed by EPA Method 20 & 3.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
64	Johnston	Rhode Island	Argon Carbon Carbon dioxide Carbon monoxide Ethane Ethene Helium Heptane Hexane Hydrogen Hydrogen sulfide Isobutane Methane n-Pentane Nitrogen NOx Oxygen Propane Propylene TNMHC	IC Engine	Carbon monoxide NOx TNMHC	Test date: 6/4-66/91. Lean combustion. NOx & CO were analyzed by EPA Method 10 &7E (Chemilume & NDIR).
65	CID	Illinois		Gas Turbine	Carbon monoxide Oxygen	Test date: 8/8/89. EPA Method 101
66	CID	Illinois		Gas Turbine	NOx Oxygen Sulfur dioxide	Test date: 7/12-14/89. EPA Method 20.
67	BFI Facility, Chicopee	MA		IC Engine	Carbon monoxide NOx Oxygen Sulfur dioxide TGNMO	Test date: 121493/ Lean combustion. NOx, SO_2 & CO determined by EPA Method 7E, 6C and 10.
68	BFI Facility, Richmond	Virginia		IC Engine	Carbon dioxide NOx Oxygen	Test date: 4/22-23/92. NOx determined by EPA Method 7E. O_2 and CO_2 determined by EPA Method 3A. No engine description.
69	Arizona St.	California	1,2-Dibromoethane 1,2-Dichloroethane Benzene Carbon tetrachloride Chloroform Methyl chloroform Methylene chloride PCE TCE Vinyl chloride	Flare	1,2-Dibromoethane 1,2-Dichloroethane Benzene Carbon monoxide Carbon tetrachloride Chloroform Methyl chloroform Methylene chloride NOx Particulates PCE TCE TNMHC Vinyl chloride	Test date: 6/25-26/90. Methane content unknown. NOx and CO determined by SDAPCD Method 20.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
70	Puente Hills	California	TCA	Boilers	TCA	Test date: 9/29/93.
			1,1-Dichloroethane		1,1-Dichloroethane	NOx & CO were analyzed using
			1,1-Dichloroethene		1,1-Dichloroethene	SCAQMD Method 100.
			1,2-Dibromoethane		1,2-Dibromoethane	
			1,2-Dichloroethane		1,2-Dichloroethane	
			Acetonitrile		Acetonitrile	
			Benzene		Benzene	
			Benzyl chloride		Benzyl chloride	
			Carbon disulfide		Carbon disulfide	
			Carbon tetrachloride		Carbon monoxide	
			Carbonyl sulfide		Carbon tetrachloride	
			Chlorobenzene		Carbonyl sulfide	
			Chloroform		Chlorobenzene	
70 cont.	Puente Hills	California	Dimethyl disulfide		Chloroform	
			Dimethyl sulfide		Dimethyl disulfide	
			Ethyl mercaptan		Dimethyl sulfide	
			Hydrogen sulfide		Ethyl mercaptan	
			m-Dichlorobenzene		Hydrogen sulfide	
			m-Xylenes		m-Dichlorobenzene	
			Methane		m-Xylenes	
			Methyl mercaptan		Methane	
			Methylene chloride		Methyl mercaptan	
			o+p Xylene		Methylene chloride	
			TCE		NMOC	
			PCE		o+p Dichlorobenzene	
			Toluene		o+p Xylene	
			Vinyl chloride		Sulfur dioxide	
					TCE	
					PCE	
					Toluene	
					Vinyl chloride	
71	CID	Illinois		Turbine	Carbon	Test date: 2/16/90.
					Oxygen	O_2 and CO_2 determined by
						EPA Method 3. TGNMO
						determined by EPA Method
					TGNMO	(modified) 25.
72	Tazewell	Illinois		Engine	Carbon monoxide	Test date: 2/22-23/90.
					TGNMO	SO2 determined by EPA
					NO_2	Method 6C. NOx determined
					Sulfur dioxide	by EPA Method 7E. CO
						determined by EPA Method10A.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
73	Scottsville	New York		Engine	1,1,2,2-Tetrachloroethane 1,1,2-Tricitloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane 1,2-Dichloropropene 1,3-Dichloropropene 2'-Chloroethyl vinyl ether Acetone Acrolein Acrylonitrile Benzene Bromodichloromethane Bromoform Bromomethane Carbon monoxide Carbon monoxide Carbon tetrachloride Chlorobenzene Chlorodibromomethane Chloroethane chloroform Chloromethane Dichlorodofluoromethane Ethane Ethylbenzene Flourotrichloromethane Mercaptans Methyl ethyl keytone Methylene chloride	Test date: 5/2/90. Engine No. 2 was used. SO2 determined by EPA Method 6C. NOx determined by EPA Method 7E. CO determined by EPA Method10A. O2 and CO2 determined by EPA Method 3A. Particulates determined by EPA Method 5. VOC was determined by EPA Methods 5040/8240.
73 cont.	Scottsville	New York			n-Butane n-Hexane n-Pentane NO_2 Particulates Propane Sulfur dioxide TCA Tetra chloroethane TGNMO TNMHC Toluene Trans -1,2-dichloroethene Trichloroethene Vinyl chloride Xylene	
74	Tripoli	New York		IC Engine	Carbon monoxide NOx Sulfur dioxide TNMHC	Test date: 4/3-5/89.
75	Oceanside	New York	Hydrogen sulfide	IC Engine	Carbon monoxide NOx Oxygen TNMHC TSP	Test date: 10/6-7/92. NOx & CO were analyzed by EPA Method 7E & 10.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
76	Dunbarton Rd.	New Hampshire	Carbon dioxide Carbon monoxide Hydrogen Methane Nitrogen Oxygen	IC Engine	Carbon dioxide Carbon monoxide Hydrogen Methane NOx Oxygen	Test date: 6/5/90. NOx & O_2 were analyzed by EPA Method 20. CO analyzed by EPA Method 10.
77	Palo Alto	California	1,1-Dichloroethane Acetone Benzene Bromomethane Carbon dioxide Carbon monoxide Ethyl benzene Methane Methylene chloride Nitrogen	Engine	Benzene Carbon dioxide Carbon monoxide Methane NOx Oxygen THC TNMOC VOC	Test date: 6/2/93. Engines No. 1 and 2 used. NOx, O_2, CO_2, CO, and THC were determined by CARB Method 1-100.
77 cont.	Palo Alto	California	Oxygen PCE TCE Toluene Xylenes			
78	Northeast	Rhode Island	Carbon dioxide Ethane Hexane Isobutane Isopentane Methane n-Butane Nitrogen Propane	Engine	Carbon dioxide Carbon monoxide Methane NOx Oxygen TNMHC	Test date: 5/25/94. Engine No. 5 used. O_2 and CO_2 analyzed by EPA Method 3A. NOx analyzed by EPA Method 7E. CO analyzed by EPA Method 10. TNMHC analyzed by EPA Method 18.
79	Johnston	Rhode Island	Argon Carbon Carbon dioxide Carbon monoxide Ethane Ethene Helium Heptane Hexane Hydrogen Hydrogen sulfide Isobutane Methane n-Pentane Nitrogen NOx Oxygen Propane Propylene TNMHC	Engine	Carbon dioxide Carbon monoxide Methane NOx Oxygen THC TNMHC	Test date: 10/9-16/90, and 11/6/90.
80	Bonsal	California		Flare	Carbon monoxide NOx Particulate matter Sulfur dioxide TNMHC TOG	Test date: 4/94. TNMHC determined by EPA Method 25.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
81	Hillsborough	California		Flare	Carbon monoxide NOx Particulate matter Sulfur dioxide TNMHC TOG	Test date: 1/94. TNMHC determined by EPA Method 25.
82	Arizona Street	California		Flare	1,2-dibromoethane 1,2-Dichloroethane Benzene Carbon monoxide Carbon tetrachloride Chloroform Methylene chloride NOx Particulates Sulfur dioxide TCA Tetrachloroethene TNMHC Trichloride Trichloroethene Vinyl chloride	Test date: 3/30-4/7/92. NOx and Carbon monoxide analyzed by SDAPCD Method 20.
83	San Marcos	California		Turbine	Carbon dioxide Carbon monoxide NOx Oxygen	Test date: 3/30/93. Engine No. 1 used. SDAPCD Methods 3A and 20.
84	Otay	California	Benzene Dichloromethane Hydrogen chloride Methylene chloride Sulphur Vinyl chloride	Engine	Benzene Carbon dioxide Carbon monoxide Carbon tetrachloride Chloroform Dichloromethane EDB EDC Formaldehyde HCl Hydrogen chloride Methyl chloroform Methylene chloride NOx Oxygen PCE TCE TNMHC Vinyl chloride	Test date: 10/20-22/87.
85	San Marcos	Cakifornia	Benzene Carbon tetrachloride Chloroform Ethylene dibromide Methylene chloride PCE TCA TCE Vinyl chloroide Vinylidene chloride	Turbine	Benzene Carbon monoxide NOx Sulfur dioxide Vinyl chloroide Vinylidene chloride	Test date: 6/26-27/89.
87	Puente Hills	California	PCB	Flare	Carbon dioxide Carbon monoxide HCl Methane NOx Oxygen PCDD PCDF Sulfur dioxide TNMHC TOC Water	Test date: Flare No. 11 was used.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
88	Spradra	California	1,1-Dichloroethane	Boiler	1,1-Dichloroethane	Test date: 7/25/90.
			1,1-Dichloroethane		1,1-Dichloroethane	
			1,1-Dichloroethene		1,1-Dichloroethene	
			1,2-Dichlorobenzene		1,2-Dichlorobenzene	
			1,3-Dichlorobenzene		1,3-Dichlorobenzene	
			1,4-Dichlorobenzene		1,4-Dichlorobenzene	
			Acetronitrile		Acetronitrile	
			Ammonia		Benzene	
			Benzene		Benzyle chloride	
			Benzyle chloride		Carbon monoxide	
			Carbon dioxide		Carbon tetrachloride	
			Carbon monoxide		Chlorobenzene	
			Carbon tetrachloride		Chloroform	
			Chlorobenzene		Methylene chloride	
			Chloroform		NOx	
			HCl		PAH	
			Methylene chloride		Sulfur dioxide	
			NOx		TCA	
			Sulfur dioxide		Trichloroethene	
			TCA		Vinyl chloride	
			Trichloroethene		Xylenes	
			Vinyl chloride			
			Xylenes			
89	Oxnard	California	Arsenic	IC Engine	Acenaphthene	Test date: 7/23-27/90.
			Beryllium		Acenaphthylene	PAH determined by CARB
			Cadmium		Anthracene	Method 429. Formaldehyde
			Chromium		Arsenic	determined by CARB
			Copper		Benzo(a)anthracene	Method 430. Metals
			Lead		Benzo(a)pyrene	determined by CARB
			Maganese		Benzo(b)floranthene	Method 436. Arsenic
			Mercury		Benzo(g,h,i)perylene	determined by CARB
			Nickel		Benzo(k)floranthene	Method 423. Cromium
			Selenium		Beryllium	determined by CARB
			Zinc		Cadmium	Method 425. HCl
					Chromium	determined by CARB
					Chrysene	Method 421. HF
					Copper	determined by EPA
89 cont.	Oxnard	California			Dibenz(a,h)anthracene	Method 13B.
					Fluoranthene	
					Fluorene	
					Formaldehyde	
					HCl	
					Hydrogen fluoride	
					Indeno(1,2,3-cd)pyrene	
					Lead	
					Manganese	
					Mercury	
					Naphthalene	
					Nickel	
					Phenanthrene	
					Pyrene	
					Selenium	
					Zinc	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
90	Oxnard	California		Engine	TCA	Test date: 10/16/90. Benzene determined by CARB Method 422. Formaldehyde, Acrolin, and Acetaldehyde determined by CARB Method 430. Phenol determined by BAAQMD ST-16.
					1,1,2-Trochloroethane	
					1,1-Dichloroehtene	
					1,1-Dichloroethane	
					1,2-Dibromoethane	
					1,2-Dichloroethane	
					1,2-Dichloropropane	
					1,4-Dichlorobenzene	
					1,4-Dioxane	
					2-Butanone, MEK	
					2-Hexanone	
					2-Methyl phenol	
					3,4-Methyl phenol	
					4-Methyl-2-Pentanone, MIBK	
					Acetaldehyde	
					Acetone	
					Acrolein	
					Acrylonitrile	
					Benzene	
					Bromodichloromethane	
					Butane	
					Carbon dioxide	
					Carbon disulfide	
					Carbontetrachloride	
					Chlorobenzene	
					Chloroethane	
					Chloroform	
					Chloromethane	
					Chloropicrin	
					Dibromochloromethane	
					Dichlorobenzene	
					Dichloromethane	
					Ethane	
					Ethylbenzene	
90 cont.	Oxnard	California			Formaldehyde	
					Hexane	
					Hydrogen sulfide	
					Hydrogen sulfide	
					Methane	
					Pentane	
					Phenol	
					Propane	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
91	Oxnard	California	Carbon dioxide	Engine	Styrene	Test date: 12/20/90.
			Carbon monoxide		TCE	Hydrocarbons determined
			Ethane		Tetrachloroethene	by EPA Method 18. O_2,
			Hexane		Toluene	N_2, and CO_2 determined
			Hydrogen sulfide		Trichlorofluoromethane	by EPA Method 3.
			Hydrogen sulfide		Trichlorotrifluoroethane	
			iso-Butane		Vinyl chloride	
			iso-Pentane		Xylenes	
			Methane			
			n-Butane			
			n-Pentane			
			Nitrogen			
			Oxygen			
			Propane			
			Sulfur			
92	Salinas	California		Engine	1,1,2-Trochloroethane	Test date: 7/31-8/2/90.
					1,1-Dichloroehtene	PAH determined by CARB
					1,1-Dichloroethane	Method 429. Formaldehyde,
					1,2-Dibromoethane	Acrolein, and Acetaldehyde
					1,2-Dichloroethane	determined by CARB
					1,2-Dichloropropane	Method 430. Metals
					1,4-Dichlorobenzene	determined by CARB
					1,4-Dioxane	Method 436. Cadnium
					2-Butanone, MEK	determined by CARB
					2-Hexanone	Method 424. Cromium
					Acenaphthene	determined by CARB
					Acenaphthylene	Method 425. HCl
					Acetone	determined by CARB
					Acrylonitrile	Method 421. Silica
					Anthracene	determined by EPA
					Arsenic	Method 5. PCB
					Benzene	determined by EPA
					Benzo(a)anthracene	Method 608/8080.
					Benzo(a)pyrene	
					Benzo(b)floranthene	
					Benzo(g,h,i)perylene	
					Benzo(k)floranthene	
					Beryllium	
					Bromodichloromethane	
					Cadmium	
					Carbon disulfide	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
92 cont.	Salinas	California			Carbontetrachloride Chlorobenzene Chloroethane Chloroform Chloromethane Chloropicrin Chromium Chrysene Copper Cristobalite Dibenz(a,h)anthracene Dibromochloromethane Dichloromethane Ethylbenzene Fluoranthene Fluorene HCl Hydrogen sulfide Indeno(1,2,3-cd)pyrene Lead Manganese Mercury Naphthalene Nickel Phenanthrene Phenols Phosphorus Pyrene Quartz Selenium Styrene TCA TCE Tetrachloroethene Toluene Trichlorofluoromethane Trichlorotrifluoroethane Tridymite Vinyl chloride Xylenes Zinc	
93	Newby Island	California			Carbon dioxide Carbon monoxide NOx Oxygen THC TNMHC	Test date: 2/7-8/90. Active landfill. CARB Method 1-100 was used.
94	Various	Various	1,1-dichloroethane 1,1-dichloroethylene 1,2-dichloroethylene Benzene Chlorobenzene Dichloromethane Hexane Iso-octane Iso-propylbenzene m,p-xylene Methylbenzene Napthalene Nonane o-xylene Pentane TCA Tetrachloroethene Trichloroethene	Various	1,1-dichloroethane 1,1-dichloroethylene 1,2-dichloroethylene Benzene Carbon dioxide Chlorobenzene Dichloromethane Hexane Iso-octane Iso-propylbenzene m,p-xylene Mercury Methane Methylbenzene Napthalene Nitrogen Nonane Oxygen o-xylene Pentane TCA Tetrachloroethene Trichloroethene	

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
95	Minnesota "Greater and "Twin Metropolitan	Minnesota		Flare	1,1-dichloroethane 1,1-dichloroethylene 1,2-Dichloroethane 1,2-dichloroethylene Carbon dioxide Carbon disulfide Carbon monoxide Carbon tetrachloride Carbonyl sulfide Chlorobenzene Chloroform Dimethyl disulfide Dimethyl sulfide Ethyl mercaptan HAP HCl Hydrogen sulfide Mercury Methane Methyl mercaptan Methylene chloride Nitrogen Nitrogen dioxide NMOC Perchloroethylene PM Sulfur dioxide TCA Trichloroethylene Vinyl chloride	Test date: 7/90 to 5/91, and 1-11/92.
96	Fresh Kills	New York	Mercury			Test date: 11/96. EPA Method 101A and SW-846 Method 7471 were used.
97	Mountaingate	California	PM Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Manganese Mercury Nickel Selenium Silver Thallium Zinc			Test date: 5/18-21/92.
98	Bakersfield	California	NMHC Butane Ethane Methane Pentane Propane	IC Engine	NMHC Butane CO Ethane Methane NOx Pentane PM Propane	Test date 12/4/90.
99	Otay Landfill	California	NMHC	IC Engine	NMHC CO NOx PM	Test date 4/2/91.
100	Penrose	California	NMHC Methane Perchloroethylene Trichloroethylene	IC Engine	NMHC Methane Perchloroethylene Trichloroethylene	Test date 2/24/88.
101	Toyon Canyon	California	1,1,1-Trichloroethylene Benzene Methane Perchloroethylene Toluene Trichloroethylene Xylene	IC Engine	1,1,1-Trichloroethylene Benzene Methane Perchloroethylene Toluene Trichloroethylene Xylene	Test date 3/8/88.

Appendix A-1. Summary of Test Report Data (pre-1992 Landfills)

Ref. No.	Landfill Name	Location	Compounds Tested (Uncontrolled)	Control Device	Compounds Tested (Controlled)	Comments
104	Y & S Maintenance	Pennsylvania	CO CO_2 Methane NMHC NOx	Flare	CO CO_2 Methane NMHC NOx	Test date 12/14/94. NOx was determined by EPA Method 7D.
105	Seneca Landfill	Pennsylvania	CO CO_2 Methane NMHC Oxygen	Flare	CO CO_2 Methane NMHC NOx	Test date 9/8/93. NOx and NMHC were determined by EPA Methods 7D and 25C, repectively.
106	Wayne Township	Pennsylvania	CO CO_2 Methane NMVOC Oxygen	Flare	CO CO_2 Methane NMVOC NOx Oxygen	Test date 4/2/96. NOx and NMVOC were determined by EPA Methods 7D and TO-14, repectively.
107	Bethlehem Landfill	Pennsylvania	NMHC	Flare	CO_2 NMHC NOx Oxygen	Test date 10/9/96. Oxygen and CO_2, NOx, and NMHC, were determined by EPA Methods 3A, 7E, and 18, respectively.
108	Hartford Landfill	Connecticut	NMOC	Flare	CO CO_2 Methane NMOC NOx Oxygen SO_2 THC	Test date 11/4/93. Oxygen, NOx, CO, SO_2, and THCwere determined by EPA Methods 3A, 7E, 10, 6C, and 25A, respectively. CO_2, NMOC and methane were determined by EPA Method 18.
109	Contra Costa Landfill	California	1,1,1-Trichloroethane 1,2-Dichloroethane Benzene Carbon tetrachloride Chloroform CO CO_2 Ethylene dibromide Methane Methylene chloride Nitrogen NMOC Oxygen Tetrachlorethene Trichlorethene Vinyl chloride	Gas Flare	1,1,1-Trichloroethane 1,2-Dichloroethane Benzene Carbon tetrachloride Chloroform CO CO_2 Ethylene dibromide Methane Methylene chloride Nitrogen NMOC Oxygen Tetrachlorethene Trichlorethene Vinyl chloride	Test date 3/22/94. EPA Method TO-14 was used.

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
53	Altamont	U	1,1,1-Trichloroethane	0.28	0.34	0.44
53	Altamont	U	1,1,1-Trichloroethane	0.47	0.55	
54	Arbor Hills	U	1,1,1-Trichloroethane	0.15	0.16	0.15
54	Arbor Hills	U	1,1,1-Trichloroethane	0.14	0.14	
54	Arbor Hills	U	1,1,1-Trichloroethane	0.15	0.15	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.0023	0.0024	0.45
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.057	0.059	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.037	0.039	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	1.80	1.88	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.079	0.082	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.058	0.060	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	1.70	1.77	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.058	0.060	
15	Azusa Land Reclamation	U	1,1,1-Trichloroethane	0.057	0.059	
12	BKK Landfill	Y	1,1,1-Trichloroethane	12.00	26.4	30.0
12	BKK Landfill	Y	1,1,1-Trichloroethane	6.50	15.3	
12	BKK Landfill	Y	1,1,1-Trichloroethane	22.00	48.4	
17	Bradley Pit	U	1,1,1-Trichloroethane	2.10	2.60	2.72
17	Bradley Pit	U	1,1,1-Trichloroethane	4.80	7.38	
17	Bradley Pit	U	1,1,1-Trichloroethane	5.70	8.52	
17	Bradley Pit	U	1,1,1-Trichloroethane	0.57	0.71	
17	Bradley Pit	U	1,1,1-Trichloroethane	0.54	0.68	
17	Bradley Pit	U	1,1,1-Trichloroethane	2.10	2.54	
19	Bradley Pit	U	1,1,1-Trichloroethane	0.98	1.29	
19	Bradley Pit	U	1,1,1-Trichloroethane	0.21	0.28	
19	Bradley Pit	U	1,1,1-Trichloroethane	2.20	2.91	
19	Bradley Pit	U	1,1,1-Trichloroethane	2.30	3.04	
41	Bradley Pit	U	1,1,1-Trichloroethane	0.0079	0.011	
6	Bradley Pit	U	1,1,1-Trichloroethane	0.73	0.97	
6	Bradley Pit	U	1,1,1-Trichloroethane	0.16	0.21	
6	Bradley Pit	U	1,1,1-Trichloroethane	0.17	0.23	
7	Calabasas	Y	1,1,1-Trichloroethane	0.33	0.50	2.57
7	Calabasas	Y	1,1,1-Trichloroethane	0.60	1.08	
7	Calabasas	Y	1,1,1-Trichloroethane	3.40	6.14	
13	Carson	U	1,1,1-Trichloroethane	0.025	0.053	0.051
13	Carson	U	1,1,1-Trichloroethane	0.037	0.051	
13	Carson	U	1,1,1-Trichloroethane	0.038	0.051	
43	CBI10	U	1,1,1-Trichloroethane	0.25	0.25	0.25
43	CBI11	U	1,1,1-Trichloroethane	4.20	4.25	4.25
43	CBI13	U	1,1,1-Trichloroethane	0.030	0.036	0.036
43	CBI14	U	1,1,1-Trichloroethane	0.48	0.49	0.49
43	CBI15	U	1,1,1-Trichloroethane	0.030	0.030	0.030
43	CBI16	Y	1,1,1-Trichloroethane	0.60	0.61	0.61
43	CBI17	U	1,1,1-Trichloroethane	0.20	0.20	0.20
43	CBI18	U	1,1,1-Trichloroethane	0.37	0.38	0.38
43	CBI20	U	1,1,1-Trichloroethane	0.40	0.40	0.40
43	CBI21	U	1,1,1-Trichloroethane	0.60	0.60	0.60
43	CBI23	U	1,1,1-Trichloroethane	1.30	1.38	1.38
43	CBI24	Y	1,1,1-Trichloroethane	0.50	0.51	0.51
43	CBI25	U	1,1,1-Trichloroethane	1.24	1.25	1.25
43	CBI27	U	1,1,1-Trichloroethane	0.47	0.47	0.47
43	CBI30	U	1,1,1-Trichloroethane	0.16	0.16	0.16
43	CBI32	U	1,1,1-Trichloroethane	1.35	1.36	1.36
43	CBI4	U	1,1,1-Trichloroethane	0.34	0.36	0.36
43	CBI5	U	1,1,1-Trichloroethane	0.15	0.15	0.15
43	CBI6	U	1,1,1-Trichloroethane	1.15	1.16	1.16
43	CBI8	U	1,1,1-Trichloroethane	0.77	0.78	0.78
43	CBI9	U	1,1,1-Trichloroethane	1.90	1.92	1.92
55	Chicopee	U	1,1,1-Trichloroethane	2.20	2.82	2.82
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.18	0.24	0.25
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.17	0.22	
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.17	0.23	
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.17	0.26	
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.21	0.30	
56	Coyote Canyon	U	1,1,1-Trichloroethane	0.18	0.26	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
57	Durham Rd.	U	1,1,1-Trichloroethane	0.67	0.88	1.66
57	Durham Rd.	U	1,1,1-Trichloroethane	0.75	0.90	
57	Durham Rd.	U	1,1,1-Trichloroethane	2.70	3.21	
10	Mission Canyon	N	1,1,1-Trichloroethane	0.016	0.066	0.066
5	Mountaingate	N	1,1,1-Trichloroethane	0.011	0.032	0.032
5	Mountaingate	N	1,1,1-Trichloroethane	0.011	0.032	
5	Mountaingate	N	1,1,1-Trichloroethane	0.012	0.035	
5	Mountaingate	N	1,1,1-Trichloroethane	0.011	0.032	
58	Otay Annex	U	1,1,1-Trichloroethane	0.17	0.18	0.18
58	Otay Landfill	Y	1,1,1-Trichloroethane	0.010	0.014	0.014
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0022	0.010	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.010	0.044	0.061
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.014	0.061	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.036	0.16	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0035	0.015	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0022	0.010	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0058	0.025	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0022	0.010	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0058	0.025	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0020	0.0087	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0028	0.012	
22	Palos Verdes	Y	1,1,1-Trichloroethane	0.0042	0.018	
51	Palos Verdes	Y	1,1,1-Trichloroethane	0.056	0.14	
51	Palos Verdes	Y	1,1,1-Trichloroethane	0.10	0.32	
20	Penrose	U	1,1,1-Trichloroethane	0.021	0.027	0.042
20	Penrose	U	1,1,1-Trichloroethane	0.021	0.027	
20	Penrose	U	1,1,1-Trichloroethane	0.046	0.079	
20	Penrose	U	1,1,1-Trichloroethane	0.045	0.077	
20	Penrose	U	1,1,1-Trichloroethane	0.0087	0.021	
20	Penrose	U	1,1,1-Trichloroethane	0.012	0.028	
20	Penrose	U	1,1,1-Trichloroethane	0.015	0.030	
20	Penrose	U	1,1,1-Trichloroethane	0.023	0.045	
18	Puente Hills	N	1,1,1-Trichloroethane	0.91	1.18	1.47
18	Puente Hills	N	1,1,1-Trichloroethane	0.94	1.27	
18	Puente Hills	N	1,1,1-Trichloroethane	0.60	0.80	
18	Puente Hills	N	1,1,1-Trichloroethane	0.50	0.66	
24	Puente Hills	N	1,1,1-Trichloroethane	2.20	3.17	
24	Puente Hills	N	1,1,1-Trichloroethane	1.70	2.35	
50	Puente Hills	N	1,1,1-Trichloroethane	0.73	0.88	
59	Rockingham LF	U	1,1,1-Trichloroethane	7.90	10.5	10.5
1	Scholl Canyon	N	1,1,1-Trichloroethane	0.46	0.74	0.53
1	Scholl Canyon	N	1,1,1-Trichloroethane	0.14	0.32	
9	Sheldon Street	U	1,1,1-Trichloroethane	8.60	17.12	4.34
9	Sheldon Street	U	1,1,1-Trichloroethane	0.015	0.030	
9	Sheldon Street	U	1,1,1-Trichloroethane	0.05	0.11	
9	Sheldon Street	U	1,1,1-Trichloroethane	0.05	0.11	
23	Toyon Canyon	N	1,1,1-Trichloroethane	0.61	0.66	0.66
43	CBI10	U	1,1,2,2-Tetrachloroethane	3.65	3.72	3.72
43	CBI15	U	1,1,2,2-Tetrachloroethane	0.010	0.010	0.010
43	CBI24	Y	1,1,2,2-Tetrachloroethane	2.00	2.03	2.03
43	CBI30	U	1,1,2,2-Tetrachloroethane	0.11	0.11	0.11
43	CBI5	U	1,1,2,2-Tetrachloroethane	0.20	0.20	0.20
43	CBI7	U	1,1,2,2-Tetrachloroethane	2.35	2.41	2.41
43	CBI9	U	1,1,2,2-Tetrachloroethane	0.20	0.20	0.20
59	Rockingham	U	1,1,2,2-Tetrachloroethane	0.15	0.20	0.20
43	CBI11	U	1,1,2-Trichloroethane	0.10	0.10	0.10
54	Arbor Hills	U	1,1-Dichloroethane	1.59	1.63	1.37
54	Arbor Hills	U	1,1-Dichloroethane	1.26	1.27	
54	Arbor Hills	U	1,1-Dichloroethane	1.18	1.20	
43	CBI10	U	1,1-Dichloroethane	2.30	2.34	2.34
43	CBI11	U	1,1-Dichloroethane	19.5	19.7	19.7
43	CBI12	U	1,1-Dichloroethane	0.85	0.94	0.94
43	CBI13	U	1,1-Dichloroethane	0.30	0.36	0.36
43	CBI14	U	1,1-Dichloroethane	11.9	12.0	12.0
43	CBI15	U	1,1-Dichloroethane	0.050	0.050	0.050

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI16	Y	1,1-Dichloroethane	0.60	0.61	0.61
43	CBI17	U	1,1-Dichloroethane	1.75	1.77	1.77
43	CBI18	U	1,1-Dichloroethane	5.63	5.74	5.74
43	CBI2	U	1,1-Dichloroethane	0.10	0.10	0.10
43	CBI20	U	1,1-Dichloroethane	2.75	2.77	2.77
43	CBI22	U	1,1-Dichloroethane	0.40	0.40	0.40
43	CBI23	U	1,1-Dichloroethane	2.60	2.76	2.76
43	CBI24	Y	1,1-Dichloroethane	11.9	12.1	12.1
43	CBI25	U	1,1-Dichloroethane	1.21	1.22	1.22
43	CBI26	U	1,1-Dichloroethane	0.45	0.45	0.45
43	CBI27	U	1,1-Dichloroethane	6.33	6.37	6.37
43	CBI29	U	1,1-Dichloroethane	3.53	3.73	3.73
43	CBI3	U	1,1-Dichloroethane	0.10	0.10	0.10
43	CBI30	U	1,1-Dichloroethane	0.71	0.72	0.72
43	CBI33	U	1,1-Dichloroethane	0.10	0.10	0.10
43	CBI4	U	1,1-Dichloroethane	2.35	2.47	2.47
43	CBI5	U	1,1-Dichloroethane	1.60	1.62	1.62
43	CBI6	U	1,1-Dichloroethane	4.50	4.53	4.53
43	CBI8	U	1,1-Dichloroethane	8.95	9.02	9.02
43	CBI9	U	1,1-Dichloroethane	7.90	7.98	7.98
55	Chicopee	U	1,1-Dichloroethane	5.02	6.44	6.44
56	Coyote Canyon	U	1,1-Dichloroethane	2.34	3.24	3.36
56	Coyote Canyon	U	1,1-Dichloroethane	2.52	3.36	
56	Coyote Canyon	U	1,1-Dichloroethane	3.13	4.17	
56	Coyote Canyon	U	1,1-Dichloroethane	2.87	4.25	
56	Coyote Canyon	U	1,1-Dichloroethane	1.80	2.62	
56	Coyote Canyon	U	1,1-Dichloroethane	1.70	2.51	
27	Lyon Development	U	1,1-dichloroethane	1.10	1.29	0.90
27	Lyon Development	U	1,1-dichloroethane	3.00	3.57	
27	Lyon Development	U	1,1-dichloroethane	0.060	0.059	
27	Lyon Development	U	1,1-dichloroethane	0.19	0.22	
27	Lyon Development	U	1,1-dichloroethane	0.15	0.18	
27	Lyon Development	U	1,1-dichloroethane	0.060	0.059	
59	Rockingham LF	U	1,1-Dichloroethane	43.7	58.1	58.1
3	Altamont	U	1,2-Dichloroethane	0.55	0.66	0.41
3	Altamont	U	1,2-Dichloroethane	0.13	0.15	
54	Arbor Hills	U	1,2-Dichloroethane	0.27	0.28	0.39
54	Arbor Hills	U	1,2-Dichloroethane	0.34	0.34	
54	Arbor Hills	U	1,2-Dichloroethane	0.54	0.55	
15	Azusa Land Reclamation	U	1,2-Dichloroethane	0.15	0.16	0.16
15	Azusa Land Reclamation	U	1,2-Dichloroethane	0.15	0.16	
12	BKK Landfill	Y	1,2-Dichloroethane	50.0	110	66.8
12	BKK Landfill	Y	1,2-Dichloroethane	10.0	23.5	
17	Bradley Pit	U	1,2-Dichloroethane	1.80	2.69	2.20
17	Bradley Pit	U	1,2-Dichloroethane	4.30	5.38	
17	Bradley Pit	U	1,2-Dichloroethane	4.30	5.38	
17	Bradley Pit	U	1,2-Dichloroethane	2.20	2.66	
17	Bradley Pit	U	1,2-Dichloroethane	2.20	2.72	
17	Bradley Pit	U	1,2-Dichloroethane	1.80	2.77	
19	Bradley Pit	U	1,2-Dichloroethane	1.60	2.06	
19	Bradley Pit	U	1,2-Dichloroethane	1.10	1.40	
19	Bradley Pit	U	1,2-Dichloroethane	0.15	0.23	
19	Bradley Pit	U	1,2-Dichloroethane	1.30	1.61	
6	Bradley Pit	U	1,2-Dichloroethane	0.43	0.54	
6	Bradley Pit	U	1,2-Dichloroethane	0.43	0.59	
6	Bradley Pit	U	1,2-Dichloroethane	0.43	0.58	
7	Calabasas	Y	1,2-Dichloroethane	15.0	27.1	29.8
7	Calabasas	Y	1,2-Dichloroethane	18.0	32.5	
43	CBI10	U	1,2-Dichloroethane	1.80	1.83	1.83
43	CBI11	U	1,2-Dichloroethane	0.45	0.46	0.46
43	CBI12	U	1,2-Dichloroethane	0.55	0.61	0.61
43	CBI13	U	1,2-Dichloroethane	0.020	0.024	0.024
43	CBI14	U	1,2-Dichloroethane	0.020	0.020	0.020
43	CBI19	U	1,2-Dichloroethane	0.50	0.50	0.50
43	CBI21	U	1,2-Dichloroethane	0.78	0.79	0.79

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI31	U	1,2-Dichloroethane	1.90	1.90	1.90
43	CBI8	U	1,2-Dichloroethane	0.18	0.18	0.18
43	CBI9	U	1,2-Dichloroethane	0.10	0.10	0.10
55	Chicopee	U	1,2-Dichloroethane	0.11	0.14	0.14
56	Coyote Canyon	U	1,2-Dichloroethane	0.12	0.15	0.21
56	Coyote Canyon	U	1,2-Dichloroethane	0.13	0.17	
56	Coyote Canyon	U	1,2-Dichloroethane	0.23	0.30	
56	Coyote Canyon	U	1,2-Dichloroethane	0.23	0.34	
56	Coyote Canyon	U	1,2-Dichloroethane	0.11	0.16	
56	Coyote Canyon	U	1,2-Dichloroethane	0.10	0.14	
57	Durham Rd.	U	1,2-Dichloroethane	0.12	0.16	0.16
57	Durham Rd.	U	1,2-Dichloroethane	0.13	0.16	
57	Durham Rd.	U	1,2-Dichloroethane	0.14	0.17	
27	Lyon Development	U	1,2-Dichloroethane	0.060	0.071	0.067
27	Lyon Development	U	1,2-Dichloroethane	0.060	0.071	
27	Lyon Development	U	1,2-Dichloroethane	0.060	0.060	
5	Mountaingate	N	1,2-Dichloroethane	0.06	0.17	0.17
5	Mountaingate	N	1,2-Dichloroethane	0.06	0.17	
5	Mountaingate	N	1,2-Dichloroethane	0.06	0.17	
5	Mountaingate	N	1,2-Dichloroethane	0.06	0.17	
58	Otay Annex	U	1,2-Dichloroethane	0.025	0.027	0.027
84	Otay Landfill	Y	1,2-Dichloroethane	0.025	0.034	0.034
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	1.78
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	
22	Palos Verdes	Y	1,2-Dichloroethane	0.08	0.35	
22	Palos Verdes	Y	1,2-Dichloroethane	1.10	4.80	
22	Palos Verdes	Y	1,2-Dichloroethane	0.15	0.65	
22	Palos Verdes	Y	1,2-Dichloroethane	0.15	0.65	
22	Palos Verdes	Y	1,2-Dichloroethane	1.10	4.80	
22	Palos Verdes	Y	1,2-Dichloroethane	1.10	4.80	
22	Palos Verdes	Y	1,2-Dichloroethane	0.81	3.53	
20	Penrose	U	1,2-Dichloroethane	0.50	0.64	0.92
20	Penrose	U	1,2-Dichloroethane	0.50	0.63	
20	Penrose	U	1,2-Dichloroethane	0.50	0.86	
20	Penrose	U	1,2-Dichloroethane	0.50	0.85	
20	Penrose	U	1,2-Dichloroethane	0.50	1.22	
20	Penrose	U	1,2-Dichloroethane	0.50	1.18	
20	Penrose	U	1,2-Dichloroethane	0.50	0.99	
20	Penrose	U	1,2-Dichloroethane	0.50	0.97	
18	Puente Hills	N	1,2-Dichloroethane	6.00	7.79	7.96
18	Puente Hills	N	1,2-Dichloroethane	6.00	8.09	
18	Puente Hills	N	1,2-Dichloroethane	6.00	8.00	
18	Puente Hills	N	1,2-Dichloroethane	6.00	7.95	
59	Rockingham	U	1,2-Dichloroethane	30.6	40.7	40.7
43	CBI11	U	1,2-Dichloropropane	1.80	1.82	1.82
43	CBI13	U	1,2-Dichloropropane	0.06	0.07	0.07
43	CBI14	U	1,2-Dichloropropane	0.02	0.02	0.02
43	CBI24	Y	1,2-Dichloropropane	0.50	0.51	0.51
43	CBI27	U	1,2-Dichloropropane	0.27	0.27	0.27
43	CBI30	U	1,2-Dichloropropane	0.22	0.22	0.22
43	CBI5	U	1,2-Dichloropropane	0.10	0.10	0.10
43	CBI8	U	1,2-Dichloropropane	0.12	0.12	0.12
41	Guadalupe	U	1,2-Dimethyl cyclohexane	8.80	10.5	10.5
41	Guadalupe	U	1,3-Dimethyl cyclohexane	5.40	6.47	6.47
41	Guadalupe	U	1,3-Dimethyl cyclopentane	21.4	25.6	25.6
41	Guadalupe	U	1-Butanol	8.20	9.82	9.82
41	Guadalupe	U	1-Propanol	3.20	3.83	3.83
41	Guadalupe	U	2,4-Dimethyl heptane	10.5	12.6	12.6
41	Guadalupe	U	2-Butanol	13.3	15.9	15.9
43	CBI15	U	2-Chloroethylvinyl ether	2.25	2.27	2.27
41	Guadalupe	U	2-Hexanone	12.6	15.1	15.1
41	Guadalupe	U	2-Methyl heptane	2.10	2.51	2.51

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
41	Guadalupe	U	2-Methyl propane	4.40	5.27	5.27
41	Guadalupe	U	2-Methyl-methylester propanoic acid	5.60	6.71	6.71
41	Guadalupe	U	2-Propanol	5.20	6.23	35.4
60	Sunshine Canyon	U	2-Propanol	54.0	64.7	64.7
41	Guadalupe	U	3-Carene	44.1	63.7	63.7
43	CBI11	U	Acetone	12.0	12.1	12.1
43	CBI12	U	Acetone	2.25	2.48	2.48
43	CBI14	U	Acetone	1.84	1.86	1.86
43	CBI18	U	Acetone	4.50	4.59	4.59
43	CBI20	U	Acetone	6.50	6.54	6.54
43	CBI21	U	Acetone	2.25	2.27	2.27
43	CBI22	U	Acetone	19.3	19.5	19.5
43	CBI23	U	Acetone	1.00	1.06	1.06
43	CBI24	Y	Acetone	20.0	20.3	20.3
43	CBI26	U	Acetone	8.50	8.54	8.54
43	CBI27	U	Acetone	5.33	5.37	5.37
43	CBI3	U	Acetone	3.40	3.41	3.41
43	CBI31	U	Acetone	7.00	7.01	7.01
43	CBI32	U	Acetone	2.50	2.51	2.51
43	CBI33	U	Acetone	8.00	8.02	8.02
43	CBI6	U	Acetone	7.50	7.55	7.55
43	CBI7	U	Acetone	32.0	32.8	32.8
43	CBI9	U	Acetone	14.0	14.1	14.1
59	Rockingham	U	Acetone	36.8	48.9	48.9
56	Coyote Canyon	U	Acetonitrile	0.023	0.023	0.021
56	Coyote Canyon	U	Acetonitrile	0.019	0.019	
43	CBI14	U	Acrylonitrile	0.80	0.81	0.81
43	CBI25	U	Acrylonitrile	7.40	7.46	7.46
43	CBI4	U	Acrylonitrile	8.93	9.38	9.38
59	Rockingham	U	Acrylonitrile	21.3	28.3	28.3
53	Altamont	U	Benzene	3.70	4.46	2.76
53	Altamont	U	Benzene	0.91	1.06	
54	Arbor Hills	U	Benzene	0.95	0.98	0.95
54	Arbor Hills	U	Benzene	0.99	1.00	
54	Arbor Hills	U	Benzene	0.84	0.86	
15	Azusa Land Reclamation	U	Benzene	0.10	0.10	2.00
15	Azusa Land Reclamation	U	Benzene	0.10	0.10	
15	Azusa Land Reclamation	U	Benzene	1.90	1.98	
15	Azusa Land Reclamation	U	Benzene	2.00	2.09	
15	Azusa Land Reclamation	U	Benzene	2.30	2.40	
15	Azusa Land Reclamation	U	Benzene	2.80	2.92	
15	Azusa Land Reclamation	U	Benzene	1.80	1.88	
15	Azusa Land Reclamation	U	Benzene	2.20	2.29	
15	Azusa Land Reclamation	U	Benzene	4.10	4.28	
12	BKK Landfill	Y	Benzene	45.0	99.1	92.6
12	BKK Landfill	Y	Benzene	34.0	79.8	
12	BKK Landfill	Y	Benzene	45.0	98.9	
17	Bradley Pit	U	Benzene	2.80	3.47	2.99
17	Bradley Pit	U	Benzene	3.10	3.74	
17	Bradley Pit	U	Benzene	2.30	3.54	
17	Bradley Pit	U	Benzene	1.10	1.38	
17	Bradley Pit	U	Benzene	2.60	3.89	
17	Bradley Pit	U	Benzene	1.10	1.38	
41	Bradley Pit	U	Benzene	0.90	1.30	
0	Bradley Pit	U	Benzene	1.70	2.31	
6	Bradley Pit	U	Benzene	6.10	7.63	
6	Bradley Pit	U	Benzene	0.90	1.23	
7	Calabasas	Y	Benzene	18.0	32.5	
7	Calabasas	Y	Benzene	32.0	57.8	
7	Calabasas	Y	Benzene	11.7	17.8	36.0
13	Carson	U	Benzene	4.20	6.46	6.67
13	Carson	U	Benzene	3.70	5.69	
13	Carson	U	Benzene	5.10	7.85	
43	CBI10	U	Benzene	1.00	1.02	1.02
43	CBI11	U	Benzene	1.95	1.97	1.97

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI12	U	Benzene	2.60	2.86	2.86
43	CBI13	U	Benzene	1.53	1.85	1.85
43	CBI14	U	Benzene	2.76	2.79	2.79
43	CBI15	U	Benzene	0.35	0.35	0.35
43	CBI16	Y	Benzene	0.30	0.30	0.30
43	CBI17	U	Benzene	0.10	0.10	0.10
43	CBI18	U	Benzene	1.53	1.56	1.56
43	CBI20	U	Benzene	0.65	0.65	0.65
43	CBI21	U	Benzene	1.05	1.06	1.06
43	CBI22	U	Benzene	0.57	0.58	0.58
43	CBI23	U	Benzene	1.20	1.27	1.27
43	CBI24	Y	Benzene	5.53	5.61	5.61
43	CBI25	U	Benzene	2.42	2.44	2.44
43	CBI26	U	Benzene	0.15	0.15	0.15
43	CBI27	U	Benzene	0.77	0.78	0.78
43	CBI29	U	Benzene	79.1	83.7	83.7
43	CBI30	U	Benzene	2.65	2.67	2.67
43	CBI31	U	Benzene	0.60	0.60	0.60
43	CBI32	U	Benzene	0.70	0.70	0.70
43	CBI33	U	Benzene	0.83	0.83	0.83
43	CBI4	U	Benzene	1.04	1.09	1.09
43	CBI5	U	Benzene	2.55	2.58	2.58
43	CBI6	U	Benzene	0.20	0.20	0.20
43	CBI7	U	Benzene	1.50	1.54	1.54
43	CBI8	U	Benzene	4.55	4.59	4.59
43	CBI9	U	Benzene	1.00	1.01	1.01
55	Chicopee	U	Benzene	4.82	6.19	6.19
56	Coyote Canyon	U	Benzene	1.64	2.18	2.37
56	Coyote Canyon	U	Benzene	1.73	2.56	
57	Durham Rd.	U	Benzene	2.30	3.03	3.20
57	Durham Rd.	U	Benzene	2.40	2.89	
57	Durham Rd.	U	Benzene	3.10	3.69	
27	Lyon Development	U	Benzene	0.55	0.65	0.79
27	Lyon Development	U	Benzene	1.20	1.43	
27	Lyon Development	U	Benzene	0.31	0.31	
10	Mission Canyon	N	Benzene	0.036	0.15	1.36
5	Mountaingate	N	Benzene	0.13	0.37	0.30
5	Mountaingate	N	Benzene	0.09	0.26	
5	Mountaingate	N	Benzene	0.10	0.29	
5	Mountaingate	N	Benzene	0.10	0.29	
8	Operating Industries	U	Benzene	4.70	9.36	9.36
58	Otay Annex	U	Benzene	3.36	4.57	4.57
84	Otay Landfill	Y	Benzene	8.48	9.17	9.17
22	Palos Verdes	Y	Benzene	13.0	56.7	36.4
22	Palos Verdes	Y	Benzene	2.50	10.9	
22	Palos Verdes	Y	Benzene	20.0	87.2	
22	Palos Verdes	Y	Benzene	1.00	4.36	
22	Palos Verdes	Y	Benzene	2.30	10.0	
22	Palos Verdes	Y	Benzene	5.40	23.5	
22	Palos Verdes	Y	Benzene	0.96	4.19	
22	Palos Verdes	Y	Benzene	6.00	26.2	
22	Palos Verdes	Y	Benzene	20.0	87.2	
22	Palos Verdes	Y	Benzene	5.40	23.5	
22	Palos Verdes	Y	Benzene	0.96	4.19	
22	Palos Verdes	Y	Benzene	1.10	4.80	
51	Palos Verdes	Y	Benzene	9.80	31.2	
51	Palos Verdes	Y	Benzene	53.0	136	
20	Penrose	U	Benzene	1.90	2.43	3.84
20	Penrose	U	Benzene	2.20	2.78	
20	Penrose	U	Benzene	4.00	6.88	
20	Penrose	U	Benzene	4.00	6.81	
20	Penrose	U	Benzene	1.40	3.41	
20	Penrose	U	Benzene	1.40	3.31	
20	Penrose	U	Benzene	1.30	2.58	
20	Penrose	U	Benzene	1.30	2.53	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
18	Puente Hills	N	Benzene	12.0	15.6	14.5
18	Puente Hills	N	Benzene	12.0	16.2	
18	Puente Hills	N	Benzene	16.0	21.3	
18	Puente Hills	N	Benzene	15.0	19.9	
24	Puente Hills	N	Benzene	6.60	9.52	
24	Puente Hills	N	Benzene	6.25	8.66	
50	Puente Hills	N	Benzene	8.50	10.30	
59	Rockingham	U	Benzene	1.30	1.73	1.73
1	Scholl Canyon	N	Benzene	3.90	6.26	3.45
1	Scholl Canyon	N	Benzene	0.28	0.64	
9	Sheldon Street	U	Benzene	0.50	1.00	6.53
9	Sheldon Street	U	Benzene	0.50	1.00	
9	Sheldon Street	U	Benzene	0.13	0.26	
9	Sheldon Street	U	Benzene	12.0	23.9	
39	Sunshine Canyon	U	Benzene	2.20	2.32	2.32
23	Toyon Canyon	N	Benzene	2.75	2.96	2.96
43	CBI13	U	Bromodichloromethane	0.22	0.27	0.27
43	CBI14	U	Bromodichloromethane	0.12	0.12	0.12
43	CBI24	Y	Bromodichloromethane	2.48	2.52	2.52
43	CBI25	U	Bromodichloromethane	7.85	7.91	7.91
43	CBI30	U	Bromodichloromethane	2.02	2.04	2.04
43	CBI4	U	Bromodichloromethane	1.14	1.20	1.20
43	CBI8	U	Bromodichloromethane	7.80	7.86	7.86
43	CBI11	U	Butane	16.5	16.7	16.7
43	CBI14	U	Butane	18.8	19.0	19.0
43	CBI16	Y	Butane	1.00	1.02	1.02
43	CBI17	U	Butane	1.00	1.01	1.01
43	CBI18	U	Butane	0.83	0.85	0.85
43	CBI19	U	Butane	2.50	2.51	2.51
43	CBI26	U	Butane	1.50	1.51	1.51
43	CBI27	U	Butane	6.07	6.11	6.11
43	CBI32	U	Butane	5.00	5.03	5.03
43	CBI33	U	Butane	1.13	1.13	1.13
43	CBI34	U	Butane	0.50	0.50	0.50
43	CBI5	U	Butane	11.8	11.9	11.9
43	CBI6	U	Butane	9.50	9.57	9.57
43	CBI9	U	Butane	32.0	32.3	32.3
60	Sunshine Canyon	U	Butane	38.0	40.0	40.0
41	Guadalupe	U	Butylester butanoic acid	11.6	16.8	16.8
54	Arbor Hills	U	Carbon disulfide	0.092	0.094	0.094
54	Arbor Hills	U	Carbon disulfide	0.093	0.095	
15	Azusa Land Reclamation	U	Carbon disulfide	0.41	0.43	0.43
12	BKK Landfill	Y	Carbon disulfide	0.83	1.86	1.20
12	BKK Landfill	Y	Carbon disulfide	0.66	1.46	
12	BKK Landfill	Y	Carbon disulfide	0.40	0.86	
12	BKK Landfill	Y	Carbon disulfide	0.50	1.08	
12	BKK Landfill	Y	Carbon disulfide	0.50	1.06	
12	BKK Landfill	Y	Carbon disulfide	0.50	1.45	
12	BKK Landfill	Y	Carbon disulfide	0.50	1.09	
12	BKK Landfill	Y	Carbon disulfide	0.60	1.28	
12	BKK Landfill	Y	Carbon disulfide	0.30	0.67	
6	Bradley Pit	U	Carbon disulfide	1.20	1.64	1.64
7	Calabasas	Y	Carbon disulfide	0.050	0.076	0.076
56	Coyote Canyon	U	Carbon disulfide	0.070	0.10	0.10
24	Puente Hills	N	Carbon disulfide	0.90	1.31	1.01
24	Puente Hills	N	Carbon disulfide	0.81	1.16	
24	Puente Hills	N	Carbon disulfide	0.85	1.18	
24	Puente Hills	N	Carbon disulfide	1.00	1.38	
50	Puente Hills	N	Carbon disulfide	0.00005	0.00006	
1	Scholl Canyon	N	Carbon disulfide	0.050	0.11	0.11
10	Mission Canyon	N	Carbon tetrachloride	0.00040	0.0016	0.0016
5	Mountaingate	N	Carbon tetrachloride	0.00036	0.0010	0.00083
5	Mountaingate	N	Carbon tetrachloride	0.00026	0.00075	
5	Mountaingate	N	Carbon tetrachloride	0.00026	0.00075	
5	Mountaingate	N	Carbon tetrachloride	0.00027	0.00078	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
18	Puente Hills	N	Carbon tetrachloride	0.030	0.039	0.024
18	Puente Hills	N	Carbon tetrachloride	0.030	0.040	
18	Puente Hills	N	Carbon tetrachloride	0.030	0.040	
18	Puente Hills	N	Carbon tetrachloride	0.030	0.040	
24	Puente Hills	N	Carbon tetrachloride	0.0014	0.0019	
24	Puente Hills	N	Carbon tetrachloride	0.0012	0.0017	
50	Puente Hills	N	Carbon tetrachloride	0.0050	0.0061	
1	Scholl Canyon	N	Carbon tetrachloride	0.18	0.41	0.41
23	Toyon Canyon	N	Carbon tetrachloride	0.0025	0.0027	0.0027
53	Altamont	U	Carbon tetrachloride	0.0025	0.0030	0.0030
53	Altamont	U	Carbon tetrachloride	0.0025	0.0029	
54	Arbor Hills	U	Carbon tetrachloride	0.0025	0.0026	0.0025
54	Arbor Hills	U	Carbon tetrachloride	0.0025	0.0025	
54	Arbor Hills	U	Carbon tetrachloride	0.0025	0.0025	
15	Azusa Land Reclamation	U	Carbon tetrachloride	0.0014	0.0015	0.0015
15	Azusa Land Reclamation	U	Carbon tetrachloride	0.0014	0.0015	
19	Bradley Pit	U	Carbon tetrachloride	0.0015	0.0019	0.0023
19	Bradley Pit	U	Carbon tetrachloride	0.0015	0.0019	
19	Bradley Pit	U	Carbon tetrachloride	0.0015	0.0023	
19	Bradley Pit	U	Carbon tetrachloride	0.0015	0.0019	
6	Bradley Pit	U	Carbon tetrachloride	0.0001	0.0001	
6	Bradley Pit	U	Carbon tetrachloride	0.0010	0.0014	
6	Bradley Pit	U	Carbon tetrachloride	0.0030	0.0041	
6	Bradley Pit	U	Carbon tetrachloride	0.0040	0.0050	
13	Carson	U	Carbon tetrachloride	0.00064	0.00086	0.047
13	Carson	U	Carbon tetrachloride	0.10	0.14	
13	Carson	U	Carbon tetrachloride	0.00080	0.0017	
43	CBI15	U	Carbon tetrachloride	0.050	0.050	0.050
55	Chicopee	U	Carbon tetrachloride	0.070	0.090	0.0899
56	Coyote Canyon	U	Carbon tetrachloride	0.0005	0.0007	0.0026
56	Coyote Canyon	U	Carbon tetrachloride	0.0005	0.0007	
56	Coyote Canyon	U	Carbon tetrachloride	0.0025	0.0033	
56	Coyote Canyon	U	Carbon tetrachloride	0.0025	0.0037	
56	Coyote Canyon	U	Carbon tetrachloride	0.0025	0.0036	
56	Coyote Canyon	U	Carbon tetrachloride	0.0025	0.0037	
57	Durham Rd.	U	Carbon tetrachloride	0.0025	0.0030	0.0030
57	Durham Rd.	U	Carbon tetrachloride	0.0025	0.0030	
57	Durham Rd.	U	Carbon tetrachloride	0.0025	0.0030	
27	Lyon Development	U	Carbon tetrachloride	0.040	0.047	0.045
27	Lyon Development	U	Carbon tetrachloride	0.040	0.048	
27	Lyon Development	U	Carbon tetrachloride	0.040	0.040	
58	Otay Annex	U	Carbon tetrachloride	0.00020	0.00027	0.00027
20	Penrose	U	Carbon tetrachloride	0.0025	0.0032	0.0053
20	Penrose	U	Carbon tetrachloride	0.0025	0.0032	
20	Penrose	U	Carbon tetrachloride	0.0025	0.0043	
20	Penrose	U	Carbon tetrachloride	0.0025	0.0043	
20	Penrose	U	Carbon tetrachloride	0.0025	0.0061	
20	Penrose	U	Carbon tetrachloride	0.0025	0.0059	
20	Penrose	U	Carbon tetrachloride	0.0040	0.0080	
20	Penrose	U	Carbon tetrachloride	0.0040	0.0078	
59	Rockingham	U	Carbon tetrachloride	0.15	0.20	
9	Sheldon Street	U	Carbon tetrachloride	0.0006	0.0012	0.21
9	Sheldon Street	U	Carbon tetrachloride	0.4100	0.8161	
9	Sheldon Street	U	Carbon tetrachloride	0.0015	0.0030	
9	Sheldon Street	U	Carbon tetrachloride	0.00030	0.00060	
12	BKK Landfill	Y	Carbon tetrachloride	0.11	0.24	0.23
12	BKK Landfill	Y	Carbon tetrachloride	0.094	0.22	
12	BKK Landfill	Y	Carbon tetrachloride	0.10	0.22	
7	Calabasas	Y	Carbon tetrachloride	0.020	0.030	0.031
7	Calabasas	Y	Carbon tetrachloride	0.015	0.027	
7	Calabasas	Y	Carbon tetrachloride	0.020	0.036	
84	Otay Landfill	Y	Carbon tetrachloride	0.00020	0.00022	0.00022
22	Palos Verdes	Y	Carbon tetrachloride	0.00024	0.0010	0.0053
22	Palos Verdes	Y	Carbon tetrachloride	0.000080	0.00035	
22	Palos Verdes	Y	Carbon tetrachloride	0.00046	0.0020	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
22	Palos Verdes	Y	Carbon tetrachloride	0.00034	0.0015	
22	Palos Verdes	Y	Carbon tetrachloride	0.00015	0.00065	
22	Palos Verdes	Y	Carbon tetrachloride	0.00015	0.00065	
22	Palos Verdes	Y	Carbon tetrachloride	0.0012	0.0052	
22	Palos Verdes	Y	Carbon tetrachloride	0.00012	0.00052	
22	Palos Verdes	Y	Carbon tetrachloride	0.00012	0.00052	
22	Palos Verdes	Y	Carbon tetrachloride	0.00034	0.0015	
22	Palos Verdes	Y	Carbon tetrachloride	0.00026	0.0011	
22	Palos Verdes	Y	Carbon tetrachloride	0.00050	0.0022	
51	Palos Verdes	Y	Carbon tetrachloride	0.010	0.032	
51	Palos Verdes	Y	Carbon tetrachloride	0.010	0.026	
54	Arbor Hills	U	Carbonyl sulfide	0.054	0.055	0.057
54	Arbor Hills	U	Carbonyl sulfide	0.058	0.059	
15	Azusa Land Reclamation	U	Carbonyl sulfide	23.0	24.0	24.0
12	BKK Landfill	Y	Carbonyl sulfide	1.40	3.14	1.64
12	BKK Landfill	Y	Carbonyl sulfide	1.40	3.09	
12	BKK Landfill	Y	Carbonyl sulfide	0.80	1.72	
12	BKK Landfill	Y	Carbonyl sulfide	0.90	1.91	
12	BKK Landfill	Y	Carbonyl sulfide	0.25	0.54	
12	BKK Landfill	Y	Carbonyl sulfide	0.25	0.54	
12	BKK Landfill	Y	Carbonyl sulfide	0.25	0.56	
7	Calabasas	Y	Carbonyl sulfide	0.05	0.08	0.08
24	Puente Hills	N	Carbonyl sulfide	0.57	0.83	0.87
24	Puente Hills	N	Carbonyl sulfide	0.81	1.16	
24	Puente Hills	N	Carbonyl sulfide	0.49	0.68	
24	Puente Hills	N	Carbonyl sulfide	1.20	1.66	
50	Puente Hills	N	Carbonyl sulfide	0.00005	0.00006	
1	Scholl Canyon	N	Carbonyl sulfide	0.050	0.11	0.11
54	Arbor Hills	U	Chlorobenzene	0.71	0.72	0.60
54	Arbor Hills	U	Chlorobenzene	0.74	0.74	
54	Arbor Hills	U	Chlorobenzene	0.70	0.72	
43	CBI12	U	Chlorobenzene	0.20	0.22	0.22
43	CBI13	U	Chlorobenzene	0.15	0.18	0.18
43	CBI15	U	Chlorobenzene	0.05	0.05	0.05
43	CBI22	U	Chlorobenzene	0.10	0.10	0.10
43	CBI24	Y	Chlorobenzene	10.0	10.2	10.2
43	CBI29	U	Chlorobenzene	9.10	9.63	9.63
43	CBI3	U	Chlorobenzene	0.20	0.20	0.20
43	CBI30	U	Chlorobenzene	0.43	0.43	0.43
43	CBI5	U	Chlorobenzene	7.15	7.22	7.22
55	Chicopee	U	Chlorobenzene	0.10	0.13	0.13
56	Coyote Canyon	U	Chlorobenzene	0.010	0.013	0.24
56	Coyote Canyon	U	Chlorobenzene	0.010	0.013	
56	Coyote Canyon	U	Chlorobenzene	0.010	0.015	
56	Coyote Canyon	U	Chlorobenzene	0.010	0.015	
56	Coyote Canyon	U	Chlorobenzene	0.50	0.74	
56	Coyote Canyon	U	Chlorobenzene	0.44	0.65	
27	Lyon Development	U	Chlorobenzene	0.20	0.24	0.68
27	Lyon Development	U	Chlorobenzene	0.27	0.32	
27	Lyon Development	U	Chlorobenzene	1.50	1.49	
59	Rockingham	U	Chlorobenzene	0.20	0.27	0.27
43	CBI6	U	Chlorodiflouromethane	0.25	0.25	0.25
43	CBI13	U	Chlorodifluoromethane	0.97	1.17	1.17
43	CBI14	U	Chlorodifluoromethane	12.6	12.7	12.7
43	CBI17	U	Chlorodifluoromethane	3.85	3.89	3.89
43	CBI18	U	Chlorodifluoromethane	0.77	0.79	0.79
43	CBI19	U	Chlorodifluoromethane	1.20	1.20	1.20
43	CBI2	U	Chlorodifluoromethane	0.10	0.10	0.10
43	CBI26	U	Chlorodifluoromethane	1.90	1.91	1.91
43	CBI30	U	Chlorodifluoromethane	1.33	1.34	1.34
43	CBI31	U	Chlorodifluoromethane	1.00	1.00	1.00
43	CBI32	U	Chlorodifluoromethane	3.00	3.02	3.02
43	CBI34	U	Chlorodifluoromethane	0.60	0.60	0.60
43	CBI8	U	Chlorodifluoromethane	4.79	4.83	4.83
43	CBI11	U	Chloroethane	1.35	1.37	1.37

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI12	U	Chloroethane	0.20	0.22	0.22
43	CBI13	U	Chloroethane	0.43	0.52	0.52
43	CBI14	U	Chloroethane	3.25	3.29	3.29
43	CBI15	U	Chloroethane	0.50	0.50	0.50
43	CBI17	U	Chloroethane	1.60	1.62	1.62
43	CBI18	U	Chloroethane	2.33	2.38	2.38
43	CBI19	U	Chloroethane	0.60	0.60	0.60
43	CBI20	U	Chloroethane	1.45	1.46	1.46
43	CBI21	U	Chloroethane	9.20	9.27	9.27
43	CBI23	U	Chloroethane	4.90	5.20	5.20
43	CBI25	U	Chloroethane	0.76	0.77	0.77
43	CBI27	U	Chloroethane	7.33	7.38	7.38
43	CBI3	U	Chloroethane	0.70	0.70	0.70
43	CBI30	U	Chloroethane	0.11	0.11	0.11
43	CBI32	U	Chloroethane	8.25	8.29	8.29
43	CBI33	U	Chloroethane	4.43	4.44	4.44
43	CBI34	U	Chloroethane	0.30	0.30	0.30
43	CBI4	U	Chloroethane	0.17	0.18	0.18
43	CBI5	U	Chloroethane	1.45	1.46	1.46
43	CBI6	U	Chloroethane	0.85	0.86	0.86
43	CBI7	U	Chloroethane	0.50	0.51	0.51
43	CBI8	U	Chloroethane	0.95	0.96	0.96
43	CBI9	U	Chloroethane	3.70	3.74	3.74
41	Guadalupe	U	Chloroethane	2.20	3.18	3.18
53	Altamont	U	Chloroform	0.011	0.013	0.012
53	Altamont	U	Chloroform	0.010	0.012	
54	Arbor Hills	U	Chloroform	0.0025	0.0026	0.0025
54	Arbor Hills	U	Chloroform	0.0025	0.0025	
54	Arbor Hills	U	Chloroform	0.0025	0.0025	
15	Azusa Land Reclamation	U	Chloroform	0.030	0.031	0.031
15	Azusa Land Reclamation	U	Chloroform	0.030	0.031	
15	Azusa Land Reclamation	U	Chloroform	0.030	0.031	
15	Azusa Land Reclamation	U	Chloroform	0.030	0.031	
12	BKK Landfill	Y	Chloroform	1.10	2.4	2.20
12	BKK Landfill	Y	Chloroform	0.66	1.5	
12	BKK Landfill	Y	Chloroform	1.20	2.6	
19	Bradley Pit	U	Chloroform	0.020	0.026	0.019
19	Bradley Pit	U	Chloroform	0.020	0.025	
19	Bradley Pit	U	Chloroform	0.020	0.030	
19	Bradley Pit	U	Chloroform	0.020	0.025	
6	Bradley Pit	U	Chloroform	0.0015	0.0022	
6	Bradley Pit	U	Chloroform	0.010	0.014	
6	Bradley Pit	U	Chloroform	0.010	0.014	
6	Bradley Pit	U	Chloroform	0.010	0.013	
7	Calabasas	Y	Chloroform	0.18	0.27	2.85
7	Calabasas	Y	Chloroform	4.00	7.22	
7	Calabasas	Y	Chloroform	0.58	1.05	
13	Carson	U	Chloroform	0.0025	0.0033	0.0040
13	Carson	U	Chloroform	0.0025	0.0034	
13	Carson	U	Chloroform	0.0025	0.0053	
43	CBI13	U	Chloroform	1.56	1.89	1.89
55	Chicopee	U	Chloroform	0.10	0.13	
56	Coyote Canyon	U	Chloroform	0.0020	0.0027	0.0032
56	Coyote Canyon	U	Chloroform	0.0020	0.0027	
56	Coyote Canyon	U	Chloroform	0.0030	0.0040	
56	Coyote Canyon	U	Chloroform	0.0030	0.0044	
56	Coyote Canyon	U	Chloroform	0.0019	0.0028	
56	Coyote Canyon	U	Chloroform	0.0019	0.0028	
57	Durham Rd.	U	Chloroform	0.00	0.00	0.01
57	Durham Rd.	U	Chloroform	0.00	0.00	
57	Durham Rd.	U	Chloroform	0.02	0.02	
27	Lyon Development	U	Chloroform	0.060	0.071	0.067
27	Lyon Development	U	Chloroform	0.060	0.071	
27	Lyon Development	U	Chloroform	0.060	0.059	
10	Mission Canyon	N	Chloroform	0.0005	0.0021	0.019

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
5	Mountaingate	N	Chloroform	0.0015	0.0043	0.0043
5	Mountaingate	N	Chloroform	0.0015	0.0043	
5	Mountaingate	N	Chloroform	0.0015	0.0043	
5	Mountaingate	N	Chloroform	0.0015	0.0043	
58	Otay Annex	U	Chloroform	0.00050	0.00054	0.00054
58	Otay Landfill	Y	Chloroform	0.00050	0.00068	0.00068
22	Palos Verdes	Y	Chloroform	0.0041	0.018	0.12
22	Palos Verdes	Y	Chloroform	0.00	0.01	
22	Palos Verdes	Y	Chloroform	0.00	0.01	
22	Palos Verdes	Y	Chloroform	0.00	0.01	
22	Palos Verdes	Y	Chloroform	0.01	0.04	
22	Palos Verdes	Y	Chloroform	0.00	0.02	
22	Palos Verdes	Y	Chloroform	0.00	0.02	
22	Palos Verdes	Y	Chloroform	0.00	0.02	
22	Palos Verdes	Y	Chloroform	0.00	0.02	
22	Palos Verdes	Y	Chloroform	0.01	0.04	
22	Palos Verdes	Y	Chloroform	0.01	0.03	
22	Palos Verdes	Y	Chloroform	0.00	0.02	
51	Palos Verdes	Y	Chloroform	0.25	0.80	
51	Palos Verdes	Y	Chloroform	0.25	0.64	
20	Penrose	U	Chloroform	0.02	0.019	0.030
20	Penrose	U	Chloroform	0.02	0.019	
20	Penrose	U	Chloroform	0.02	0.034	
20	Penrose	U	Chloroform	0.02	0.034	
20	Penrose	U	Chloroform	0.02	0.036	
20	Penrose	U	Chloroform	0.02	0.035	
20	Penrose	U	Chloroform	0.02	0.030	
20	Penrose	U	Chloroform	0.02	0.029	
18	Puente Hills	N	Chloroform	0.17	0.21	0.22
18	Puente Hills	N	Chloroform	0.17	0.22	
18	Puente Hills	N	Chloroform	0.17	0.22	
18	Puente Hills	N	Chloroform	0.17	0.22	
24	Puente Hills	N	Chloroform	0.24	0.35	
24	Puente Hills	N	Chloroform	0.030	0.042	
50	Puente Hills	N	Chloroform	0.20	0.24	
59	Rockingham	U	Chloroform	0.20	0.27	0.27
1	Scholl Canyon	N	Chloroform	0.027	0.043	0.56
1	Scholl Canyon	N	Chloroform	0.47	1.08	
9	Sheldon Street	U	Chloroform	0.00035	0.00070	0.00070
9	Sheldon Street	U	Chloroform	0.00035	0.00070	
23	Toyon Canyon	N	Chloroform	0.064	0.069	0.069
43	CBI10	U	Chloromethane	0.90	0.92	0.92
43	CBI11	U	Chloromethane	0.60	0.61	0.61
43	CBI12	U	Chloromethane	0.10	0.11	0.11
43	CBI13	U	Chloromethane	1.12	1.36	1.36
43	CBI14	U	Chloromethane	0.90	0.91	0.91
43	CBI17	U	Chloromethane	1.25	1.26	1.26
43	CBI18	U	Chloromethane	0.18	0.18	0.18
43	CBI19	U	Chloromethane	0.20	0.20	0.20
43	CBI21	U	Chloromethane	0.28	0.28	0.28
43	CBI23	U	Chloromethane	1.40	1.49	1.49
43	CBI24	Y	Chloromethane	0.70	0.71	0.71
43	CBI25	U	Chloromethane	7.19	7.25	7.25
43	CBI26	U	Chloromethane	1.20	1.21	1.21
43	CBI27	U	Chloromethane	1.33	1.34	1.34
43	CBI30	U	Chloromethane	1.34	1.35	1.35
43	CBI32	U	Chloromethane	6.10	6.13	6.13
43	CBI4	U	Chloromethane	3.73	3.92	3.92
43	CBI5	U	Chloromethane	0.55	0.56	0.56
43	CBI6	U	Chloromethane	0.24	0.24	0.24
43	CBI8	U	Chloromethane	10.2	10.3	10.3
43	CBI9	U	Chloromethane	3.60	3.64	3.64
55	Chicopee	U	Dichlorobenzene	0.08	0.10	0.10
56	Coyote Canyon	U	Dichlorobenzene	0.23	0.31	0.33
56	Coyote Canyon	U	Dichlorobenzene	0.26	0.35	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI10	U	Dichlorodifluoromethane	11.8	12.0	12.0
43	CBI11	U	Dichlorodifluoromethane	7.45	7.53	7.53
43	CBI12	U	Dichlorodifluoromethane	1.30	1.43	1.43
43	CBI14	U	Dichlorodifluoromethane	44.0	44.5	44.5
43	CBI15	U	Dichlorodifluoromethane	11.9	12.0	12.0
43	CBI17	U	Dichlorodifluoromethane	23.3	23.5	23.5
43	CBI18	U	Dichlorodifluoromethane	11.9	12.2	12.2
43	CBI19	U	Dichlorodifluoromethane	14.3	14.3	14.3
43	CBI2	U	Dichlorodifluoromethane	0.50	0.50	0.50
43	CBI20	U	Dichlorodifluoromethane	8.85	8.90	8.90
43	CBI21	U	Dichlorodifluoromethane	33.0	33.2	33.2
43	CBI22	U	Dichlorodifluoromethane	13.3	13.4	13.4
43	CBI24	Y	Dichlorodifluoromethane	16.0	16.2	16.2
43	CBI26	U	Dichlorodifluoromethane	11.5	11.5	11.5
43	CBI27	U	Dichlorodifluoromethane	24.5	24.6	24.6
43	CBI3	U	Dichlorodifluoromethane	1.10	1.10	1.10
43	CBI31	U	Dichlorodifluoromethane	19.0	19.0	19.0
43	CBI32	U	Dichlorodifluoromethane	34.5	34.7	34.7
43	CBI33	U	Dichlorodifluoromethane	8.90	8.92	8.92
43	CBI34	U	Dichlorodifluoromethane	2.05	2.05	2.05
43	CBI5	U	Dichlorodifluoromethane	4.90	4.95	4.95
43	CBI6	U	Dichlorodifluoromethane	37.5	37.8	37.8
43	CBI7	U	Dichlorodifluoromethane	16.5	16.9	16.9
43	CBI8	U	Dichlorodifluoromethane	0.19	0.19	0.19
43	CBI9	U	Dichlorodifluoromethane	30.0	30.3	30.3
43	CBI1	U	Dichlorofluoromethane	4.28	4.40	4.40
43	CBI13	U	Dichlorofluoromethane	0.36	0.44	0.44
43	CBI14	U	Dichlorofluoromethane	5.01	5.07	5.07
43	CBI30	U	Dichlorofluoromethane	0.48	0.48	0.48
43	CBI8	U	Dichlorofluoromethane	26.1	26.3	26.3
53	Altamont	U	Dichloromethane	33.0	39.8	27.4
53	Altamont	U	Dichloromethane	13.0	15.1	
54	Arbor Hills	U	Dichloromethane	3.55	3.63	3.16
54	Arbor Hills	U	Dichloromethane	2.84	2.87	
54	Arbor Hills	U	Dichloromethane	2.92	2.98	
43	CBI10	U	Dichloromethane	20.0	20.4	20.4
43	CBI11	U	Dichloromethane	128	129	129
43	CBI12	U	Dichloromethane	3.25	3.58	3.58
43	CBI13	U	Dichloromethane	0.18	0.22	0.22
43	CBI14	U	Dichloromethane	38.8	39.3	39.3
43	CBI15	U	Dichloromethane	0.20	0.20	0.20
43	CBI16	Y	Dichloromethane	0.70	0.71	0.71
43	CBI17	U	Dichloromethane	8.00	8.08	8.08
43	CBI18	U	Dichloromethane	14.0	14.3	14.3
43	CBI19	U	Dichloromethane	3.00	3.01	3.01
43	CBI2	U	Dichloromethane	2.00	2.02	2.02
43	CBI20	U	Dichloromethane	9.25	9.31	9.31
43	CBI21	U	Dichloromethane	44.0	44.4	44.4
43	CBI22	U	Dichloromethane	0.33	0.33	0.33
43	CBI23	U	Dichloromethane	14.0	14.9	14.9
43	CBI24	Y	Dichloromethane	29.9	30.4	30.4
43	CBI25	U	Dichloromethane	24.5	24.7	24.7
43	CBI26	U	Dichloromethane	2.00	2.01	2.01
43	CBI27	U	Dichloromethane	24.7	24.8	24.8
43	CBI30	U	Dichloromethane	1.48	1.49	1.49
43	CBI32	U	Dichloromethane	35.0	35.2	35.2
43	CBI4	U	Dichloromethane	18.4	19.3	19.3
43	CBI5	U	Dichloromethane	6.30	6.36	6.36
43	CBI6	U	Dichloromethane	17.0	17.1	17.1
43	CBI7	U	Dichloromethane	3.45	3.53	3.53
43	CBI8	U	Dichloromethane	51.0	51.4	51.4
43	CBI9	U	Dichloromethane	50.0	50.5	50.5
55	Chicopee	U	Dichloromethane	11.9	15.3	15.3
56	Coyote Canyon	U	Dichloromethane	7.35	9.79	11.3
56	Coyote Canyon	U	Dichloromethane	9.65	12.9	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
56	Coyote Canyon	U	Dichloromethane	7.58	10.1	12.5
56	Coyote Canyon	U	Dichloromethane	7.12	9.48	
56	Coyote Canyon	U	Dichloromethane	9.50	12.6	
56	Coyote Canyon	U	Dichloromethane	9.64	14.3	
56	Coyote Canyon	U	Dichloromethane	9.70	14.1	
56	Coyote Canyon	U	Dichloromethane	9.60	14.2	
57	Durham Rd.	U	Dichloromethane	6.00	7.89	7.62
57	Durham Rd.	U	Dichloromethane	6.10	7.35	
57	Durham Rd.	U	Dichloromethane	6.40	7.62	
41	Guadalupe	U	Dichloromethane	6.10	7.31	7.31
58	Otay Annex	U	Dichloromethane	12.4	16.8	16.8
84	Otay Landfill	Y	Dichloromethane	22.8	24.6	24.6
59	Rockingham	U	Dichloromethane	24.9	33.1	33.1
54	Arbor Hills	U	Dimethyl disulfide	0.11	0.11	0.11
54	Arbor Hills	U	Dimethyl disulfide	0.11	0.11	
54	Arbor Hills	U	Dimethyl sulfide	3.07	3.12	3.20
54	Arbor Hills Landfill	U	Dimethyl sulfide	3.23	3.29	
15	Azusa Land Reclamation	U	Dimethyl sulfide	47.0	49.0	73.5
15	Azusa Land Reclamation	U	Dimethyl sulfide	74.0	77.2	
15	Azusa Land Reclamation	U	Dimethyl sulfide	73.0	76.1	
15	Azusa Land Reclamation	U	Dimethyl sulfide	74.0	77.2	
15	Azusa Land Reclamation	U	Dimethyl sulfide	74.0	77.2	
15	Azusa Land Reclamation	U	Dimethyl sulfide	76.0	79.3	
15	Azusa Land Reclamation	U	Dimethyl sulfide	75.0	78.2	
12	BKK Landfill	Y	Dimethyl sulfide	6.70	15.02	14.81
12	BKK Landfill	Y	Dimethyl sulfide	6.60	14.57	
12	BKK Landfill	Y	Dimethyl sulfide	6.90	14.90	
12	BKK Landfill	Y	Dimethyl sulfide	5.80	12.50	
12	BKK Landfill	Y	Dimethyl sulfide	6.30	13.38	
12	BKK Landfill	Y	Dimethyl sulfide	6.60	19.08	
12	BKK Landfill	Y	Dimethyl sulfide	6.70	14.60	
12	BKK Landfill	Y	Dimethyl sulfide	6.70	14.35	
12	BKK Landfill	Y	Dimethyl sulfide	6.70	14.92	
6	Bradley Pit	U	Dimethyl sulfide	7.00	9.59	9.59
7	Calabasas	Y	Dimethyl sulfide	2.20	3.35	3.35
56	Coyote Canyon	U	Dimethyl sulfide	0.05	0.07	0.15
56	Coyote Canyon	U	Dimethyl sulfide	0.17	0.23	
56	Coyote Canyon	U	Dimethyl sulfide	8.70	12.9	11.7
56	Coyote Canyon	U	Dimethyl sulfide	7.90	10.5	
24	Puente Hills	N	Dimethyl sulfide	8.50	12.4	9.12
24	Puente Hills	N	Dimethyl sulfide	8.00	11.5	
24	Puente Hills	N	Dimethyl sulfide	7.80	10.8	
24	Puente Hills	N	Dimethyl sulfide	7.90	10.9	
50	Puente Hills	N	Dimethyl sulfide	0.0032	0.0039	
1	Scholl Canyon	N	Dimethyl sulfide	1.30	2.97	2.97
39	Sunshine Canyon	U	Dimethyl sulfide	6.20	6.53	6.53
43	CBI13	U	Ethane	930	1125	1125
43	CBI14	Y	Ethane	1780	1802	1802
43	CBI24	U	Ethane	269	273	273
43	CBI25	U	Ethane	1420	1431	1431
43	CBI30	U	Ethane	930	938	938
43	CBI4	U	Ethane	877	921	921
43	CBI8	U	Ethane	1240	1250	1250
102	Fresh Kills Landfill	U	Ethane	16.9	21.9	21.9
103	Puente Hills	U	Ethane	22.3	240.4	240.4
41	Guadalupe	U	Ethanol	5.00	5.99	5.99
60	Sunshine Canyon	U	Ethanol	46.0	48.4	48.4
54	Arbor Hills	U	Ethyl benzene	18.7	19.1	19.4
54	Arbor Hills	U	Ethyl benzene	19.6	19.8	
54	Arbor Hills	U	Ethyl benzene	19.0	19.4	
54	Arbor Hills	U	Ethyl benzene	18.7	19.1	19.4
54	Arbor Hills	U	Ethyl benzene	19.6	19.8	
54	Arbor Hills	U	Ethyl benzene	19.0	19.4	
43	CBI1	U	Ethyl benzene	6.15	6.32	6.32
43	CBI10	U	Ethyl benzene	5.70	5.81	5.81

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI11	U	Ethyl benzene	5.00	5.06	5.06
43	CBI12	U	Ethyl benzene	4.06	4.47	4.47
43	CBI13	U	Ethyl benzene	37.0	44.7	44.7
43	CBI14	U	Ethyl benzene	4.20	4.25	4.25
43	CBI15	U	Ethyl benzene	0.23	0.23	0.23
43	CBI16	Y	Ethyl benzene	1.30	1.32	1.32
43	CBI17	U	Ethyl benzene	0.15	0.15	0.15
43	CBI18	U	Ethyl benzene	7.00	7.14	7.14
43	CBI19	U	Ethyl benzene	0.20	0.20	0.20
43	CBI2	U	Ethyl benzene	0.55	0.55	0.55
43	CBI20	U	Ethyl benzene	10.9	11.0	11.0
43	CBI21	U	Ethyl benzene	0.25	0.25	0.25
43	CBI22	U	Ethyl benzene	5.27	5.32	5.32
43	CBI23	U	Ethyl benzene	4.00	4.25	4.25
43	CBI24	Y	Ethyl benzene	35.4	35.9	35.9
43	CBI25	U	Ethyl benzene	48.1	48.5	48.5
43	CBI26	U	Ethyl benzene	0.70	0.70	0.70
43	CBI27	U	Ethyl benzene	3.73	3.76	3.76
43	CBI28	U	Ethyl benzene	0.80	0.80	0.80
43	CBI29	U	Ethyl benzene	38.7	40.9	40.9
43	CBI3	U	Ethyl benzene	4.40	4.41	4.41
43	CBI30	U	Ethyl benzene	23.4	23.6	23.6
43	CBI31	U	Ethyl benzene	4.60	4.61	4.61
43	CBI32	U	Ethyl benzene	0.65	0.65	0.65
43	CBI33	U	Ethyl benzene	2.73	2.74	2.74
43	CBI4	U	Ethyl benzene	16.2	17.0	17.0
43	CBI5	U	Ethyl benzene	6.75	6.82	6.82
43	CBI6	U	Ethyl benzene	0.30	0.30	0.30
43	CBI7	U	Ethyl benzene	22.0	22.5	22.5
43	CBI8	U	Ethyl benzene	7.22	7.28	7.28
43	CBI9	U	Ethyl benzene	3.80	3.84	3.84
41	Guadalupe	U	Ethyl benzene	3.10	3.71	3.71
27	Lyon Development	U	Ethyl benzene	5.50	6.47	4.61
27	Lyon Development	U	Ethyl benzene	2.90	3.45	
27	Lyon Development	U	Ethyl benzene	3.90	3.90	
59	Rockingham	U	Ethyl benzene	8.00	10.6	10.6
60	Sunshine Canyon	U	Ethyl benzene	59.0	62.1	62.1
54	Arbor Hills	U	Ethyl mercaptan	0.29	0.30	0.21
54	Arbor Hills	U	Ethyl mercaptan	0.13	0.13	
12	BKK Landfill	Y	Ethyl mercaptan	1.90	4.26	5.39
12	BKK Landfill	Y	Ethyl mercaptan	1.90	4.19	
12	BKK Landfill	Y	Ethyl mercaptan	2.20	4.75	
12	BKK Landfill	Y	Ethyl mercaptan	1.70	3.66	
12	BKK Landfill	Y	Ethyl mercaptan	2.30	4.88	
12	BKK Landfill	Y	Ethyl mercaptan	2.90	8.38	
12	BKK Landfill	Y	Ethyl mercaptan	3.10	6.75	
12	BKK Landfill	Y	Ethyl mercaptan	2.60	5.57	
12	BKK Landfill	Y	Ethyl mercaptan	2.70	6.01	
56	Coyote Canyon	U	Ethyl mercaptan	0.40	0.60	1.25
56	Coyote Canyon	U	Ethyl mercaptan	1.40	1.90	
53	Altamont	U	Ethylene dibromide	0.00050	0.00060	0.00059
53	Altamont	U	Ethylene dibromide	0.00050	0.00058	
57	Durham Rd.	U	Ethylene dibromide	0.00050	0.00070	0.00063
57	Durham Rd.	U	Ethylene dibromide	0.00050	0.00060	
57	Durham Rd.	U	Ethylene dibromide	0.00050	0.00060	
41	Guadalupe	U	Ethylester acetic acid	34.1	40.8	40.8
41	Guadalupe	U	Ethylester butanoic acid	25.6	30.7	30.7
41	Guadalupe	U	Ethylester propanoic acid	4.70	5.63	5.63
43	CBI10	U	Fluorotrichloromethane	0.60	0.61	0.61
43	CBI11	U	Fluorotrichloromethane	2.85	2.88	2.88
43	CBI12	U	Fluorotrichloromethane	0.48	0.53	0.53
43	CBI13	U	Fluorotrichloromethane	0.66	0.80	0.80
43	CBI14	U	Fluorotrichloromethane	1.35	1.37	1.37
43	CBI15	U	Fluorotrichloromethane	0.73	0.74	0.74
43	CBI16	Y	Fluorotrichloromethane	0.70	0.71	0.71

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI17	U	Fluorotrichloromethane	2.35	2.37	2.37
43	CBI18	U	Fluorotrichloromethane	1.30	1.33	1.33
43	CBI19	U	Fluorotrichloromethane	1.05	1.05	1.05
43	CBI20	U	Fluorotrichloromethane	3.25	3.27	3.27
43	CBI21	U	Fluorotrichloromethane	1.08	1.09	1.09
43	CBI22	U	Fluorotrichloromethane	0.67	0.68	0.68
43	CBI23	U	Fluorotrichloromethane	2.10	2.23	2.23
43	CBI24	Y	Fluorotrichloromethane	0.06	0.06	0.06
43	CBI25	U	Fluorotrichloromethane	0.77	0.78	0.78
43	CBI26	U	Fluorotrichloromethane	0.45	0.45	0.45
43	CBI27	U	Fluorotrichloromethane	0.50	0.50	0.50
43	CBI30	U	Fluorotrichloromethane	0.47	0.47	0.47
43	CBI32	U	Fluorotrichloromethane	7.90	7.94	7.94
43	CBI33	U	Fluorotrichloromethane	0.10	0.10	0.10
43	CBI4	U	Fluorotrichloromethane	0.72	0.76	0.76
43	CBI5	U	Fluorotrichloromethane	0.25	0.25	0.25
43	CBI6	U	Fluorotrichloromethane	11.9	12.0	12.0
43	CBI7	U	Fluorotrichloromethane	0.20	0.20	0.20
43	CBI8	U	Fluorotrichloromethane	0.63	0.64	0.64
43	CBI9	U	Fluorotrichloromethane	1.10	1.11	1.11
43	CBI11	U	Hexane	6.50	6.57	6.57
43	CBI13	U	Hexane	2.49	3.01	3.01
43	CBI14	U	Hexane	20.8	21.1	21.1
43	CBI16	Y	Hexane	2.40	2.44	2.44
43	CBI17	U	Hexane	3.00	3.03	3.03
43	CBI18	U	Hexane	4.17	4.26	4.26
43	CBI19	U	Hexane	1.50	1.51	1.51
43	CBI24	Y	Hexane	6.34	6.44	6.44
43	CBI25	U	Hexane	13.4	13.5	13.5
43	CBI27	U	Hexane	7.13	7.18	7.18
43	CBI30	U	Hexane	6.06	6.12	6.12
43	CBI31	U	Hexane	1.00	1.00	1.00
43	CBI32	U	Hexane	10.0	10.1	10.1
43	CBI33	U	Hexane	3.83	3.84	3.84
43	CBI4	U	Hexane	7.30	7.67	7.67
43	CBI5	U	Hexane	11.3	11.4	11.4
43	CBI6	U	Hexane	7.00	7.05	7.05
43	CBI8	U	Hexane	18.0	18.1	18.1
43	CBI9	U	Hexane	25.0	25.3	25.3
54	Arbor Hills	U	Hydrogen sulfide	20.7	21.1	20.9
54	Arbor Hills	U	Hydrogen sulfide	20.4	20.8	
15	Azusa Land Reclamation	U	Hydrogen sulfide	28.0	29.2	29.2
15	Azusa Land Reclamation	U	Hydrogen sulfide	28.0	29.2	29.2
15	Azusa Land Reclamation	U	Hydrogen sulfide	34.0	35.5	35.5
15	Azusa Land Reclamation	U	Hydrogen sulfide	36.0	37.5	37.5
15	Azusa Land Reclamation	U	Hydrogen sulfide	39.0	40.7	40.7
15	Azusa Land Reclamation	U	Hydrogen sulfide	36.0	37.5	37.5
12	BKK Landfill	Y	Hydrogen sulfide	3.70	8.30	13.0
12	BKK Landfill	Y	Hydrogen sulfide	5.30	11.7	
12	BKK Landfill	Y	Hydrogen sulfide	8.20	17.7	
12	BKK Landfill	Y	Hydrogen sulfide	0.50	1.08	
12	BKK Landfill	Y	Hydrogen sulfide	2.30	4.88	
12	BKK Landfill	Y	Hydrogen sulfide	5.80	16.8	
12	BKK Landfill	Y	Hydrogen sulfide	7.60	16.6	
12	BKK Landfill	Y	Hydrogen sulfide	8.40	18.0	
12	BKK Landfill	Y	Hydrogen sulfide	10.0	22.3	
6	Bradley Pit	U	Hydrogen sulfide	64.0	87.7	80.8
6	Bradley Pit	U	Hydrogen sulfide	54.0	74.0	
7	Calabasas	Y	Hydrogen sulfide	11.3	17.2	17.2
56	Coyote Canyon	U	Hydrogen sulfide	46.4	68.5	62.5
56	Coyote Canyon	U	Hydrogen sulfide	42.4	56.5	
51	Palos Verdes	Y	Hydrogen sulfide	20.0	51.2	51.2
50	Puente Hills	N	Hydrogen sulfide	0.010	0.012	0.012
1	Scholl Canyon	N	Hydrogen sulfide	5.10	11.7	11.7
60	Sunshine Canyon	U	Hydrogen sulfide	78.0	82.1	82.1

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
12	BKK Landfill	Y	i-Propyl mercaptan	1.80	4.04	4.60
12	BKK Landfill	Y	i-Propyl mercaptan	1.60	3.53	
12	BKK Landfill	Y	i-Propyl mercaptan	1.70	3.67	
12	BKK Landfill	Y	i-Propyl mercaptan	1.70	3.66	
12	BKK Landfill	Y	i-Propyl mercaptan	1.90	4.03	
12	BKK Landfill	Y	i-Propyl mercaptan	2.50	7.23	
12	BKK Landfill	Y	i-Propyl mercaptan	2.30	5.01	
12	BKK Landfill	Y	i-Propyl mercaptan	2.40	5.14	
12	BKK Landfill	Y	i-Propyl mercaptan	2.30	5.12	
41	Guadalupe	U	Isooctanol	7.20	8.62	8.62
103	Fresh Kills Landfill	U	Mercury (total)	0.00149	0.00149	0.00149
94	Landfill A	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill B	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill C	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill D	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill E	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill F	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill G	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill H	U	Mercury (total)	0.000134	0.000134	0.000134
94	Landfill I	U	Mercury (total)	0.000134	0.000134	0.000134
95	Landfill A	U	Mercury (total)	0.000545	0.000545	0.000545
95	Landfill B	U	Mercury (total)	0.000246	0.000246	0.000246
95	Landfill C	U	Mercury (total)	0.00004	0.00004	0.00004
97	Mountaingate Landfill	U	Mercury (total)	0.000013	0.000013	0.000013
41	Guadalupe	U	Methyl cyclohexane	26.0	31.1	31.1
43	CBI10	U	Methyl ethyl ketone	5.00	5.10	5.10
43	CBI11	U	Methyl ethyl ketone	4.95	5.01	5.01
43	CBI12	U	Methyl ethyl ketone	12.0	13.2	13.2
43	CBI14	U	Methyl ethyl ketone	1.48	1.50	1.50
43	CBI15	U	Methyl ethyl ketone	3.75	3.79	3.79
43	CBI18	U	Methyl ethyl ketone	7.67	7.83	7.83
43	CBI20	U	Methyl ethyl ketone	11.0	11.1	11.1
43	CBI22	U	Methyl ethyl ketone	31.3	31.6	31.6
43	CBI23	U	Methyl ethyl ketone	5.50	5.84	5.84
43	CBI24	Y	Methyl ethyl ketone	18.8	19.0	19.0
43	CBI26	U	Methyl ethyl ketone	6.00	6.03	6.03
43	CBI27	U	Methyl ethyl ketone	5.00	5.04	5.04
43	CBI3	U	Methyl ethyl ketone	1.60	1.60	1.60
43	CBI31	U	Methyl ethyl ketone	21.0	21.0	21.0
43	CBI32	U	Methyl ethyl ketone	3.65	3.67	3.67
43	CBI33	U	Methyl ethyl ketone	6.33	6.34	6.34
43	CBI5	U	Methyl ethyl ketone	20.0	20.2	20.2
43	CBI6	U	Methyl ethyl ketone	4.70	4.73	4.73
43	CBI7	U	Methyl ethyl ketone	57.5	58.9	58.9
43	CBI9	U	Methyl ethyl ketone	15.0	15.2	15.2
41	Guadalupe	U	Methyl ethyl ketone	13.6	16.3	16.3
59	Rockingham	U	Methyl ethyl ketone	10.8	14.4	14.4
43	CBI11	U	Methyl isobutyl ketone	1.15	1.16	1.16
43	CBI12	U	Methyl isobutyl ketone	0.50	0.55	0.55
43	CBI15	U	Methyl isobutyl ketone	0.45	0.45	0.45
43	CBI18	U	Methyl isobutyl ketone	2.50	2.55	2.55
43	CBI20	U	Methyl isobutyl ketone	4.00	4.02	4.02
43	CBI22	U	Methyl isobutyl ketone	3.33	3.36	3.36
43	CBI23	U	Methyl isobutyl ketone	1.00	1.06	1.06
43	CBI24	Y	Methyl isobutyl ketone	5.00	5.08	5.08
43	CBI27	U	Methyl isobutyl ketone	1.00	1.01	1.01
43	CBI3	U	Methyl isobutyl ketone	0.70	0.70	0.70
43	CBI31	U	Methyl isobutyl ketone	1.00	1.00	1.00
43	CBI33	U	Methyl isobutyl ketone	3.33	3.34	3.34
43	CBI5	U	Methyl isobutyl ketone	6.50	6.57	6.57
43	CBI7	U	Methyl isobutyl ketone	11.50	11.78	11.78
43	CBI9	U	Methyl isobutyl ketone	1.20	1.21	1.21
54	Arbor Hills	U	Methyl mercaptan	0.29	0.30	0.52
54	Arbor Hills	U	Methyl mercaptan	0.73	0.74	
54	Arbor Hills	U	Methyl mercaptan	0.51	0.54	0.54

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
15	Azusa Land Reclamation	U	Methyl mercaptan	12.0	12.5	9.67
15	Azusa Land Reclamation	U	Methyl mercaptan	11.0	11.5	
15	Azusa Land Reclamation	U	Methyl mercaptan	10.0	10.4	
15	Azusa Land Reclamation	U	Methyl mercaptan	10.0	10.4	
15	Azusa Land Reclamation	U	Methyl mercaptan	10.0	10.4	
15	Azusa Land Reclamation	U	Methyl mercaptan	11.0	11.5	
15	Azusa Land Reclamation	U	Methyl mercaptan	0.88	0.92	
12	BKK Landfill	Y	Methyl mercaptan	2.50	5.61	4.60
12	BKK Landfill	Y	Methyl mercaptan	2.10	4.64	
12	BKK Landfill	Y	Methyl mercaptan	2.40	5.18	
12	BKK Landfill	Y	Methyl mercaptan	1.30	2.80	
12	BKK Landfill	Y	Methyl mercaptan	1.60	3.40	
12	BKK Landfill	Y	Methyl mercaptan	2.10	6.07	
12	BKK Landfill	Y	Methyl mercaptan	2.00	4.36	
12	BKK Landfill	Y	Methyl mercaptan	2.20	4.71	
12	BKK Landfill	Y	Methyl mercaptan	2.10	4.68	
6	Bradley Pit	U	Methyl mercaptan	2.20	3.01	3.01
56	Coyote Canyon	U	Methyl mercaptan	1.80	2.40	2.40
24	Puente Hills	N	Methyl mercaptan	1.10	1.60	1.30
24	Puente Hills	N	Methyl mercaptan	0.90	1.29	
24	Puente Hills	N	Methyl mercaptan	1.30	1.81	
24	Puente Hills	N	Methyl mercaptan	1.30	1.80	
50	Puente Hills	N	Methyl mercaptan	0.0014	0.0017	
60	Sunshine Canyon	U	Methyl mercaptan	12.0	12.6	12.6
41	Guadalupe	U	Methylester acetic acid	5.10	6.11	6.11
41	Guadalupe	U	Methylester butanoic acid	49.6	59.4	59.4
54	Arbor Hills	U	NMOC (as hexane)	1435	1469	1539
54	Arbor Hills	U	NMOC (as hexane)	1833	1850	
54	Arbor Hills	U	NMOC (as hexane)	1348	1374	
12	BKK Landfill	Y	NMOC (as hexane)	3133	6902	4533
12	BKK Landfill	Y	NMOC (as hexane)	1408	3306	
12	BKK Landfill	Y	NMOC (as hexane)	1543	3392	
6	Bradley Pit	U	NMOC (as hexane)	518	704	780
6	Bradley Pit	U	NMOC (as hexane)	757	947	
17	Bradley Pit	U	NMOC (as hexane)	335	419	
17	Bradley Pit	U	NMOC (as hexane)	407	509	
17	Bradley Pit	U	NMOC (as hexane)	848	1268	
17	Bradley Pit	U	NMOC (as hexane)	833	1282	
17	Bradley Pit	U	NMOC (as hexane)	735	910	
17	Bradley Pit	U	NMOC (as hexane)	705	851	
19	Bradley Pit	U	NMOC (as hexane)	202	306	
19	Bradley Pit	U	NMOC (as hexane)	555	707	
19	Bradley Pit	U	NMOC (as hexane)	723	932	
19	Bradley Pit	U	NMOC (as hexane)	717	889	
41	Bradley Pit	U	NMHC (as hexane)	285	412	940
26	CA	N	NMHC (as hexane)	162	183	183
26	CA	U	NMHC (as hexane)	912	1586	1586
7	Calabasas	Y	NMOC (as hexane)	1372	2432	2439
7	Calabasas	Y	NMOC (as hexane)	1247	2296	
7	Calabasas	Y	NMOC (as hexane)	1435	2590	
13	Carson	U	NMOC (as hexane)	342	457	712
13	Carson	U	NMOC (as hexane)	305	420	
13	Carson	U	NMOC (as hexane)	600	1261	
26	FL	U	NMHC (as hexane)	314	319	319
26	IL	U	NMHC (as hexane)	210	234	234
10	Mission Canyon	N	NMOC (as hexane)	26	105	105
5	Mountaingate	N	NMOC (as hexane)	88	254	245
5	Mountaingate	N	NMOC (as hexane)	70	202	
5	Mountaingate	N	NMOC (as hexane)	102	293	
5	Mountaingate	N	NMOC (as hexane)	80	230	
26	PA	Y	NMHC (as hexane)	411	459	459
22	Palos Verdes	Y	NMOC (as hexane)	475	2420	4337
22	Palos Verdes	Y	NMOC (as hexane)	562	2065	
22	Palos Verdes	Y	NMOC (as hexane)	190	731	
22	Palos Verdes	Y	NMOC (as hexane)	197	771	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
22	Palos Verdes	Y	NMOC (as hexane)	210	787	
51	Palos Verdes	Y	NMOC (as hexane)	8567	21910	
51	Palos Verdes	Y	NMOC (as hexane)	527	1677	
20	Penrose	U	NMOC (as hexane)	130	167	273
20	Penrose	U	NMOC (as hexane)	147	185	
20	Penrose	U	NMOC (as hexane)	177	304	
20	Penrose	U	NMOC (as hexane)	322	548	
20	Penrose	U	NMOC (as hexane)	99	240	
20	Penrose	U	NMOC (as hexane)	102	241	
20	Penrose	U	NMOC (as hexane)	117	233	
20	Penrose	U	NMOC (as hexane)	138	268	
61	Pinelands	U	NMOC (as hexane)	145	166	166
18	Puente Hills	N	NMOC (as hexane)	322	418	957
18	Puente Hills	N	NMOC (as hexane)	368	496	
18	Puente Hills	N	NMOC (as hexane)	342	456	
18	Puente Hills	N	NMOC (as hexane)	308	408	
24	Puente Hills	N	NMOC (as hexane)	1077	1565	
24	Puente Hills	N	NMOC (as hexane)	1035	1485	
24	Puente Hills	N	NMOC (as hexane)	852	1176	
24	Puente Hills	N	NMOC (as hexane)	903	1255	
50	Puente Hills	N	NMOC (as hexane)	1118	1355	
59	Rockingham	U	NMOC (as hexane)	129	172	172
1	Scholl Canyon	N	TGNMHC (hexane)	397	593	880
1	Scholl Canyon	N	TGNMHC (hexane)	672	1166	
9	Sheldon Street	U	NMOC (as hexane)	480	621	364
9	Sheldon Street	U	NMOC (as hexane)	292	388	
9	Sheldon Street	U	NMOC (as hexane)	113	315	
9	Sheldon Street	U	NMOC (as hexane)	49.7	133	
60	Sunshine Canyon	U	NMOC (as hexane)	733	772	772
23	Toyon Canyon	N	TGNMHC (hexane)	527	571	491
23	Toyon Canyon	N	TGNMHC (hexane)	455	485	
26	WI	Y	NMHC (as hexane)	296	348	348
43	CBI11	U	Pentane	3.25	3.29	3.29
43	CBI13	U	Pentane	0.58	0.70	0.70
43	CBI14	U	Pentane	11.1	11.2	11.2
43	CBI16	Y	Pentane	1.20	1.22	1.22
43	CBI17	U	Pentane	0.50	0.51	0.51
43	CBI18	U	Pentane	3.83	3.91	3.91
43	CBI19	U	Pentane	1.00	1.00	1.00
43	CBI24	Y	Pentane	0.39	0.40	0.40
43	CBI26	U	Pentane	0.50	0.50	0.50
43	CBI27	U	Pentane	46.5	46.9	46.9
43	CBI30	U	Pentane	3.96	4.00	4.00
43	CBI32	U	Pentane	9.00	9.05	9.05
43	CBI33	U	Pentane	1.10	1.10	1.10
43	CBI5	U	Pentane	17.6	17.8	17.8
43	CBI6	U	Pentane	18.0	18.1	18.1
43	CBI8	U	Pentane	0.67	0.68	0.68
43	CBI9	U	Pentane	45.0	45.5	45.5
53	Altamont	U	Perchloroethylene	2.30	2.77	2.61
53	Altamont	U	Perchloroethylene	2.10	2.44	
54	Arbor Hills	U	Perchloroethylene	7.74	7.92	7.63
54	Arbor Hills	U	Perchloroethylene	7.78	7.85	
54	Arbor Hills	U	Perchloroethylene	6.98	7.12	
15	Azusa Land Reclamation	U	Perchloroethylene	3.50	3.65	2.68
15	Azusa Land Reclamation	U	Perchloroethylene	3.60	3.75	
15	Azusa Land Reclamation	U	Perchloroethylene	3.90	4.07	
15	Azusa Land Reclamation	U	Perchloroethylene	1.90	1.98	
15	Azusa Land Reclamation	U	Perchloroethylene	2.30	2.40	
15	Azusa Land Reclamation	U	Perchloroethylene	2.90	3.02	
15	Azusa Land Reclamation	U	Perchloroethylene	0.33	0.34	
15	Azusa Land Reclamation	U	Perchloroethylene	1.40	1.46	
15	Azusa Land Reclamation	U	Perchloroethylene	3.30	3.44	
12	BKK Landfill	Y	Perchloroethylene	24.0	52.9	64.5
12	BKK Landfill	Y	Perchloroethylene	14.0	32.9	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
12	BKK Landfill	Y	Perchloroethylene	49.0	108	
17	Bradley Pit	U	Perchloroethylene	16.0	19.8	10.4
17	Bradley Pit	U	Perchloroethylene	14.0	21.5	
17	Bradley Pit	U	Perchloroethylene	16.0	23.9	
17	Bradley Pit	U	Perchloroethylene	16.0	19.3	
17	Bradley Pit	U	Perchloroethylene	6.00	7.51	
17	Bradley Pit	U	Perchloroethylene	7.80	9.76	
19	Bradley Pit	U	Perchloroethylene	6.20	7.69	
19	Bradley Pit	U	Perchloroethylene	7.30	9.30	
19	Bradley Pit	U	Perchloroethylene	3.80	5.77	
19	Bradley Pit	U	Perchloroethylene	6.50	8.38	
41	Bradley Pit	U	Perchloroethylene	0.08	0.11	
6	Bradley Pit	U	Perchloroethylene	2.10	2.85	
6	Bradley Pit	U	Perchloroethylene	5.80	7.26	
6	Bradley Pit	U	Perchloroethylene	1.40	1.92	
7	Calabasas	Y	Perchloroethylene	6.60	10.1	29.2
7	Calabasas	Y	Perchloroethylene	25.0	45.1	
7	Calabasas	Y	Perchloroethylene	18.0	32.5	
13	Carson	U	Perchloroethylene	0.039	0.082	0.055
13	Carson	U	Perchloroethylene	0.028	0.039	
13	Carson	U	Perchloroethylene	0.033	0.044	
43	CBI1	U	Perchloroethylene	4.75	4.88	4.88
43	CBI10	U	Perchloroethylene	4.60	4.69	4.69
43	CBI11	U	Perchloroethylene	12.0	12.1	12.1
43	CBI12	U	Perchloroethylene	2.40	2.64	2.64
43	CBI13	U	Perchloroethylene	0.74	0.90	0.90
43	CBI14	U	Perchloroethylene	14.9	15.1	15.1
43	CBI15	U	Perchloroethylene	0.23	0.23	0.23
43	CBI16	Y	Perchloroethylene	0.30	0.30	0.30
43	CBI17	U	Perchloroethylene	0.90	0.91	0.91
43	CBI18	U	Perchloroethylene	5.63	5.74	5.74
43	CBI19	U	Perchloroethylene	0.25	0.25	0.25
43	CBI2	U	Perchloroethylene	0.40	0.40	0.40
43	CBI20	U	Perchloroethylene	12.3	12.3	12.3
43	CBI21	U	Perchloroethylene	7.10	7.16	7.16
43	CBI22	U	Perchloroethylene	3.70	3.73	3.73
43	CBI23	U	Perchloroethylene	11.0	11.7	11.7
43	CBI24	Y	Perchloroethylene	12.6	12.8	12.8
43	CBI25	U	Perchloroethylene	8.20	8.27	8.27
43	CBI26	U	Perchloroethylene	0.40	0.40	0.40
43	CBI27	U	Perchloroethylene	2.63	2.65	2.65
43	CBI3	U	Perchloroethylene	0.10	0.10	0.10
43	CBI30	U	Perchloroethylene	6.82	6.88	6.88
43	CBI31	U	Perchloroethylene	3.80	3.81	3.81
43	CBI32	U	Perchloroethylene	1.00	1.01	1.01
43	CBI33	U	Perchloroethylene	1.53	1.53	1.53
43	CBI4	U	Perchloroethylene	12.1	12.7	12.7
43	CBI5	U	Perchloroethylene	10.5	10.6	10.6
43	CBI6	U	Perchloroethylene	0.95	0.96	0.96
43	CBI7	U	Perchloroethylene	7.75	7.94	7.94
43	CBI8	U	Perchloroethylene	65.0	65.5	65.5
43	CBI9	U	Perchloroethylene	9.30	9.39	9.39
55	Chicopee	U	Perchloroethylene	1.59	2.04	2.04
56	Coyote Canyon	U	Perchloroethylene	5.31	7.07	8.75
56	Coyote Canyon	U	Perchloroethylene	5.12	6.82	
56	Coyote Canyon	U	Perchloroethylene	4.73	6.30	
56	Coyote Canyon	U	Perchloroethylene	4.86	7.20	
56	Coyote Canyon	U	Perchloroethylene	7.91	11.53	
56	Coyote Canyon	U	Perchloroethylene	9.18	13.6	
57	Durham Rd.	U	Perchloroethylene	7.60	10.0	10.2
57	Durham Rd.	U	Perchloroethylene	8.20	9.88	
57	Durham Rd.	U	Perchloroethylene	9.10	10.8	
41	Guadalupe	U	Perchloroethylene	54.4	65.1	65.1
27	Lyon Development	U	Perchloroethylene	2.90	3.41	2.90
27	Lyon Development	U	Perchloroethylene	4.40	5.24	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
27	Lyon Development	U	Perchloroethylene	0.040	0.040	
10	Mission Canyon	N	Perchloroethylene	0.0026	0.011	0.01
5	Mountaingate	N	Perchloroethylene	1.00	2.89	2.89
5	Mountaingate	N	Perchloroethylene	1.10	3.18	3.18
5	Mountaingate	N	Perchloroethylene	0.91	2.61	2.61
5	Mountaingate	N	Perchloroethylene	1.10	3.16	3.16
8	Operating Industries	U	Perchloroethylene	0.27	0.54	0.54
58	Otay Annex	U	Perchloroethylene	2.94	3.18	3.18
84	Otay Landfill	Y	Perchloroethylene	3.47	4.71	4.71
22	Palos Verdes	Y	Perchloroethylene	0.16	0.70	2.60
22	Palos Verdes	Y	Perchloroethylene	0.42	1.83	
22	Palos Verdes	Y	Perchloroethylene	0.22	0.96	
22	Palos Verdes	Y	Perchloroethylene	0.34	1.48	
22	Palos Verdes	Y	Perchloroethylene	0.69	3.01	
22	Palos Verdes	Y	Perchloroethylene	0.49	2.14	
22	Palos Verdes	Y	Perchloroethylene	0.34	1.48	
22	Palos Verdes	Y	Perchloroethylene	0.15	0.65	
22	Palos Verdes	Y	Perchloroethylene	0.42	1.83	
22	Palos Verdes	Y	Perchloroethylene	0.57	2.49	
22	Palos Verdes	Y	Perchloroethylene	0.09	0.41	
22	Palos Verdes	Y	Perchloroethylene	0.52	2.27	
51	Palos Verdes	Y	Perchloroethylene	3.40	10.8	
51	Palos Verdes	Y	Perchloroethylene	2.50	6.39	
20	Penrose	U	Perchloroethylene	1.50	1.92	2.79
20	Penrose	U	Perchloroethylene	1.60	2.02	
20	Penrose	U	Perchloroethylene	3.00	5.16	
20	Penrose	U	Perchloroethylene	3.20	5.45	
20	Penrose	U	Perchloroethylene	0.91	2.21	
20	Penrose	U	Perchloroethylene	0.97	2.29	
20	Penrose	U	Perchloroethylene	0.64	1.27	
20	Penrose	U	Perchloroethylene	1.00	1.95	
18	Puente Hills	N	Perchloroethylene	7.90	10.3	24.25
18	Puente Hills	N	Perchloroethylene	8.50	11.5	
18	Puente Hills	N	Perchloroethylene	7.40	9.87	
18	Puente Hills	N	Perchloroethylene	5.90	7.81	
24	Puente Hills	N	Perchloroethylene	8.80	12.7	
24	Puente Hills	N	Perchloroethylene	0.94	1.30	
50	Puente Hills	N	Perchloroethylene	96.0	116	
59	Rockingham	U	Perchloroethylene	9.00	12.0	12.0
1	Scholl Canyon	N	Perchloroethylene	2.80	4.49	4.65
1	Scholl Canyon	N	Perchloroethylene	2.10	4.81	
9	Sheldon Street	U	Perchloroethylene	0.02	0.03	2.09
9	Sheldon Street	U	Perchloroethylene	4.10	8.16	
9	Sheldon Street	U	Perchloroethylene	0.04	0.08	
9	Sheldon Street	U	Perchloroethylene	0.04	0.08	
60	Sunshine Canyon	U	Perchloroethylene	13.0	13.7	13.7
23	Toyon Canyon	N	Perchloroethylene	0.98	1.05	1.05
43	CBI11	U	Propane	86.5	87.5	87.5
43	CBI13	U	Propane	9.76	11.8	11.8
43	CBI14	U	Propane	48.8	49.4	49.4
43	CBI16	Y	Propane	5.20	5.28	5.28
43	CBI17	U	Propane	7.00	7.07	7.07
43	CBI18	U	Propane	4.67	4.77	4.77
43	CBI19	U	Propane	6.50	6.53	6.53
43	CBI24	Y	Propane	4.26	4.33	4.33
43	CBI25	U	Propane	18.2	18.3	18.3
43	CBI26	U	Propane	11.0	11.1	11.1
43	CBI27	U	Propane	1.40	1.41	1.41
43	CBI30	U	Propane	13.1	13.2	13.2
43	CBI32	U	Propane	6.50	6.53	6.53
43	CBI33	U	Propane	0.63	0.63	0.63
43	CBI34	U	Propane	2.50	2.51	2.51
43	CBI4	U	Propane	43.6	45.8	45.8
43	CBI5	U	Propane	32.0	32.3	32.3
43	CBI6	U	Propane	36.5	36.8	36.8

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI8	U	Propane	25.3	25.5	25.5
43	CBI9	U	Propane	68.0	68.7	68.7
41	Guadalupe	U	Propane	4.60	5.51	5.51
60	Sunshine Canyon	U	Propyl mercaptan	0.25	0.26	0.26
41	Guadalupe	U	Propylester acetic acid	34.0	40.7	40.7
41	Guadalupe	U	Propylester butanoic acid	86.6	104	104
19	Bradley Pit	U	t-1,2-Dichloroethene	12.0	15.5	7.89
19	Bradley Pit	U	t-1,2-Dichloroethene	9.30	11.8	
19	Bradley Pit	U	t-1,2-Dichloroethene	2.40	3.64	
19	Bradley Pit	U	t-1,2-Dichloroethene	11.0	13.6	
6	Bradley Pit	U	t-1,2-Dichloroethene	1.30	1.78	
6	Bradley Pit	U	t-1,2-Dichloroethene	0.60	0.82	
6	Bradley Pit	U	t-1,2-Dichloroethene	6.40	8.01	
7	Calabasas	Y	t-1,2-Dichloroethene	52.0	93.9	93.9
43	CBI10	U	t-1,2-Dichloroethene	6.20	6.32	6.32
43	CBI11	U	t-1,2-Dichloroethene	18.5	18.7	18.7
43	CBI12	U	t-1,2-Dichloroethene	5.27	5.81	5.81
43	CBI13	U	t-1,2-Dichloroethene	0.13	0.16	0.16
43	CBI14	U	t-1,2-Dichloroethene	8.58	8.68	8.68
43	CBI15	U	t-1,2-Dichloroethene	0.83	0.84	0.84
43	CBI17	U	t-1,2-Dichloroethene	1.65	1.67	1.67
43	CBI18	U	t-1,2-Dichloroethene	7.82	7.98	7.98
43	CBI19	U	t-1,2-Dichloroethene	0.30	0.30	0.30
43	CBI2	U	t-1,2-Dichloroethene	0.25	0.25	0.25
43	CBI20	U	t-1,2-Dichloroethene	5.45	5.48	5.48
43	CBI21	U	t-1,2-Dichloroethene	2.78	2.80	2.80
43	CBI22	U	t-1,2-Dichloroethene	6.23	6.29	6.29
43	CBI23	U	t-1,2-Dichloroethene	13.00	13.80	13.8
43	CBI24	Y	t-1,2-Dichloroethene	4.55	4.62	4.62
43	CBI26	U	t-1,2-Dichloroethene	0.50	0.50	0.50
43	CBI27	U	t-1,2-Dichloroethene	3.93	3.96	3.96
43	CBI28	U	t-1,2-Dichloroethene	1.20	1.20	1.20
43	CBI29	U	t-1,2-Dichloroethene	11.49	12.16	12.2
43	CBI3	U	t-1,2-Dichloroethene	0.60	0.60	0.60
43	CBI30	U	t-1,2-Dichloroethene	0.11	0.11	0.11
43	CBI31	U	t-1,2-Dichloroethene	8.80	8.82	8.82
43	CBI32	U	t-1,2-Dichloroethene	1.20	1.21	1.21
43	CBI33	U	t-1,2-Dichloroethene	2.87	2.88	2.88
43	CBI34	U	t-1,2-Dichloroethene	0.50	0.50	0.50
43	CBI5	U	t-1,2-Dichloroethene	7.35	7.42	7.42
43	CBI6	U	t-1,2-Dichloroethene	0.90	0.91	0.91
43	CBI7	U	t-1,2-Dichloroethene	1.35	1.38	1.38
43	CBI8	U	t-1,2-Dichloroethene	1.30	1.31	1.31
43	CBI9	U	t-1,2-Dichloroethene	0.90	0.91	0.91
27	Lyon Development	U	t-1,2-Dichloroethene	0.20	0.24	0.26
27	Lyon Development	U	t-1,2-Dichloroethene	0.41	0.49	
27	Lyon Development	U	t-1,2-Dichloroethene	0.060	0.060	
5	Mountaingate	N	t-1,2-Dichloroethene	0.080	0.23	0.23
5	Mountaingate	N	t-1,2-Dichloroethene	0.080	0.23	
5	Mountaingate	N	t-1,2-Dichloroethene	0.080	0.23	
5	Mountaingate	N	t-1,2-Dichloroethene	0.080	0.23	
20	Penrose	U	t-1,2-Dichloroethene	1.50	1.92	2.90
20	Penrose	U	t-1,2-Dichloroethene	1.50	1.90	
20	Penrose	U	t-1,2-Dichloroethene	1.50	2.58	
20	Penrose	U	t-1,2-Dichloroethene	1.50	2.56	
20	Penrose	U	t-1,2-Dichloroethene	1.50	3.65	
20	Penrose	U	t-1,2-Dichloroethene	1.50	3.55	
20	Penrose	U	t-1,2-Dichloroethene	1.80	3.58	
20	Penrose	U	t-1,2-Dichloroethene	1.80	3.51	
18	Puente Hills	N	t-1,2-Dichloroethene	17.0	22.1	22.5
18	Puente Hills	N	t-1,2-Dichloroethene	17.0	22.9	
18	Puente Hills	N	t-1,2-Dichloroethene	17.0	22.7	
18	Puente Hills	N	t-1,2-Dichloroethene	17.0	22.5	
41	Guadalupe	U	Tetrahydrofuran	3.40	4.07	4.07
41	Guadalupe	U	Thiobismethane	10.6	12.7	12.7

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
54	Arbor Hills	U	Toluene	69.5	71.1	70.1
54	Arbor Hills	U	Toluene	69.7	70.3	
54	Arbor Hills	U	Toluene	67.6	68.9	
15	Azusa Land Reclamation	U	Toluene	21.0	21.9	38.1
15	Azusa Land Reclamation	U	Toluene	45.0	46.9	
15	Azusa Land Reclamation	U	Toluene	29.0	30.2	
15	Azusa Land Reclamation	U	Toluene	32.0	33.4	
15	Azusa Land Reclamation	U	Toluene	53.0	55.3	
15	Azusa Land Reclamation	U	Toluene	46.0	48.0	
15	Azusa Land Reclamation	U	Toluene	44.0	45.9	
15	Azusa Land Reclamation	U	Toluene	28.0	29.2	
15	Azusa Land Reclamation	U	Toluene	31.0	32.3	
12	BKK Landfill	Y	Toluene	180	396	380
12	BKK Landfill	Y	Toluene	130	305	
12	BKK Landfill	Y	Toluene	200	440	
17	Bradley Pit	U	Toluene	34.0	50.8	26.3
17	Bradley Pit	U	Toluene	30.0	46.2	
17	Bradley Pit	U	Toluene	15.0	18.8	
17	Bradley Pit	U	Toluene	14.0	17.5	
17	Bradley Pit	U	Toluene	24.0	29.7	
17	Bradley Pit	U	Toluene	24.0	29.0	
41	Bradley Pit	U	Toluene	4.50	6.50	
6	Bradley Pit	U	Toluene	5.80	7.95	
6	Bradley Pit	U	Toluene	26.0	32.5	
6	Bradley Pit	U	Toluene	18.0	24.5	
7	Calabasas	Y	Toluene	196	299	256
7	Calabasas	Y	Toluene	110	199	
7	Calabasas	Y	Toluene	150	271	
13	Carson	U	Toluene	24.0	50.4	30.4
13	Carson	U	Toluene	14.0	19.3	
13	Carson	U	Toluene	16.0	21.4	
43	CBI1	U	Toluene	70.8	72.8	72.8
43	CBI10	U	Toluene	31.5	32.1	32.1
43	CBI11	U	Toluene	40.0	40.4	40.4
43	CBI12	U	Toluene	28.2	31.1	31.1
43	CBI13	U	Toluene	35.5	43.0	43.0
43	CBI14	U	Toluene	60.9	61.6	61.6
43	CBI15	U	Toluene	1.45	1.46	1.46
43	CBI16	Y	Toluene	17.2	17.5	17.5
43	CBI17	U	Toluene	3.00	3.03	3.03
43	CBI18	U	Toluene	77.2	78.7	78.7
43	CBI19	U	Toluene	2.10	2.11	2.11
43	CBI2	U	Toluene	2.50	2.52	2.52
43	CBI20	U	Toluene	47.5	47.8	47.8
43	CBI21	U	Toluene	19.4	19.5	19.5
43	CBI22	U	Toluene	23.3	23.5	23.5
43	CBI23	U	Toluene	37.0	39.3	39.3
43	CBI24	Y	Toluene	125	127	127
43	CBI25	U	Toluene	221	223	223
43	CBI26	U	Toluene	5.85	5.88	5.88
43	CBI27	U	Toluene	13.9	14.0	14.0
43	CBI28	U	Toluene	1.05	1.05	1.05
43	CBI29	U	Toluene	347	367	367
43	CBI3	U	Toluene	19.0	19.0	19.0
43	CBI30	U	Toluene	123	124	124
43	CBI31	U	Toluene	53.0	53.1	53.1
43	CBI32	U	Toluene	12.7	12.8	12.8
43	CBI33	U	Toluene	27.2	27.3	27.3
43	CBI34	U	Toluene	0.85	0.85	0.85
43	CBI4	U	Toluene	37.9	39.8	39.8
43	CBI5	U	Toluene	43.5	43.9	43.9
43	CBI6	U	Toluene	10.1	10.1	10.1
43	CBI7	U	Toluene	68.5	70.2	70.2
43	CBI8	U	Toluene	51.0	51.4	51.4
43	CBI9	U	Toluene	30.0	30.3	30.3

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
55	Chicopee	U	Toluene	119	153	153
56	Coyote Canyon	U	Toluene	57.5	76.6	84.7
56	Coyote Canyon	U	Toluene	59.8	79.6	
56	Coyote Canyon	U	Toluene	59.3	79.0	
56	Coyote Canyon	U	Toluene	60.4	89.5	
56	Coyote Canyon	U	Toluene	59.8	87.2	
56	Coyote Canyon	U	Toluene	65.2	96.4	
41	Guadalupe	U	Toluene	160	192	192
27	Lyon Development	U	Toluene	32.0	37.6	21.8
27	Lyon Development	U	Toluene	23.0	27.4	
27	Lyon Development	U	Toluene	0.40	0.40	
10	Mission Canyon	N	Toluene	0.05	0.20	0.20
5	Mountaingate	N	Toluene	1.90	5.49	6.27
5	Mountaingate	N	Toluene	1.80	5.20	
5	Mountaingate	N	Toluene	1.90	5.46	
5	Mountaingate	N	Toluene	3.10	8.91	
8	Operating Industries	U	Toluene	56	112	112
22	Palos Verdes	Y	Toluene	1.00	4.36	44.5
22	Palos Verdes	Y	Toluene	9.50	41.4	
22	Palos Verdes	Y	Toluene	1.00	4.36	
22	Palos Verdes	Y	Toluene	4.30	18.7	
22	Palos Verdes	Y	Toluene	1.10	4.80	
22	Palos Verdes	Y	Toluene	5.50	24.0	
22	Palos Verdes	Y	Toluene	12.0	52.3	
22	Palos Verdes	Y	Toluene	19.0	82.8	
22	Palos Verdes	Y	Toluene	3.90	17.0	
22	Palos Verdes	Y	Toluene	9.50	41.4	
22	Palos Verdes	Y	Toluene	1.00	4.36	
22	Palos Verdes	Y	Toluene	19.0	82.8	
51	Palos Verdes	Y	Toluene	22.0	70.1	
51	Palos Verdes	Y	Toluene	68.0	174	
20	Penrose	U	Toluene	22.0	28.2	49.8
20	Penrose	U	Toluene	21.0	26.5	
20	Penrose	U	Toluene	42.0	72.3	
20	Penrose	U	Toluene	68.0	116	
20	Penrose	U	Toluene	14.0	34.1	
20	Penrose	U	Toluene	15.0	35.5	
20	Penrose	U	Toluene	16.0	31.8	
20	Penrose	U	Toluene	28.0	54.6	
18	Puente Hills	N	Toluene	180	234	212
18	Puente Hills	N	Toluene	190	256	
18	Puente Hills	N	Toluene	240	320	
18	Puente Hills	N	Toluene	230	305	
24	Puente Hills	N	Toluene	57.5	83.0	
24	Puente Hills	N	Toluene	55.5	76.9	
50	Puente Hills	N	Toluene	100	121	121
59	Rockingham	U	Toluene	99	132	132
1	Scholl Canyon	N	Toluene	47.0	75.4	46.3
1	Scholl Canyon	N	Toluene	7.50	17.2	
9	Sheldon Street	U	Toluene	20.0	39.8	14.1
9	Sheldon Street	U	Toluene	0.54	1.07	
9	Sheldon Street	U	Toluene	3.90	7.76	
9	Sheldon Street	U	Toluene	3.90	7.76	
60	Sunshine Canyon	U	Toluene	100	105	105
23	Toyon Canyon	N	Toluene	8.40	9.03	9.03
53	Altamont	U	Trichloroethene	6.90	8.31	4.95
53	Altamont	U	Trichloroethene	3.10	3.60	
53	Altamont	U	Trichloroethene	5.00	5.92	5.92
53	Arbor Hills	U	Trichloroethene	4.37	4.47	4.24
53	Arbor Hills	U	Trichloroethene	4.14	4.18	
53	Arbor Hills	U	Trichloroethene	4.00	4.08	
53	Arbor Hills	U	Trichloroethene	4.17	4.44	4.44
15	Azusa Land Reclamation	U	Trichloroethene	4.30	4.48	3.72
15	Azusa Land Reclamation	U	Trichloroethene	3.40	3.55	
15	Azusa Land Reclamation	U	Trichloroethene	8.90	9.28	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
15	Azusa Land Reclamation	U	Trichloroethene	3.30	3.44	
15	Azusa Land Reclamation	U	Trichloroethene	3.50	3.65	
15	Azusa Land Reclamation	U	Trichloroethene	0.79	0.82	
15	Azusa Land Reclamation	U	Trichloroethene	3.60	3.75	
15	Azusa Land Reclamation	U	Trichloroethene	3.70	3.86	
15	Azusa Land Reclamation	U	Trichloroethene	0.59	0.62	
12	BKK Landfill	Y	Trichloroethene	13.0	28.6	28.7
12	BKK Landfill	Y	Trichloroethene	4.80	11.3	
12	BKK Landfill	Y	Trichloroethene	21.0	46.2	
17	Bradley Pit	U	Trichloroethene	5.90	7.30	5.15
17	Bradley Pit	U	Trichloroethene	2.40	3.00	
17	Bradley Pit	U	Trichloroethene	1.90	2.38	
17	Bradley Pit	U	Trichloroethene	6.20	7.49	
17	Bradley Pit	U	Trichloroethene	6.50	9.72	
17	Bradley Pit	U	Trichloroethene	5.50	8.46	
19	Bradley Pit	U	Trichloroethene	4.90	6.47	
19	Bradley Pit	U	Trichloroethene	4.90	6.24	
19	Bradley Pit	U	Trichloroethene	1.60	2.43	
19	Bradley Pit	U	Trichloroethene	4.60	5.71	
6	Bradley Pit	U	Trichloroethene	5.10	6.57	
6	Bradley Pit	U	Trichloroethene	0.20	0.29	
6	Bradley Pit	U	Trichloroethene	3.70	4.63	
6	Bradley Pit	U	Trichloroethene	1.00	1.36	
7	Calabasas	Y	Trichloroethene	0.69	0.95	14.8
7	Calabasas	Y	Trichloroethene	12.0	21.7	
7	Calabasas	Y	Trichloroethene	12.0	21.7	
13	Carson	U	Trichloroethene	0.17	0.23	0.28
13	Carson	U	Trichloroethene	0.16	0.22	
13	Carson	U	Trichloroethene	0.19	0.40	
43	CBI10	U	Trichloroethene	3.25	3.31	3.31
43	CBI11	U	Trichloroethene	21.5	21.7	21.7
43	CBI12	U	Trichloroethene	1.54	1.70	1.70
43	CBI13	U	Trichloroethene	0.22	0.27	0.27
43	CBI14	U	Trichloroethene	6.96	7.04	7.04
43	CBI15	U	Trichloroethene	0.18	0.18	0.18
43	CBI16	Y	Trichloroethene	0.30	0.30	0.30
43	CBI17	U	Trichloroethene	0.40	0.40	0.40
43	CBI18	U	Trichloroethene	5.23	5.34	5.34
43	CBI19	U	Trichloroethene	0.15	0.15	0.15
43	CBI2	U	Trichloroethene	0.20	0.20	0.20
43	CBI20	U	Trichloroethene	3.75	3.77	3.77
43	CBI21	U	Trichloroethene	1.38	1.39	1.39
43	CBI22	U	Trichloroethene	1.63	1.64	1.64
43	CBI23	U	Trichloroethene	3.10	3.29	3.29
43	CBI24	Y	Trichloroethene	13.0	13.2	13.2
43	CBI25	U	Trichloroethene	7.85	7.91	7.91
43	CBI26	U	Trichloroethene	0.20	0.20	0.20
43	CBI27	U	Trichloroethene	1.67	1.68	1.68
43	CBI30	U	Trichloroethene	2.02	2.04	2.04
43	CBI31	U	Trichloroethene	1.80	1.80	1.80
43	CBI32	U	Trichloroethene	1.55	1.56	1.56
43	CBI33	U	Trichloroethene	0.50	0.50	0.50
43	CBI4	U	Trichloroethene	1.14	1.20	1.20
43	CBI5	U	Trichloroethene	3.05	3.08	3.08
43	CBI6	U	Trichloroethene	0.45	0.45	0.45
43	CBI7	U	Trichloroethene	4.70	4.82	4.82
43	CBI8	U	Trichloroethene	7.80	7.86	7.86
43	CBI9	U	Trichloroethene	3.40	3.43	3.43
55	Chicopee	U	Trichloroethene	2.20	2.82	2.82
56	Coyote Canyon	U	Trichloroethene	2.38	3.17	3.64
56	Coyote Canyon	U	Trichloroethene	2.23	2.97	
56	Coyote Canyon	U	Trichloroethene	2.47	3.29	
56	Coyote Canyon	U	Trichloroethene	2.37	3.51	
56	Coyote Canyon	U	Trichloroethene	3.01	4.39	
56	Coyote Canyon	U	Trichloroethene	3.06	4.53	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
57	Durham Rd.	U	Trichloroethene	2.50	3.29	3.21
57	Durham Rd.	U	Trichloroethene	2.60	3.13	
57	Durham Rd.	U	Trichloroethene	2.70	3.21	
57	Durham Rd.	U	Trichloroethene	2.60	3.19	3.19
41	Guadalupe	U	Trichloroethene	18.7	22.4	22.4
27	Lyon Development	U	Trichloroethene	2.60	3.06	2.14
27	Lyon Development	U	Trichloroethene	2.80	3.33	
27	Lyon Development	U	Trichloroethene	0.040	0.040	
10	Mission Canyon	N	Trichloroethene	0.0062	0.026	0.026
5	Mountaingate	N	Trichloroethene	0.54	1.55	1.72
5	Mountaingate	N	Trichloroethene	0.62	1.79	
5	Mountaingate	N	Trichloroethene	0.60	1.73	
5	Mountaingate	N	Trichloroethene	0.63	1.81	
8	Operating Industries	U	Trichloroethene	1.20	2.39	2.39
58	Otay Annex	U	Trichloroethene	2.09	2.84	2.84
84	Otay Landfill	Y	Trichloroethene	3.23	3.49	3.49
22	Palos Verdes	Y	Trichloroethene	0.36	1.57	1.38
22	Palos Verdes	Y	Trichloroethene	0.29	1.26	
22	Palos Verdes	Y	Trichloroethene	0.32	1.40	
22	Palos Verdes	Y	Trichloroethene	0.31	1.35	
22	Palos Verdes	Y	Trichloroethene	0.36	1.57	
22	Palos Verdes	Y	Trichloroethene	0.28	1.22	
22	Palos Verdes	Y	Trichloroethene	0.20	0.87	
22	Palos Verdes	Y	Trichloroethene	0.19	0.83	
22	Palos Verdes	Y	Trichloroethene	0.29	1.26	
22	Palos Verdes	Y	Trichloroethene	0.15	0.65	
22	Palos Verdes	Y	Trichloroethene	0.34	1.48	
22	Palos Verdes	Y	Trichloroethene	0.09	0.38	
51	Palos Verdes	Y	Trichloroethene	0.91	2.33	
51	Palos Verdes	Y	Trichloroethene	0.98	3.12	
20	Penrose	U	Trichloroethene	1.20	1.54	1.97
20	Penrose	U	Trichloroethene	1.30	1.64	
20	Penrose	U	Trichloroethene	1.90	3.27	
20	Penrose	U	Trichloroethene	2.00	3.41	
20	Penrose	U	Trichloroethene	0.65	1.58	
20	Penrose	U	Trichloroethene	0.68	1.61	
20	Penrose	U	Trichloroethene	0.61	1.21	
20	Penrose	U	Trichloroethene	0.75	1.46	
18	Puente Hills	N	Trichloroethene	3.90	5.06	6.36
18	Puente Hills	N	Trichloroethene	4.30	5.80	
18	Puente Hills	N	Trichloroethene	4.30	5.73	
18	Puente Hills	N	Trichloroethene	3.60	4.77	
24	Puente Hills	N	Trichloroethene	4.40	6.35	
24	Puente Hills	N	Trichloroethene	0.75	1.03	
50	Puente Hills	N	Trichloroethene	13.0	15.8	
59	Rockingham	U	Trichloroethene	5.30	7.05	7.05
1	Scholl Canyon	N	Trichloroethene	2.10	3.37	1.90
1	Scholl Canyon	N	Trichloroethene	0.19	0.43	
9	Sheldon Street	U	Trichloroethene	0.19	0.38	0.80
9	Sheldon Street	U	Trichloroethene	0.04	0.07	
9	Sheldon Street	U	Trichloroethene	0.19	0.38	
9	Sheldon Street	U	Trichloroethene	1.20	2.39	
60	Sunshine Canyon	U	Trichloroethene	2.40	2.53	2.53
23	Toyon Canyon	N	Trichloroethene	0.86	0.92	0.92
10	Mission Canyon	N	Vinyl chloride	0.05	0.22	0.22
5	Mountaingate	N	Vinyl chloride	4.40	12.6	12.5
5	Mountaingate	N	Vinyl chloride	4.40	12.7	
5	Mountaingate	N	Vinyl chloride	4.20	12.1	
5	Mountaingate	N	Vinyl chloride	4.40	12.6	
18	Puente Hills	N	Vinyl chloride	18.0	23.4	16.7
18	Puente Hills	N	Vinyl chloride	18.0	24.3	
18	Puente Hills	N	Vinyl chloride	15.0	20.0	
18	Puente Hills	N	Vinyl chloride	14.0	18.5	
24	Puente Hills	N	Vinyl chloride	6.80	9.81	
24	Puente Hills	N	Vinyl chloride	6.70	9.28	

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
50	Puente Hills	N	Vinyl chloride	9.40	11.4	
1	Scholl Canyon	N	Vinyl chloride	6.70	10.8	10.1
1	Scholl Canyon	N	Vinyl chloride	4.10	9.38	
23	Toyon Canyon	N	Vinyl chloride	0.12	0.13	0.13
53	Altamont	U	Vinyl Chloride	55.0	66.3	52.3
53	Altamont	U	Vinyl Chloride	33.0	38.4	
54	Arbor Hills	U	Vinyl Chloride	6.58	6.73	6.70
54	Arbor Hills	U	Vinyl Chloride	6.58	6.64	
54	Arbor Hills	U	Vinyl Chloride	6.61	6.74	
15	Azusa Land Reclamation	U	Vinyl chloride	2.80	2.92	2.25
15	Azusa Land Reclamation	U	Vinyl chloride	2.90	3.02	
15	Azusa Land Reclamation	U	Vinyl chloride	2.80	2.92	
15	Azusa Land Reclamation	U	Vinyl chloride	0.00	0.00	
15	Azusa Land Reclamation	U	Vinyl chloride	2.80	2.92	
15	Azusa Land Reclamation	U	Vinyl chloride	1.10	1.15	
15	Azusa Land Reclamation	U	Vinyl chloride	1.10	1.15	
15	Azusa Land Reclamation	U	Vinyl chloride	2.50	2.61	
15	Azusa Land Reclamation	U	Vinyl chloride	2.80	2.92	
15	Azusa Land Reclamation	U	Vinyl chloride	2.80	2.92	
17	Bradley Pit	U	Vinyl chloride	13.00	17.13	12.44
17	Bradley Pit	U	Vinyl chloride	2.30	3.03	
17	Bradley Pit	U	Vinyl chloride	11.00	14.49	
17	Bradley Pit	U	Vinyl chloride	11.00	14.49	
17	Bradley Pit	U	Vinyl chloride	4.00	5.27	
17	Bradley Pit	U	Vinyl chloride	4.00	5.27	
17	Bradley Pit	U	Vinyl chloride	13.00	17.13	
17	Bradley Pit	U	Vinyl chloride	11.00	14.49	
17	Bradley Pit	U	Vinyl chloride	13.00	17.13	
19	Bradley Pit	U	Vinyl chloride	20.0	25.5	
19	Bradley Pit	U	Vinyl chloride	3.40	5.16	
19	Bradley Pit	U	Vinyl chloride	13.0	16.1	
19	Bradley Pit	U	Vinyl chloride	11.0	14.2	
6	Bradley Pit	U	Vinyl chloride	0.80	1.16	
6	Bradley Pit	U	Vinyl chloride	22.0	27.5	
6	Bradley Pit	U	Vinyl chloride	5.00	6.79	
6	Bradley Pit	U	Vinyl chloride	4.80	6.58	
13	Carson	U	Vinyl chloride	4.90	6.74	6.52
13	Carson	U	Vinyl chloride	4.70	6.29	
43	CBI10	U	Vinyl chloride	2.05	2.09	2.09
43	CBI11	U	Vinyl chloride	19.0	19.2	19.2
43	CBI12	U	Vinyl chloride	8.43	9.29	9.29
43	CBI13	U	Vinyl chloride	9.98	12.08	12.08
43	CBI14	U	Vinyl chloride	6.11	6.18	6.18
43	CBI15	U	Vinyl chloride	2.70	2.73	2.73
43	CBI17	U	Vinyl chloride	11.4	11.5	11.5
43	CBI18	U	Vinyl chloride	10.9	11.1	11.1
43	CBI19	U	Vinyl chloride	1.95	1.96	1.96
43	CBI2	U	Vinyl chloride	0.40	0.40	0.40
43	CBI20	U	Vinyl chloride	7.60	7.65	7.65
43	CBI21	U	Vinyl chloride	15.0	15.1	15.1
43	CBI22	U	Vinyl chloride	4.93	4.97	4.97
43	CBI23	U	Vinyl chloride	13.0	13.8	13.8
43	CBI25	U	Vinyl chloride	15.2	15.3	15.3
43	CBI26	U	Vinyl chloride	5.20	5.23	5.23
43	CBI27	U	Vinyl chloride	12.4	12.5	12.5
43	CBI3	U	Vinyl chloride	1.30	1.30	1.30
43	CBI30	U	Vinyl chloride	5.61	5.66	5.66
43	CBI32	U	Vinyl chloride	7.70	7.74	7.74
43	CBI33	U	Vinyl chloride	14.4	14.4	14.4
43	CBI34	U	Vinyl chloride	9.60	9.62	9.62
43	CBI4	U	Vinyl chloride	2.65	2.78	2.78
43	CBI5	U	Vinyl chloride	7.70	7.78	7.78
43	CBI6	U	Vinyl chloride	3.25	3.27	3.27
43	CBI7	U	Vinyl chloride	3.00	3.07	3.07
43	CBI8	U	Vinyl chloride	3.83	3.86	3.86

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI9	U	Vinyl chloride	5.30	5.35	5.35
55	Chicopee	U	Vinyl chloride	8.59	11.0	11.0
56	Coyote Canyon	U	Vinyl chloride	1.90	2.53	2.62
56	Coyote Canyon	U	Vinyl chloride	1.84	2.45	
56	Coyote Canyon	U	Vinyl chloride	1.83	2.44	
56	Coyote Canyon	U	Vinyl chloride	1.83	2.71	
56	Coyote Canyon	U	Vinyl chloride	1.85	2.70	
56	Coyote Canyon	U	Vinyl chloride	1.95	2.88	
57	Durham Rd.	U	Vinyl chloride	6.00	7.89	7.34
357	Durham Rd.	U	Vinyl chloride	5.80	6.99	
57	Durham Rd.	U	Vinyl chloride	6.00	7.14	
27	Lyon Development	U	Vinyl chloride	0.87	1.02	2.68
27	Lyon Development	U	Vinyl chloride	5.20	6.19	
27	Lyon Development	U	Vinyl chloride	0.84	0.83	
8	Operating Industries	U	Vinyl chloride	6.80	13.5	13.5
58	Otay Annex	U	Vinyl chloride	2.40	3.26	3.26
20	Penrose	U	Vinyl chloride	0.64	0.82	3.13
20	Penrose	U	Vinyl chloride	0.46	0.58	
20	Penrose	U	Vinyl chloride	4.40	7.57	
20	Penrose	U	Vinyl chloride	4.60	7.84	
20	Penrose	U	Vinyl chloride	0.73	1.78	
20	Penrose	U	Vinyl chloride	0.65	1.54	
20	Penrose	U	Vinyl chloride	1.20	2.39	
20	Penrose	U	Vinyl chloride	1.30	2.53	
59	Rockingham	U	Vinyl chloride	22.4	29.8	29.8
9	Sheldon Street	U	Vinyl chloride	0.08	0.16	1.28
9	Sheldon Street	U	Vinyl chloride	0.25	0.50	
9	Sheldon Street	U	Vinyl chloride	0.25	0.50	
9	Sheldon Street	U	Vinyl chloride	2.00	3.98	
12	BKK Landfill	Y	Vinyl chloride	160	352	225
12	BKK Landfill	Y	Vinyl chloride	77.0	181	
12	BKK Landfill	Y	Vinyl chloride	65.0	143	
7	Calabasas	Y	Vinyl chloride	22.8	34.8	46.5
7	Calabasas	Y	Vinyl chloride	30.0	54.2	
7	Calabasas	Y	Vinyl chloride	28.0	50.5	
43	CBI16	Y	Vinyl chloride	1.00	1.02	1.02
43	CBI24	Y	Vinyl chloride	16.9	17.2	17.2
58	Otay Valley	Y	Vinyl chloride	16.4	17.7	17.7
22	Palos Verdes	Y	Vinyl chloride	2.20	9.59	7.25
22	Palos Verdes	Y	Vinyl chloride	2.20	9.59	
22	Palos Verdes	Y	Vinyl chloride	1.80	7.85	
22	Palos Verdes	Y	Vinyl chloride	2.20	9.59	
22	Palos Verdes	Y	Vinyl chloride	0.83	3.62	
22	Palos Verdes	Y	Vinyl chloride	1.80	7.85	
22	Palos Verdes	Y	Vinyl chloride	0.96	4.19	
22	Palos Verdes	Y	Vinyl chloride	2.10	9.16	
22	Palos Verdes	Y	Vinyl chloride	2.20	9.59	
22	Palos Verdes	Y	Vinyl chloride	0.59	2.57	
22	Palos Verdes	Y	Vinyl chloride	2.20	9.59	
22	Palos Verdes	Y	Vinyl chloride	1.30	5.67	
51	Palos Verdes	Y	Vinyl chloride	2.60	8.28	
51	Palos Verdes	Y	Vinyl chloride	1.70	4.35	
54	Arbor Hills	U	Vinylidene chloride	0.24	0.24	0.24
54	Arbor Hills	U	Vinylidene chloride	0.24	0.24	
54	Arbor Hills	U	Vinylidene chloride	0.24	0.25	
17	Bradley Pit	U	Vinylidene chloride	32.0	42.2	18.6
17	Bradley Pit	U	Vinylidene chloride	9.80	12.9	
17	Bradley Pit	U	Vinylidene chloride	9.30	12.3	
17	Bradley Pit	U	Vinylidene chloride	29.0	38.2	
17	Bradley Pit	U	Vinylidene chloride	2.30	3.03	
17	Bradley Pit	U	Vinylidene chloride	2.40	3.16	
43	CBI10	U	Vinylidene chloride	0.10	0.10	0.10
43	CBI11	U	Vinylidene chloride	0.65	0.66	0.66
43	CBI12	U	Vinylidene chloride	0.05	0.06	0.06
43	CBI13	U	Vinylidene chloride	0.08	0.10	0.10

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
43	CBI14	U	Vinylidene chloride	0.23	0.23	0.23
43	CBI17	U	Vinylidene chloride	0.15	0.15	0.15
43	CBI18	U	Vinylidene chloride	0.18	0.18	0.18
43	CBI20	U	Vinylidene chloride	0.20	0.20	0.20
43	CBI21	U	Vinylidene chloride	0.43	0.43	0.43
43	CBI24	Y	Vinylidene chloride	0.75	0.76	0.76
43	CBI27	U	Vinylidene chloride	0.13	0.13	0.13
43	CBI4	U	Vinylidene chloride	0.07	0.07	0.07
43	CBI5	U	Vinylidene chloride	0.10	0.10	0.10
43	CBI6	U	Vinylidene chloride	0.20	0.20	0.20
43	CBI8	U	Vinylidene chloride	0.49	0.49	0.49
43	CBI9	U	Vinylidene chloride	0.20	0.20	0.20
55	Chicopee	U	Vinylidene chloride	0.12	0.15	0.15
56	Coyote Canyon	U	Vinylidene chloride	0.34	0.46	0.49
56	Coyote Canyon	U	Vinylidene chloride	0.33	0.44	
56	Coyote Canyon	U	Vinylidene chloride	0.37	0.49	
56	Coyote Canyon	U	Vinylidene chloride	0.36	0.53	
56	Coyote Canyon	U	Vinylidene chloride	0.36	0.52	
56	Coyote Canyon	U	Vinylidene chloride	0.36	0.53	
41	Guadalupe	U	Vinylidene chloride	28.2	33.8	33.8
54	Arbor Hills	U	Xylenes	55.8	57.1	58.0
54	Arbor Hills	U	Xylenes	63.8	64.4	
54	Arbor Hills	U	Xylenes	51.4	52.4	
43	CBI1	U	Xylenes	4.66	4.79	4.79
43	CBI10	U	Xylenes	10.0	10.2	10.2
43	CBI11	U	Xylenes	12.5	12.6	12.6
43	CBI12	U	Xylenes	8.55	9.42	9.42
43	CBI13	U	Xylenes	65.0	78.6	78.6
43	CBI14	U	Xylenes	2.47	2.50	2.50
43	CBI15	U	Xylenes	9.78	9.88	9.88
43	CBI16	Y	Xylenes	2.90	2.94	2.94
43	CBI17	U	Xylenes	0.45	0.45	0.45
43	CBI18	U	Xylenes	15.3	15.6	15.6
43	CBI19	U	Xylenes	0.45	0.45	0.45
43	CBI2	U	Xylenes	1.30	1.31	1.31
43	CBI20	U	Xylenes	37.5	37.7	37.7
43	CBI21	U	Xylenes	0.50	0.50	0.50
43	CBI22	U	Xylenes	13.3	13.5	13.5
43	CBI23	U	Xylenes	12.0	12.7	12.7
43	CBI24	Y	Xylenes	70.8	71.8	71.8
43	CBI26	U	Xylenes	1.50	1.51	1.51
43	CBI27	U	Xylenes	4.63	4.66	4.66
43	CBI28	U	Xylenes	0.40	0.40	0.40
43	CBI29	U	Xylenes	28.7	30.4	30.4
43	CBI3	U	Xylenes	12.0	12.0	12.0
43	CBI30	U	Xylenes	70.9	71.5	71.5
43	CBI31	U	Xylenes	12.0	12.0	12.0
43	CBI32	U	Xylenes	1.55	1.56	1.56
43	CBI33	U	Xylenes	5.57	5.58	5.58
43	CBI5	U	Xylenes	24.0	24.2	24.2
43	CBI6	U	Xylenes	0.75	0.76	0.76
43	CBI7	U	Xylenes	67.5	69.2	69.2
43	CBI8	U	Xylenes	22.8	23.0	23.0
43	CBI9	U	Xylenes	12.0	12.1	12.12
55	Chicopee	U	Xylenes	41.5	53.3	53.3
56	Coyote Canyon	U	Xylenes	34.0	45.2	44.06
56	Coyote Canyon	U	Xylenes	35.3	47.0	
56	Coyote Canyon	U	Xylenes	27.9	37.1	
56	Coyote Canyon	U	Xylenes	27.7	41.0	
56	Coyote Canyon	U	Xylenes	31.0	45.2	
56	Coyote Canyon	U	Xylenes	33.0	48.8	
41	Guadalupe	U	Xylenes	9.60	11.5	11.5
51	Palos Verdes	Y	Xylenes	34.0	108	182
51	Palos Verdes	Y	Xylenes	100	256	
50	Puente Hills	N	Xylenes	98.0	119	119

Appendix A-2. Default LFG Constituent Concentrations (pre-1992 Landfills)

Reference	Landfill Name	Co-disposal (Y, N, or U)*	Compound	Raw Concentration (ppmv)	Air Infiltration Corrected Conc. (ppmv)	Site Avg.** (ppmv)
59	Rockingham	U	Xylenes	24.1	32.0	32.0
1	Scholl Canyon	N	Xylenes	3.10	7.09	7.09
60	Sunshine Canyon	U	Xylenes	92.0	96.8	96.8

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-001	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Timberlands Landfill	Timberlands	Brewton	AL	10/19/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-002	Tier 2 Nonmethane Organic Compounds Emission Rate Report for the Pineview Landfill	Pineview	Dora	AL	3/3/97	Alabama Department of Environmental Mangement	8/5/97	N
TR-003	Tier 2 Sampling and Analysis Report for the Morris Farm Sanitary Landfill	Morris Farm	Hillsboro	AL	5/24/99	Browning-Ferris Industries Inc.	7/16/99	Y
TR-004	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Saline County Regional Solid Waste Management District Landfill	Saline County Regional Solid Waste Management District	Bauxite	AR	11/22/96	Genesis Environmental Consulting, Inc.	12/13/96	N
TR-005	Tier 2 Test Report - Modelfill Landfill	Modelfill	Little Rock	AR	9/17/97 - 9/19/97	Browning-Ferris Industries Inc.	10/8/97	N
TR-006	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Pen-Rob Landfill	Pen-Rob	Junction City	AZ	7/9/96 - 7/10/96	Allied Waste Industries, Inc.	12/10/96	N
TR-007	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Sierra Estrella Landfill	Sierra Estrella		AZ	9/3/97 - 9/4/97	USA Waste of Arizona	12/3/97	N
TR-008	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Northwest Regional Landfill	Northwest Regional		AZ	9/4/97 - 9/7/97	USA Waste of Arizona	12/3/97	N
TR-009	Test Report - 27th Ave. Landfill	27th Ave.		AZ	8/6/97	No Origin Given	8/12/97	N
TR-010	Limited Tier 2 Testing Results for the Skunk Creek Landfill	Skunk Creek	Phoenix	AZ	8/1/97	City of Phoenix Public Works Department	10/7/97	Y
TR-011	Test Report - Copper Mountain Landfill	Copper Mountain	Wellton	AZ	4/18/98	No Origin Given	5/8/98	N
TR-012	Test Report - Cocopah Landfill	Cocopah	Yuma	AZ	4/17/98	No Origin Given	5/8/98	N
TR-013	Tier 2 Sampling, Analysis, and NMOC Emission Estimate Report, Arvin Sanitary Landfill	Arvin	Arvin	CA	7/13/98 - 7/21/98	Kern County Waste Management Department	September 1998	N
TR-014	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates Neal Road Landfill	Neal Road		CA	12/12/97, 1/5/98 - 1/7/98	Butte County Department of Public Works	2/19/98	Y
TR-015	Bakersfield Metropolitan Sanitary Landfill Tier 2 Test Results	Bakersfield Metropolitan (Bena)	Bakersfield	CA	5/27/98	Kern County Waste Management Department	7/30/98	N
TR-016	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Summary Report for the Chateau Fresno Landfill	Chateau Fresno	Fresno	CA	5/21/97	Browning-Ferris Gas Services, Inc.	5/28/97	N
TR-017	New Source Performance Standards Tier II Sampling, Analysis, and Landfill NMOC Emission Estimates Forward Landfill	Forward	Manteca	CA	12/15/98 - 12/16/98	Allied Waste Industries, Inc.	1/15/99	Y
TR-018	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates Highway 59 Landfill	Highway 59	Merced	CA	10/27/98, 11/30/98, 12/21/98 - 12/22/98	Merced County Department of Public Works	2/1/99	Y
TR-019	New Source Performance Standards (NSPS) Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Eastern Regional Landfill	Eastern Regional	Truckee	CA	10/30/98	Placer County Department of Facility Services	11/18/98	N
TR-020	Tier 2 Sampling, Analysis, and NMOC Emission Estimate Report, Shafter-Wasco Sanitary Landfill	Shafter-Wasco	Shafter	CA	7/7/98 - 7/9/98	Kern County Waste Management Department	September 1998	N
TR-021	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates Fink Road Sanitary Landfill	Fink Road	Crows Landing	CA	9/22/97 - 9/23/97	Stanislaus County Department of Public Works	11/7/97	N
TR-022	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates Geer Road Sanitary Landfill	Geer Road		CA	9/9/98	Stanislaus County Department of Public Works	10/13/98	N
TR-023	Tier 2 Sampling, Analysis, and NMOC Emission Estimate Report, Taft Sanitary Landfill	Taft	Taft	CA	7/21/98 - 7/22/98	Kern County Waste Management Department	September 1998	N
TR-024	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates B&J Drop Box Sanitary Landfill	B&J Drop Box	Vacaville	CA	5/5/97 - 5/8/97	Norcal Waste Systems, Inc., B&J Drop Box Corporation	5/30/97	N
TR-025	Test Report - Ostrom Road Landfill	Ostrom Road	Wheatland	CA	5/8/98	No Origin Given	5/26/98	N
TR-026	Test Report - Yolo County Central Landfill	Yolo County Central		CA	11/10/98	No Origin Given	11/23/98	N

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-027	Test Report - Tower Road Landfill	Tower Road	Denver	CO	3/1/99 - 3/4/99	Browning-Ferris Gas Services, Inc.	3/15/99	N
TR-028	Test Report - Denver Regional Landfill	Denver Regional	Denver	CO	6/7/99	No Origin Given	6/14/99	N
TR-029	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Denver Regional Landfill (South)	Denver Regional (South)	Erie	CO	3/3/97 - 3/7/97	Laidlaw Waste Systems (Colorado), Inc.	3/21/97	N
TR-030	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Fountain Landfill	Fountain	Fountain	CO	10/16/96 - 10/19/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-031	Test Report - Foothill Jeffco Landfill	Foothills	Golden	CO	3/8/99, 5/21/99	Browning-Ferris Gas Services, Inc.	3/15/99, 5/27/99	N
TR-032	Test Report - Landfill Name Confidential #1	Landfill Name Confidential #1			8/31/98 - 9/3/98	No Origin Given	9/14/98	N
TR-033	Test Report - Southern Solid Waste Management Center	Southern Solid Waste Management Center	Georgetown	DE	Date Not Given	Delaware Solid Waste Authority	12/28/99	N
TR-034	Test Report - Pigeon Point Landfill	Pigeon Point	New Castle	DE	Date Not Given	Delaware Solid Waste Authority	12/28/99	N
TR-035	Test Report - Central Solid Waste Management Center	Central Solid Waste Management Center	Sandtown	DE	Date Not Given	Delaware Solid Waste Authority	12/28/99	N
TR-036	Test Report - Cherry Island Landfill	Cherry Island	Wilmington	DE	Date Not Given	Delaware Solid Waste Authority	12/28/99	N
TR-037	Test Report - Hillsborough County/SCLF	Hillsborough County/SCLF		FL	11/10/97 - 11/13/97	No Origin Given	11/20/97	N
TR-038	Test Report - Huntsville SWDA	Huntsville SWDA	Huntsville	AL	3/31/98 - 4/3/98	No Origin Given	4/22/98	N
TR-039	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Buford Landfill	Buford	Buford	GA	10/16/96 - 10/17/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-040	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Hickory Ridge Landfill	Hickory Ridge	Conley	GA	10/15/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-041	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at the Wayne County Regional Landfill	Wayne County Regional	Jesup	GA	9/14/96 - 9/24/96	Republic Services, Inc.	3/4/97	Y
TR-042	Documentation of Tier 2 Non-methane Organic Compound (NMOC) Determination at the Republic Industries Swift Creek Environmental Landfill	Swift Creek Environmental	Macon	GA	9/17/98	Republic Services, Inc.	4/28/99	Y
TR-043	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Taylor County Landfill	Taylor County	Mauk	GA	7/16/96 - 7/18/96	Allied Waste Industries, Inc.	12/10/96	N
TR-044	NSPS Tier 2 Revised Emission Report for Central Disposal Landfill	Central Disposal	Lake Mills	IA	10/16/96	Central Disposal Systems, Inc.	12/6/96	N
TR-045	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Brickyard Disposal & Recycling Landfill	Brickyard Disposal & Recycling	Danville	IL	6/22/96 - 6/25/96	Allied Waste Industries, Inc.	12/10/96	N
TR-046	Test Report - S. Illinois Regional Landfill	S. Illinois Regional	De Soto	IL	2/24/97 - 2/26/97	No Origin Given	3/20/97	N
TR-047	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Upper Rock Island Landfill	Upper Rock Island	East Moline	IL	6/29/96 - 6/30/96	Allied Waste Industries, Inc.	12/10/96	N
TR-048	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Report for the Spoon Ridge Landfill	Spoon Ridge	Fairview	IL	5/5/97	Browning-Ferris Gas Services, Inc.	5/28/97	N
TR-049	Test Report - Illinois Landfill, Inc. (Hoopston)	Hoopeston	Hoopeston	IL	1/13/99 - 1/14/99	No Origin Given	2/1/99	N
TR-050	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Quad Cities Landfill	Quad Cities	Milan	IL	11/14/96 - 11/17/96	Browning-Ferris Gas Services, Inc.	12/4/96	N
TR-051	NSPS Tier 2 Work at Cahokia Road Landfill	Cahokia Road	Roxana	IL	6/10/97	Laidlaw/Allied	7/1/97	N
TR-052	New Source Performance Standards Tier 2 Sampling and Analysis Report for the County Line Landfill	County Line	Argos	IN	6/26/96 - 6/27/96	Allied Waste Industries, Inc.	12/10/96	N
TR-053	Test Report - United Refuse Landfill	United Refuse	Fort Wayne	IN	2/12/97 - 2/15/97	No Origin Given	4/11/97	N
TR-054	Test Report - Landfill Name Confidential #2	Landfill Name Confidential #2	Greensburg	IN	10/21/98 - 10/22/98	No Origin Given	11/10/98	N
TR-055	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Caldwell Landfill	Caldwell	Morristown	IN	4/6/98 - 4/7/98	Caldwell Gravel Sales, Inc.	7/22/98	Y

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-056	Test Report - Newton County Landfill	Newton County		IN	7/9/98	Allied Waste Industries, Inc.	7/21/98	N
TR-057	Test Report - Yaw Hill Landfill	Yaw Hill		IN	2/17/97 - 2/20/97, 2/22/97	No Origin Given	3/19/97	N
TR-058	Test Report - Wabash, Indiana Landfill	Wabash	Wabash	IN	2/23/98 - 2/24/98	No Origin Given	3/26/98	N
TR-059	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at Addington Environmental, Inc.'s Green Valley Environmental Corp. Landfill	Green Valley Environmental Corp.	Ashland	KY	9/20/96	Republic Services, Inc.	11/29/96	N
TR-060	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at Addington Environmental, Inc.'s Ohio Balefill, Inc. Landfill	Ohio Balefill, Inc.	Beaver Dam	KY	9/16/96, 9/18/96, 11/22/96 - 11/23/96	Republic Services, Inc.	12/6/96	N
TR-061	New Source Peformance Standards (NSPS) Tier 2 Results Laurel Ridge Landfill	Laurel Ridge	Lilly	KY	10/9/96 - 10/11/96	United Waste Systems, Inc.	12/4/96	N
TR-062	Test Report - Montgomery County Landfill	Montgomery County		KY	7/13/98 - 7/14/98	Rumpke Waste, Inc.	7/21/98	N
TR-063	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at Addington Environmental, Inc.'s Dozit Co., Inc. Landfill	Dozit Co., Inc.	Morganfield	KY	9/20/96 - 9/21/96	Republic Services, Inc.	11/29/96	N
TR-064	New Source Performance Standards (NSPS) Tier 2 Results, Local Sanitation Service, Inc. Landfill	Local Sanitation Service, Inc.	Morehead	KY	11/6/96	Mid-American Waste Systems, Inc.	1/17/97	N
TR-065	Test Report - Pendleton County Landfill	Pendleton County		KY	7/6/98 - 7/8/98	Rumpke Waste, Inc.	7/21/98	N
TR-066	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at Addington Environmental, Inc.'s Tri-K Landfill, Inc.	Tri-K	Stanford	KY	9/17/96 - 9/20/96	Republic Services, Inc.	11/29/96	N
TR-067	Tier 2 Sampling and Analysis Report for the Crescent Acres Landfill	Crescent Acres	New Orleans	LA	2/26/99	Browning-Ferris Industries	4/2/99	N
TR-068	NSPS Tier 2 Results for the Chicopee Landfill	Chicopee	Chicopee	MA	Date Not Given	Connecticut Valley Sanitary Waste Disposal, Inc.	12/10/96	N
TR-069	NSPS Tier 2 Results for the Fitchburg/Westminster Landfill	Fitchburg/Westminster	Westminster	MA	Date Not Given	Resource Control, Inc.	1/9/97	N
TR-070	Test Report - Taunton Landfill	Taunton	Taunton	MA	6/18/98	No Origin Given	6/30/98	N
TR-071	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling, Analysis, and Landfill Emission Estimates for Non-Methane Organic Compounds Alpha Ridge Landfill	Alpha Ridge	Marriottsville	MD	9/4/98	Howard County Department of Public Works	11/16/98	N
TR-072	Test Report - Oaks Landfill	Oaks	Laytonsville	MD	11/25/97	No Origin Given	12/9/97	N
TR-073	Tier 2 NMOC Emission Rate Report - Landfill Name Confidential #3	Landfill Name Confidential #3		MD	2/21/97, 3/27/97	Maryland Department of the Environment	4/28/97	N
TR-074	New Source Performance Standards (NSPS) Tier 2 Results for the Glen's Sanitary Landfill, Inc.	Glen's	Maple City	MI	10/7/96	United Waste Systems	12/4/96	N
TR-075	Test Report - Forest Lawn Landfill	Forest Lawn	Three Oaks	MI	3/3/97 - 3/6/97	No Origin Given	3/28/97	N
TR-076	New Source Performance Standards Tier 2 Sampling and Analysis for the Flying Cloud Landfill	Flying Cloud	Eden Prairie	MN	5/20/98	Browning-Ferris Industries	6/30/98	Y
TR-077	New Source Performance Standards Tier 2 Sampling and Analysis for the Lamar Landfill	Lamar	Lamar	MO	10/29/97 - 10/31/97	Browning-Ferris Industries	12/3/97	Y
TR-078	Test Report - Mo Pass Landfill	Mo Pass		MO	12/8/98	No Origin Given	12/14/98	N
TR-079	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Butler County Landfill	Butler County	Poplar Bluff	MO	6/20/96 - 6/21/96	Allied Waste Industries, Inc.	12/10/96	N
TR-080	NSPS Tier 2 Revised Emission Report for St. Joseph Landfill	City of St. Joseph	St. Joseph	MO	Date Not Given	City of St. Joseph Department of Public Works & Transportation	12/17/96	N
TR-081	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Show-Me Landfill	Show-Me	Warrensburg	MO	7/1/96 - 7/2/96	Allied Waste Industries, Inc.	12/10/96	N
TR-082	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Big River Landfill	Big River	Leland	MS	10/21/96 - 10/22/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-083	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Missoula Landfill	Missoula	Missoula	MT	11/18/96	Browning-Ferris Gas Services, Inc.	12/3/96	N

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-084	Tier 2 NMOC Emission Rate Report for the Buncombe County Landfill	Buncombe County	Asheville	NC	4/14/99	Buncombe County Solid Waste Services	5/12/99	Y
TR-085	Harrisburg Road Landfill Tier 2 NMOC Emission Rate Report	Harrisburg Road		NC	9/6/96	Mecklenburg County	12/5/96	N
TR-086	Tier 2 NMOC Emission Rate Report for the White Street Landfill	White Street	Greensboro	NC	4/12/99	Duke Engineering and Services, City of Greensboro Solid Waste Management Division	5/18/99	Y
TR-087	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Charlotte Motor Speedway #1-#4 Landfill	Charlotte Motor Speedway #1-#4	Harrisburg	NC	11/20/96 - 11/23/96	Browning-Ferris Gas Services, Inc.	2/14/97	N
TR-088	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Charlotte Motor Speedway #5 Landfill	Charlotte Motor Speedway #5	Harrisburg	NC	11/22/96	Browning-Ferris Gas Services, Inc.	12/3/96	N
TR-089	Test Report - Blackburn Landfill	Blackburn		NC	5/5/98 - 5/6/98	No Origin Given	5/18/98	N
TR-090	Documentation of Tier 2 Non-methane Organic Compound (NMOC) Determination at the Republic Industries Uwharrie Environmental Landfill	Uwharrie Environmental	Mount Gilead	NC	9/17/98	Republic Industries	12/29/98	N
TR-091	Tier 2 NMOC Emission Rate Report for the New Hanover County Landfill	New Hanover County	Wilmington	NC	1/12/99 - 1/15/99	New Hanover County Department of Environmental Management	3/31/99	N
TR-092	Report of Tier 2 Non-methane Organic Compound (NMOC) Determination at Addington Environmental, Inc.'s East Carolina Landfill	East Carolina	Aulander	NC	8/5/96	Republic Services, Inc.	9/25/96	N
TR-093	Test Report - Hanes Mill Road Landfill	Hanes Mill Road	Winston-Salem	NC	11/5/97	No Origin Given	11/13/97	N
TR-094	NSPS Tier 2 Revised Emission Report for Bluff Road Landfill	Bluff Road	Lincoln	NE	Date Not Given	City of Lincoln Solid Waste Division	12/20/96	N
TR-095	Test Report - Camino Real Landfill	Camino Real	Sunland Park	NM	11/10/98 - 11/13/98, 11/17/98 - 11/18/98	National Solid Wastes Management Association	7/7/99	Y
TR-096	Test Report - Douglas County Landfill	Douglas County	Gardnerville	NV	4/14/98 - 4/16/98	No Origin Given	4/28/98	N
TR-097	Test Report - Colonie Landfill	Colonie	Colonie	NY	11/4/98 - 11/6/98	Town of Colonie	11/23/98	N
TR-098	Test Report - Chautauqua County Landfil	Chautauqua County		NY	4/10/98	Chautauqua County DPW	5/6/98	N
TR-099	Tier 2 Test and Emission Rate Report for the Monroe County Department of Environmental Services Mill Seat Landfill	Mill Seat		NY	12/9/96	Monroe County Department of Environmental Services, Clark Patterson Associates	1/2/97	N
TR-100	MSW Landfill Tier 2 Test and Emission Rate Report for the Development Authority of the North Country Solid Waste Management Facility	Development Authority of the North Country Solid Waste Management Facility	Rodman	NY	11/4/96	Development Authority of the North Country	12/2/96	Y
TR-101	Test Report - Brown County Landfill	Brown County		OH	4/22/98 - 4/23/98	Rumpke Waste, Inc.	5/13/98	N
TR-102	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Summary Report for the Glenwillow Landfill	Glenwillow	Glenwillow	OH	5/7/97 - 5/11/97	Browning-Ferris Gas Services, Inc.	5/28/97	Y
TR-103	Test Report - Beech Hollow Landfill	Beech Hollow		OH	4/21/98	Rumpke Waste, Inc.	5/13/98	N
TR-104	Test Report - Lewis Landfill	Lewis	Salem	OH	4/20/99	Browning-Ferris Industries	4/22/99	N
TR-105	NSPS Tier 2 Revised Emission Report Southern Plains Landfil	Southern Plains	Chickasha	OK	10/2/96 - 10/3/96	Martin & Martin, Inc.	12/6/96	Y
TR-106	Test Report - Great Plains Landfill	Great Plains		OK	10/2/96 - 10/3/96	Sanifill	10/18/96	N
TR-107	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Southeast Landfill	Southeast	Oklahoma City	OK	11/9/96 - 11/12/96	Laidlaw Waste Systems, Inc.	12/19/96	Y
TR-108	New Source Performance Standards Tier 2 Sampling and Analysis for the Earthtech Landfill	Earthtech	Porter	OK	9/15/97 - 9/16/97	Browning-Ferris Industries	10/31/97	N
TR-109	Test Report - Broken Arrow Landfill	Broken Arrow	Broken Arrow	OK	7/12/99 - 7/15/99	Browning-Ferris Industries	7/21/99	N

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-110	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill Non-Methane Organic Compound Emission Estimates for the Landfill Name Confidential #4	Landfill Name Confidential #4	Boardman	OR	7/29/97 - 7/31/97	No Origin Given	9/12/97	N
TR-111	R & A Bender, Inc. Landfill Tier 2 NMOC Emission Rate Report	R & A Bender, Inc.	Chambersburg	PA	11/5/96 - 11/7/96, 1/17/97 - 1/18/97	Martin & Martin, Inc	3/12/97	N
TR-112	Revised Nonmethane Organic Compounds Emissions Calculations Landfill Name Confidential # 5	Landfill Name Confidential #5		PA	Date Not Given	USA Waste Services Inc.	8/7/97	N
TR-113	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Summary Report for the Mon Valley Landfill	Mon Valley	Charleroi	PA	5/14/97	Browning-Ferris Gas Services, Inc.	5/28/97	Y
TR-114	Summary Report of Tier 2 Sampling, Analysis, and Landfill Emissions Estimates for Non-Methane Organic Compounds Chrin Brothers Landfill	Chrin Brothers	Easton	PA	3/18/98	Chrin Brothers Sanitary Landfill	4/24/98	Y
TR-115	Seneca Landfill - Revised Tier 2 NMOC Emission Rate Report	Seneca	Evans City	PA	7/2/96	Seneca Landfill, Inc.	12/5/96	Y
TR-116	Test Report - Pine Grove Landfill	Pine Grove	Pine Grove	PA	2/27/98	No Origin Given	3/18/98	N
TR-117	New Source Peformance Standards Tier 2 Sampling and Analysis Summary Report for the Ponce Municipal Sanitary Landfill	Ponce Municipal	Ponce	PR	10/28/96 - 10/29/96	Browning-Ferris Gas Services, Inc.	11/26/96	Y
TR-118	New Source Performance Standards (NSPS) Tier 2 Results, Lee County Regional Recycling & Disposal Facility	Lee County Regional Recycling & Disposal Facility	Bishopville	SC	11/21/96	Mid-American Waste Systems, Inc.	1/16/97	Y
TR-119	Test Report - Landfill Name Confidential #7	Landfill Name Confidential #7		TN	10/27/97 - 10/30/97	No Origin Given	11/13/97	N
TR-120	Test Report - Landfill Name Confidential #6	Landfill Name Confidential #6		TN	4/6/98 - 4/7/98	No Origin Given	4/24/98	N
TR-121	Test Report - NW Tennessee Sanitary Landfil	NW Tennessee Disposal Corp	Union City	TN	3/6/97	No Origin Given	3/26/97	N
TR-122	New Source Performance Standards Tier 2 Sampling and Analysis Report for the Abilene Landfill	Abilene	Abilene	TX	12/22/96	Browning-Ferris Gas Services, Inc.	2/14/97	N
TR-123	Tier 2 Nonmethane Organic Compounds Emission Rate Report for the Turkey Creek Landfill	Turkey Creek	Alvarado	TX	11/7/96 - 11/8/96	Texas Natural Resource Conservation Commission, Laidlaw	7/25/97	N
TR-124	Test Report - Brazoria County Landfill	Brazoria County		TX	12/2/96 - 12/4/96	USA Waste Services, Inc.	12/9/96	N
TR-125	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for the Baytown Landfill	Baytown	Baytown	TX	9/9/96 - 9/12/96	USA Waste Services, Inc.	12/4/96	N
TR-126	Tier 2 Nonmethane Organic Compounds Emission Rate Report for the Beaumont/Golden Triangle Landfill	Golden Triangle	Beaumont	TX	11/26/96	Texas Natural Resource Conservation Commission, Browning-Ferris Industries	7/25/97	N
TR-127	Test Report - Victoria Landfill	Victoria	Bloomington	TX	6/23/98 - 6/26/98	Browning-Ferris Industries	7/8/98	N
TR-128	New Source Peformance Standards Tier 2 Sampling and Analysis Summary Report for the Southwest Landfill	Southwest (Amarillo)	Canyon	TX	10/22/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-129	Tier 2 Nonmethane Organic Compounds Emission Rate Report for the FM 521/Blue Ridge Landfill	FM 521/Blue Ridge	Fresno	TX	11/4/96	Texas Natural Resource Conservation Commission, Browning-Ferris Industries	7/25/97	N
TR-130	Tier 2 Sampling and Analysis Report for the Itasca Landfill	Itasca	Itasca	TX	3/26/98, 4/13/98	Browning-Ferris Industries	5/21/98	Y
TR-131	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Mill Creek Landfill	Mill Creek	Fort Worth	TX	8/6/97, 8/9/97, 8/14/97	Laidlaw Waste Systems, Inc.	10/10/97	Y
TR-132	Tier 2 Non-Methane Organic Compounds Emission Rate Report for the Hawthorn Park Landfill	Hawthorn Park	Houston	TX	9/13/96 - 9/16/96	Texas Natural Resource Conservation Commission, Sanifill	4/20/98	N
TR-133	New Source Performance Standards Tier 2 Sampling and Analysis for the Hutchins Landfill	Hutchins	Hutchins	TX	10/17/97	Browning-Ferris Industries	11/5/97	N

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-134	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Fort Worth Landfill	Fort Worth	Fort Worth	TX	2/5/97	Laidlaw Waste Systems, Inc.	4/15/97	Y
TR-135	State of Texas Chapter 116 Standard Permitting Applicability Review for the Royal Oaks Landfill	Royal Oaks	Jacksonville	TX	No Testing Occurred	Laidlaw Waste Systems, Inc.	2/19/97	N
TR-136	New Source Performance Standards Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimates for the Pinehill Landfill	Pinehill	Kilgore	TX	4/16/97 - 4/19/97	Laidlaw Waste Systems, Inc.	6/10/97	N
TR-137	Tier 2 Nonmethane Organic Compounds Emission Rate Report for the Mexia Landfill	Mexia	Mexia	TX	11/22/96	Texas Natural Conservation Commission, BFI	7/25/97	N
TR-138	Test Report - King George Co. Landfill	King George County		VA	12/8/98	Waste Management, Inc.	12/14/98	N
TR-139	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Summary Report for the Old Dominion Landfill	Old Dominion	Richmond	VA	3/19/97	Browning-Ferris Gas Services, Inc.	4/7/97	N
TR-140	Tier 1 and Tier 2 NMOC Emission Rate Reports for the Smith Gap Regional Landfill	Smith Gap		VA	3/18/97	Roanoke Valley Resource Authority	4/23/97	Y
TR-141	Tier 2 NMOC Emission Rate Report for the SPSA Regional Landfill	Southeastern Public Service Authority Regional	Suffolk	VA	3/20/97, 4/18/97	Southeastern Public Service Authority, MSA Consulting Engineers	6/10/97	Y
TR-142	Tier 2 NMOC Emission Rate Report for the Frederick County Regional Landfill	Frederick County	Winchester	VA	8/19/97 - 8/21/97	Frederick County Department of Public Works	10/8/97	Y
TR-143	New Source Performance Standards/Emissions Guidelines Tier 2 Sampling and Analysis Summary Report for the Lake Area Landfill	Lake Area	Sarona	WI	5/10/97	Browning-Ferris Gas Services, Inc.	5/28/97	N
TR-144	New Source Performance Standards (NSPS) Tier 2 Results Meadowfill Landfill	Meadowfill	Bridgeport	WV	11/20/96	Mid-American Waste Systems, Inc.	1/16/97	N
TR-145	Compliance Testing of a Landfill Flare at Browning-Ferris Gas Services, Inc.'s Facility in Halifax, Massachusetts	Halifax	Halifax	MA	4/19/96 - 4/22/96	BFI Waste Systems of North America, Inc.	May 1996	Y
TR-146	Compliance Source Testing of a Landfill Flare at Northern Dispisal, Inc. East Bridgewater Landfill	East Bridgewater	East Bridgewater	MA	4/19/96 - 4/22/96	Northern Disposal, Inc.	June 1994	Y
TR-147	Compliance Emissions Test Program for BFI of Ohio, Inc.	Bobmeyer Road	Fairfield	OH	6/3/98	BFI of Ohio, Inc.	6/26/98	Y
TR-148	Compliance Testing of Landfill Flare at Browning-Ferris Gas Services, Inc.'s Fall River Landfill Flare	Fall River	Fall River	MA	11/8/94 - 11/9/94	BFI Waste Systems of North America, Inc.	March 1995	Y
TR-149	Test Report - BFI Fall River Landfill Unit 2	Fall River	Fall River	MA	3/16/99	No Origin Given	No Report Date Given	N
TR-150	Results of the Emissions Compliance Test at the Bigfoot Run Sanitary Landfill	Bigfoot Run	Morrow	OH	11/14/95	Browning-Ferris Gas Services, Inc.	12/8/95	Y
TR-151	Report on Hydrogen Chloride Testing	Laubscher Meadows	Evansville	IN	3/19/99	Browning-Ferris Industries	No Report Date Given	Y
TR-152	Submission of Hydrogen Chloride Test Data from Landfill Gas Fired Combusion Devices - Hanover Park, IL	Landfill Name Not Given	Hanover Park	IL	Date Not Given	Waste Industry Air Coalition	11/16/99	N
TR-153	Results of the Emission Compliance Test on the Enclosed Flare System at the Carbon Limestone Landfill	Carbon Limestone	Lowellville	OH	5/14/96	Browning-Ferris Industrial Gas Services, Inc.	8/8/96	Y
TR-154	Emission Compliance Tests at the Jefferson Davis Parish Sanitary Landfill Flare	Jefferson Davis Parish	Sorrento	LA	4/24/98	BFI Waste Systems of North America, Inc.	April 1998	Y
TR-155	Results of the Emission Compliance Test on the Enclosed Flare System at the Lorain County Landfill No. 1	Lorain County	Oberlin	OH	7/24/96	Browning-Ferris Industrial Gas Services, Inc.	9/5/96	Y
TR-156	Results of the Emission Compliance Test on the Enclosed Flare System at the Lorain County Landfill No. 2	Lorain County	Oberlin	OH	7/23/96	Browning-Ferris Industrial Gas Services, Inc.	9/5/96	Y
TR-157	Emission Compliance Testing Browning-Ferris Gas Services, Inc. Willowcreek Landfill	Willowcreek	Atwater	OH	1/6/98	BFI-Willowcreek	2/2/98	Y
TR-158	Submission of Hydrogen Chloride Test Data from Landfill Gas Fired Combusion Devices - Santa Ana, CA	Landfill Name Not Given	Santa Ana	CA	Date Not Given	Waste Industry Air Coalition	11/16/99	N

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-159	Compliance Stack Sampling Report, Monmouth County Reclamation Center	Monmouth County Reclamation Center	Tinton Falls	NJ	8/1/95	SCS Engineers (Reston, VA)	9/8/95	Y
TR-160	Source Emission Testing of an Enclosed Landfill Gas Ground Flare	Millersville	Severn	MD	6/17/97	SCS Engineers (Reston, VA)	September 1997	Y
TR-161	Submission of Hydrogen Chloride Test Data from Landfill Gas Fired Combusion Devices - Lopez Canyon, CA	Landfill Name Not Given	Lopez Canyon	CA	Date Not Given	Waste Industry Air Coalition	11/16/99	N
TR-162	Emissions Tests at Puente Hills Energy Recovery from Landfill Gas Facility	Puente Hills		CA	4/2/91	County Sanitation Districts of Los Angeles County	April 1991	N
TR-163	Compliance Testing for SPADRA Landfill Gas-to-Energy Plant	Spadra	Spadra	CA	7/25/90 - 7/26/90	Ebasco Constructors, Inc.	November 1990	N
TR-164	1995 Annual Source Test Results for Emission Testing of One Landfill Gas Flare at Bowerman Landfill	Bowerman	Irvine	CA	8/3/95	CH2M Hill	October 1995	Y
TR-165	1997 Annual Compliance Source Testing Results for the Coyote Canyon Landfill Gas Recovery Facility Flare No. 1	Coyote Canyon		CA	12/3/97	Laidlaw Gas Recovery Systems	January 1998	Y
TR-166	1996 Annual Compliance Source Testing Results for the Coyote Canyon Landfill Gas Recovery Facility Flare No. 4	Coyote Canyon		CA	11/6/96	Laidlaw Gas Recovery Systems	January 1997	Y
TR-167	1997 Annual Compliance Source Testing Results for the Coyote Canyon Landfill Gas Recovery Facility Boiler	Coyote Canyon		CA	12/4/97	Laidlaw Gas Recovery Systems	January 1998	Y
TR-168	Colton Sanitary Landfill Gas Flare No. 2 (John Zink) 1998 Source Tests Results	Colton		CA	7/16/98	Bryan A. Stirrat & Associates	9/29/98	Y
TR-169	Colton Sanitary Landfill Gas Flare No. 1 (McGill) 1998 Source Tests Results	Colton		CA	7/17/98	Bryan A. Stirrat & Associates	9/29/98	Y
TR-170	Emissions Test Results of a McGill Landfill Gas Flare	Colton		CA	6/4/97	SCS Engineers	June 1997	Y
TR-171	High Landfill Gas Flow Rate Source Test Results from One Landfill Gas Flare at FRB Landfill in Orange County, California	Bowerman	Irvine	CA	6/4/97	Bryan A. Stirrat & Associates	July 1997	Y
TR-172	Emissions Test Results of a John Zink Landfill Gas Flare	Colton		CA	6/5/97	SCS Engineers	June 1997	Y
TR-173	Annual Emissions Test of Landfill Gas Flare #3 Bradley Landfill	Bradley	Sun Valley	CA	3/10/99	Waste Management Recycling and Disposal Services of California, Inc.	4/12/99	Y
TR-174	Emissions Tests on Flares #3, #4, and #8 at the Lopez Canyon Landfill	Lopez Canyon	Lake View Terrace	CA	8/11/99 - 8/13/99	City of Los Angeles	August 1999	Y
TR-175	Emissions Tests on Flares #2, #4 and #6 at the Lopez Canyon Landfill	Lopez Canyon	Lake View Terrace	CA	7/30/97 - 8/1/97	City of Los Angeles	August 1997	Y
TR-176	Emissions Test Results on Flares #1, #4 and #9 Calabasas Landfill	Calabasas		CA	2/9/98 - 2/11/98	County Sanitation Districts of Los Angeles County	February 1998	Y
TR-177	Annual Emissions Test of Landfill Gas Flare #2 Bradley Landfill	Bradley	Sun Valley	CA	6/11/97 - 6/12/97	Waste Management Recycling and Disposal Services of California, Inc.	July 1997	Y
TR-178	Annual Emission Test of Landfill Gas Flare #3 Bradley Landfill	Bradley	Sun Valley	CA	5/21/98	Waste Management Recycling and Disposal Services of California, Inc.	5/21/98	Y
TR-179	Annual Emissions Test of Landfill Gas Flare #1 Bradley Landfill	Bradley	Sun Valley	CA	3/9/99	Waste Management Recycling and Disposal Services of California, Inc.	4/13/99	Y
TR-180	Emissions Test of a Sur-Lite Landfill Gas Flare	Mid Valley	Fontana	CA	6/3/97	SCS Field Services, Inc.	June 1997	Y
TR-181	The Mid-Valley Sanitary Landfill Gas Flare No.1 (McGill) 1998 Source Test Results	Mid Valley	Fontana	CA	7/30/98	Bryan A. Stirrat & Associates	9/29/98	Y
TR-182	The Mid-Valley Sanitary Landfill Gas Flare No.2 (SurLite) 1998 Source Test Results	Mid Valley	Fontana	CA	7/29/98	Bryan A. Stirrat & Associates	9/29/98	Y
TR-183	Annual Emissions Test of Landfill Gas Flare #2 Bradley Landfill	Bradley	Sun Valley	CA	3/11/99	Waste Management Recycling and Disposal Services of California, Inc.	4/13/99	Y
TR-184	Annual Emissions Test of Landfill Gas Flare #1 Bradley Landfill	Bradley	Sun Valley	CA	5/20/98	Waste Management Recycling and Disposal Services of California, Inc.	May 1998	Y
TR-185	Emissions Tests on Flares #5, #7 and #9 at the Lopez Canyon Landfill	Lopez Canyon	Lake View Terrace	CA	8/11/98 - 8/13/98	City of Los Angeles	August 1998	Y

Appendix B. List of Test Reports Considered in Update

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-186	Emissions Test of a McGill Landfill Gas Flare - Mid Valley Landfill	Mid Valley	Fontana	CA	6/3/97	SCS Field Services, Inc.	June 1997	Y
TR-187	Emissions Test of a Landfill Gas Flare - Lowry Landfill/Denver-Arapohoe Disposal Site	Lowry Denver-Arapahoe	Aurora	CA	2/12/97 - 2/13/97	Sur-Lite Corporation	February 1997	Y
TR-188	Characterization of Emissions from a Power Boiler Fired with Landfill Gas	Landfill Name Not Given		Canada	November 1999	Environment Canada Emissions Research and Measurement Division	March 2000	Y
TR-189	Characterization of Emissions from 925 kWe Reciprocating Engine Fired with Landfill Gas	Waterloo Regional	Waterloo	Canada	6/21/00 - 6/23/00	Environment Canada Emissions Research and Measurement Division	December 2000	Y
TR-190	Characterization of Emissions from 812 kWe Reciprocating Engine Fired with Landfill Gas	Meloche	Kirkland	Canada	9/21/99 - 9/24/99	Environment Canada Emissions Research and Measurement Division	December 1999	Y
TR-191	Characterization of Emissions from Enclosed Flare - Trail Road Landfill	Trail Road	Ottawa-Carleton	Canada	4/18/00 - 4/25/00	Environment Canada Emissions Research and Measurement Division	August 2000	Y
TR-192	Determination of Impact of Waste Management Activities on Greenhouse Gas Emissions	Landfill Name Not Given	None	Canada	3/30/01	Environment Canada	3/30/01	N
TR-193	Emission Reduction Benefits of LFG Combustion	Landfill Name Not Given	Toronto	Canada	February 2002	Environment Canada	February 2002	N
TR-194	Characterization of Emissions from 1 MWe Reciprocating Engine Fired with Landfill Gas	Usine de Triage Lachenaie Ltee	Lachenaie	Canada	10/1/01 - 10/4/01	Environment Canada Emissions Research and Measurement Division	January 2002	Y
TR-195	Characteristics of Semi-volatile Organic Compounds from Vented Landfills	Beare, Cornwall, Miron, Vaughn and Cook Road		Canada	August 1996	Environment Canada Environmental Technology Advancement Directorate	August 1996	Y
TR-196	Results of the Biennial Criteria and AB 2588 Air Toxics Source Test on the Simi Valley Landfill Flare	Simi Valley	Simi Valley	CA	3/18/97 - 3/21/97, 3/29/97	Simi Valley Landfill and Recycling Center	April 1997	Y
TR-197	Emission Test Results of a Landfill Gas Flare	San Timoteo	Redlands	CA	6/6/97	SCS Engineers	June 1997	Y
TR-198	S. Oak Ridge Landfill Gas Quality	Oak Ridge	Valley Park	MO	2/11/99	No Origin Given	3/9/99	N
TR-199	Emission Compliance Test on a Landfill Flare	Sheldon-Arleta	Sun Valley	CA	12/17/98	City of Los Angeles	January 1999	Y
TR-200	Test Report - Newton Landfill	Newton		NC	9/4/97	No Origin Given	9/15/97	N
TR-201	Emission Compliance Test on a Landfill Gas Flare	Santiago Canyon		CA	9/24/98	County of Orange Integrated Waste Management Department	September 1998	Y
TR-202	Report on Emissions Test of a Landfill Gas Flare at Santiago Canyon Landfill	Santiago Canyon		CA	10/30/97, 12/10/97	County of Orange Integrated Waste Management Department	12/24/97	Y
TR-203	Emission Compliance Test on a Landfill Flare - Chiquita Canyon Landfill	Chiquita Canyon	Valencia	CA	8/20/96 - 8/21/96	EMCON Associates	September 1996	Y
TR-204	Test Report - BFI Mallard Lake Landfill	Mallard Lake			3/16/99	No Origin Given	No Report Date Given	N
TR-205	The Mid-Valley Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results	Mid Valley	Fontana	CA	7/28/98	Bryan A. Stirrat & Associates	9/29/98	Y
TR-206	Compliance Source Test Report Landfill Gas-fired Flare Stations I-4 and F-5	BKK	West Covina	CA	8/28/96 - 8/30/96	BKK Landfill	10/3/96	Y
TR-207	Compliance Source Test Report Landfill Gas-fired Flare Stations I-4 and F-2	BKK	West Covina	CA	10/16/97, 10/20/97	BKK Landfill	12/12/97	Y
TR-208	Annual Emissions Test of Landfill Gas Flare #2 Bradley Landfill	Bradley	Sun Valley	CA	5/19/98	Waste Management Recycling and Disposal Services of California, Inc.	7/15/98	Y
TR-209	Emission Test Report Volumes I and II - Source/Compliance Emissions Testing for Cedar Hills Landfill	Cedar Hills Regional	Maple Valley	WA	10/19/04 - 10/22/04	King County Solid Waste Division	1/20/05	Y
TR-210	Characterization of Ammonia, Total Amine, Organic Sulfur Compound, and Total Non-Methane Organic Compound (TGNMOC) Emissions from Composting Operations	Landfill Name Not Given (composting operations)	Corona	CA	11/16/95, 1/24/96, 1/26/96	South Coast Air Quality Management District	1996	Y

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-211a	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #1		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211b	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #2		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211c	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #3		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211d	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #4		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211e	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #5		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211f	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #6		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211g	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #7		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-211h	Determination of Total and Dimethyl Mercury in Raw Landfill Gas with Site Screening for Elemental Mercury at Eight Washington State Landfills	Landfill Site #8		WA	May 2003, June 2003	Washington State Department of Ecology	July 2003	Y
TR-212	Determination of Total, and Monomethyl Mercury in Raw Landfill Gas at the Central Solid Waste Management Center	Central Solid Waste Management Center	Sandtown	DE	January 2003	Delaware Solid Waste Authority	February 2003	Y
TR-213	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for Landfill Name Confidential #8	Landfill Name Confidential #8	Leland	MS	10/21/96 - 10/22/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-214	Intertek Testing Services NA, Inc. Report number D97-10194	SEOKE	Oklahoma City	OK	9/15/97	SCS Engineers	December 1997	N
TR-215	Characterization of Ammonia, Total Amine, Organic Sulfur Compound, and Total Non-Methane Organic Compound (TGNMOC) Emissions from Composting Operations	Landfill Name Not Given (San Joaquin Composting)	Lost Hills	CA	2/15/96, 3/1/96, 3/11/96	South Coast Air Quality Management District	No Report Date Given	N
TR-216	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for Landfill Name Confidential #9	Landfill Name Confidential #9	Beaumont	TX	11/25/96	Browning-Ferris Gas Services, Inc.	12/3/96	N
TR-217	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for Landfill Name Confidential #10	Landfill Name Confidential #10	Canyon	TX	10/22/96	Browning-Ferris Gas Services, Inc.	11/26/96	N
TR-218	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for Landfill Name Confidential #11	Landfill Name Confidential #11	Fresno	TX	11/4/96 - 11/5/96	Browning-Ferris Gas Services, Inc.	12/3/96	N
TR-219	New Source Performance Standards Tier 2 Sampling and Analysis Summary Report for Landfill Name Confidential #12	Landfill Name Confidential #12	Mexia	TX	11/22/96	Browning-Ferris Gas Services, Inc.	12/4/96	N
TR-220	SCAQMD Performance Tests on the Spadra Energy Recovery from Landfill Gas (SPERG) Facility	Spadra	Spadra	CA	10/22/91 - 10/24/91	County Sanitation Districts of Los Angeles County	April 1992	Y
TR-221	Tier 2 Calculations for the Butler County (Kansas) Sanitary Landfill	Butler County	El Dorado	KS	3/11/97 - 3/12/97	Butler County	3/28/97	Y
TR-222	Results of the August 1994 On-site GC/MS Landfill Gas Chemical Charicterization at the Anoka County Landfill	Anoka County	Anoka	MN	8/23/94 - 8/25/94	Kaltec	9/9/94	Y
TR-223	Tier 2 Calculations for the Columbia Sanitary Landfill	Columbia	Columbia	MO	11/15/96 - 11/17/96	City of Columbia	12/5/96	Y
TR-224	Landfill Gas Characterization for Equipment at Livermore, CA	Calderon	Livermore	CA	4/7/88	Bay Area Quality Management District	6/23/88	Y
TR-225	Report, Destruction Test, Flare, Durham Road Landfill	Durham Road	Fremont	CA	10/19/88	Waste Management of North America	10/19/88	Y
TR-226	Methane and Nonmethane Organic Destruction Efficiency Tests of an Enclosed Landfill Gas Flare	Pinelands Park		NJ	April 1992	Newco Waste Systems	April 1992	Y

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-227	Stack Test and Modeling Report L & RR Superfund Site	L & RR Superfund Site	North Smithfield	NJ	1/31/95 - 2/2/95	de maximis, inc.	July 1998	Y
TR-228	Landfill Gas Emissions: A study of two landfills in Prince George's County, Maryland	Sandy Hill & Brown Station Road		MD	Various	University of Maryland	No Report Date Given	N
TR-229	Scholl Canyon Landfill Gas Flares No. 9, 10 11 and 12 Emission Source Testing April 1999	Scholl Canyon		CA	4/26/99 - 4/29/99	South Coast Air Quality Management District	April 1999	Y
TR-230	Test Report - Fitchburg, Massachusetts Landfill	Fitchburg	Fitchburg	MA	8/5/98	Organic Waste Technologies	8/18/98	N
TR-231	Test Report - Lowell, Massachusetts Landfill	Lowell	Lowell	MA	8/5/98	Organic Waste Technologies	8/18/98	N
TR-232	Test Report - Cranberry Creek Landfill	Cranberry Creek		WI	7/5/99	Superior Services	7/20/99	N
TR-233	Test Report - Santiago Canyon Landfill Flare No. 1	Santiago Canyon		CA	8/2/95	No Origin Given	9/12/95	N
TR-234	Test Report - Oak Ridge Landfill	Oak Ridge	Valley Park	MO	6/13/97	Superior Services, Inc.	6/24/97	N
TR-235	Test Report - Coachella Valley Disposal Site	Coachella Valley Disposal Site	Coachella	CA	7/1/99	Riverside County WRMD	7/9/99	N
TR-236	Landfill Gas Flare Hydrogen Chloride Emissons Atascocita Landfill	Atascocita	Humble	TX	2/4/99	Waste Management of Houston	4/20/99	Y
TR-237	Test Report - Shoosmith Landfill	Shoosmith	Chester	VA	4/30/97	Shoosmith Brothers, Inc.	5/13/97	N
TR-238	Test Report - Burlington LFG Plant	Burlington	Waitsfield	VA	8/20/93	Zapco Energy Tactics	11/10/93	N
TR-239	Test Report - Cumberland County Landfill	Cumberland County	Millville	NJ	8/10/95	No Origin Given	8/23/95	N
TR-240	Test Report - Roanoke Regional Municipal Landfill	Roanoke Regional Municipal	Rutrough	VA	1/19/96	Roanoke County	March 1996	N
TR-241	Performance Evaluation, Enclosed Landfill Gas Flare, Valley Landfill	Valley	Irwin	PA	11/26/91	Waste Energy Technology	November 1991	Y
TR-242	Enclosed Flare Inlet at Chester County Solid Waste Authority Lanchester Landfill	Lanchester	Honeybrook	PA	8/28/96	Allegheny Energy Resources	9/9/96	N
TR-243	Test Report - ELDA Recycling and Disposal Facility	ELDA Recycling and Disposal Facility	Cincinnati	OH	10/16/97	Thompson, Hine & Flory, PLL	11/5/97	N
TR-244	Test Report - New Cut Landfill	New Cut		MD	11/8/96, 11/15/96	No Origin Given	12/6/96	N
TR-245	Test Report - Monmouth County Reclamation Center Phase II	Monmouth County Reclamation Center Phase II	Tinton Falls	NJ	6/2/94	No Origin Given	6/10/94	N
TR-246	Test Report - Blackburn Landfill	Blackburn		NC	9/4/97	No Origin Given	9/15/97	N
TR-247	Test Report - Hanes Mill Road Sanitary Landfill	Hanes Mill Road	Winston-Salem	NC	3/8/95	No Origin Given	3/14/95	N
TR-248	Landfill Gas Test Program Oaks Sanitary Landfill	Oaks	Laytonsville	MD	7/20/95	Montgomery County Department of Environmental Protection	9/7/95	N
TR-249	Test Report - Mead Valley Landfill	Mead Valley		CA	1/19/99	Riverside County WRMD	10/19/99	N
TR-250	Test Report - Mead Valley Landfill	Mead Valley		CA	5/20/99	Riverside County WRMD	10/19/99	N
TR-251	Emission Compliance Test on a Landfill Gas Flare - Flare #1, Frank R. Bowerman Landfill	Bowerman	Irvine	CA	10/28/98	Orange County	1/25/99	Y
TR-252	Emission Compliance Test on a Landfill Gas Flare -Chiquita Canyon Landfill	Chiquita Canyon	Valencia	CA	8/29/95	Laidlaw Waste Systems	9/27/95	Y
TR-253	Emission Source Testing on Two Flares (Nos. 3 and 6) at the Spadra Landfill	Spadra	Spadra	CA	5/20/98 - 5/21/98	Los Angeles County Sanitation Districts	7/21/98	Y
TR-254	Emission Test on Palos Verdes Flare Station No. 3	Palos Verdes	Rolling Hills Estates	CA	10/11/89 - 10/12/89	Los Angeles County Sanitation Districts	January 1990	Y
TR-255	Emission Compliance Test on a Landfill Gas Flare -Olinda Alpha Landfill	Olinda Alpha	Brea	CA	9/22/98	Orange County Integrated Waste Management Department	No Report Date Given	Y
TR-256	Emission Test Results of a Sur-Lite Landfill Gas Flare	Milliken	Ontario	CA	6/10/97	San Bernandino County Solid Waste Management	June 1997	Y
TR-257	Compliance Test Report, Gas Flare No. 2	Palos Verdes	Rolling Hills Estates	CA	12/9/97	Los Angeles County Sanitation Districts	2/12/98	Y
TR-258	Source Test Report, City of Sacramento Landfill Gas Flare	City of Sacramento	Sacramento	CA	6/17/96	City of Sacramento	6/26/96	Y
TR-259	The Millikan Sanitary Landfill Gas Flare No. 1 (Surlite) 1998 Source Test Results	Milliken	Ontario	CA	7/23/98	South Coast Air Quality Management District	9/29/98	Y

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-260	The Millikan Sanitary Landfill Gas Flare No. 2 (John Zink) 1998 Source Test Results	Milliken	Ontario	CA	7/21/98	South Coast Air Quality Management District	9/29/98	Y
TR-261	The Millikan Sanitary Landfill Gas Flare No. 3 (John Zink) 1998 Source Test Results	Milliken	Ontario	CA	7/22/98	South Coast Air Quality Management District	9/29/98	Y
TR-262	Emissions Test Results of a John Zink Landfill Gas Flare	Milliken	Ontario	CA	6/9/97	San Bernandino County Solid Waste Management	June 1997	Y
TR-263	Annual Emissions Test of a Landfill Gas Flare	Pick Your Part	Wilmington	CA	3/31/94	South Coast Air Quality Management District	4/22/94	Y
TR-264	Emission Compliance Test on a Landfill Gas Flare	Prima Deshecha	San Juan Capistrano	CA	10/30/98	Orange County Integrated Waste Management Department	No Report Date Given	Y
TR-265	Test Report - Burlington County, NJ	Burlington County		NJ	4/14/99	No Origin Given	4/26/99	N
TR-266	Compliance Source Test Report - Landfill Gas-Fired Engine	Landfill Name Not Given	Corona	CA	1/28/98	Minnesota Methane	3/3/98	Y
TR-267	Report on Emissions Test of a Landfill Gas Flare - Olinda Alpha Landfill	Olinda Alpha	Brea	CA	12/30/96	Orange County Integrated Waste Management Department	2/28/97	Y
TR-268	Emission Testing at PERG - Maximum Boiler Load	Puente Hills		CA	10/27/86 - 10/30/86, 11/22/86, 11/24/86 - 11/25/86	County Sanitation Districts of Los Angeles County	December 1986	Y
TR-269	Test Report - Ox Mountain Landfill	Ox Mountain	Half Moon Bay	CA	4/29/99	Browning-Ferris Industries	5/7/99	N
TR-270	Test Report - Ox Mountain Landfill	Ox Mountain	Half Moon Bay	CA	10/2/98	Browning-Ferris Industries	10/12/98	N
TR-271	Test Report - Seneca Meadows Landfill	Seneca Meadows		NY	3/20/97	No Origin Given	4/4/97	N
TR-272	Source Testing Final Report - Landfill A	Landfill A			11/1/02 - 11/2/02	US EPA Air Pollution Prevention and Control Division	10/6/05	Y
TR-273	Source Testing Final Report - Landfill B	Landfill B			11/4/02 - 11/5/02	US EPA Air Pollution Prevention and Control Division	10/6/05	Y
TR-274	Test Report - Los Reales Landfill	Los Reales	Tucson	AZ	10/15/97	No Origin Given	11/7/97	N
TR-275	Test Report - Woodland Landfill	Woodland			10/1/97, 10/6/97	No Origin Given	10/17/97	N
TR-276	Test Report - Lamb Canyon Landfill	Lamb Canyon		CA	12/8/98	Riverside County WRMD	10/19/99	N
TR-277	Test Report - Badlands Landfill	Badlands		CA	11/12/97	Riverside County WRMD	10/19/99	N
TR-278	Test Report - Edom Hill Landfill	Edom Hill		CA	1/14/99 - 1/15/99	Riverside County WRMD	2/5/99	N
TR-279	Test Report - Highgrove Landfill	Highgrove		CA	9/8/98	Riverside County WRMD	10/19/99	N
TR-280	Test Report - Highgrove Landfill	Highgrove		CA	6/17/99	Riverside County WRMD	10/19/99	N
TR-281	Test Report - Badlands Landfill	Badlands		CA	12/8/98	Riverside County WRMD	12/11/98	N
TR-282	Test Report - Corona Landfill	Corona		CA	6/17/99	Riverside County WRMD	6/25/99	N
TR-283	Test Report - West Riverside Landfill	West Riverside		CA	12/8/98	Riverside County WRMD	12/10/98	N
TR-284	Source Testing Final Report - Landfill C	Landfill C			5/13/04 - 5/14/04	US EPA Air Pollution Prevention and Control Division	10/6/05	Y
TR-285	Test Report - Mead Valley Landfill	Mead Valley		CA	12/8/98	Riverside County WRMD	12/29/98	N
TR-286	Test Report - Nashua, New Hampshire Landfill	Nashua	Nashua	NH	8/5/98	Organic Waste Technologies	8/18/98	N
TR-287	Source Testing Final Report - Landfill D	Landfill D			5/15/04 - 5/16/04	US EPA Air Pollution Prevention and Control Division	10/6/05	Y
TR-288	Test Report - YSDI Landfill	YSDI	Marysville	CA	1/15/98	Norcal	1/19/98	N
TR-289	Annual Emissions Test of Landfill Gas Flare #1 Bradley Landfill	Bradley	Sun Valley	CA	6/12/97, 7/8/97	Waste Management Recycling and Disposal Services of California, Inc.	7/23/97	Y
TR-290	San Timoteo Sanitary Landfill 1998 Source Test Results	San Timoteo	Redlands	CA	7/14/98	San Bernandino County Solid Waste Management	9/29/98	Y

Appendix B. List of Test Reports Considered in Update

Test Report	Report Title	Landfill Name	Landfill City	Landfill State	Test Dates	Test Origin	Report Date	Complete Report?
TR-291	'PCDD/PCDF Emissions Tests on the Palos Verdes Energy Recovery from Landfill Gas (PVERG) Facility, Unit 2	Palos Verdes		CA	11/23/93 - 11/24/93	County Sanitation Districts of Los Angeles County	February 1994	Y
TR-292	Source Testing Final Report - Landfill E	Landfill E			6/22/05 - 6/23/05	US EPA Air Pollution Prevention and Control Division	October 2005	Y
TR-293	Quantifying Uncontrolled Air Emissions from Two Florida Landfills	Sites 1 and 2		FL	February and October 2007	US EPA Air Pollution Prevention and Control Division	3/26/2008	Y

APPENDIX C. LANDFILL GAS CONSTITUENTS (UNCORRECTED CONCENTRATIONS)

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Limit (ppm)
1,1,1-Trichloroethane	40	2.10E-03	7.84E-01	2.07E-01	2.21E-01	6.86E-02
1,1,2,2-Tetrachloroethane	3	2.97E-02	1.31E+00	6.58E-01	6.39E-01	7.23E-01
1,1,2,3,4,4-Hexachloro-1,3-butadiene (Hexachlorobutadiene)	3	1.00E-03	5.33E-03	2.61E-03	2.37E-03	2.68E-03
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	13	2.00E-03	4.47E-01	4.99E-02	1.20E-01	6.52E-02
1,1,2-Trichloroethane	6	6.54E-03	5.43E-01	1.76E-01	2.48E-01	1.98E-01
1,1-Dichloroethane	43	3.48E-03	1.54E+01	1.79E+00	2.61E+00	7.81E-01
1,1-Dichloroethene (1,1-Dichloroethylene)	39	2.00E-03	1.17E+00	1.40E-01	2.29E-01	7.18E-02
1,2,3-Trimethylbenzene	9	2.53E-01	1.88E+00	8.97E-01	6.14E-01	4.01E-01
1,2,4-Trichlorobenzene	11	8.40E-04	1.27E-02	5.29E-03	3.53E-03	2.08E-03
1,2,4-Trimethylbenzene	19	1.90E-01	6.31E+00	2.10E+00	1.75E+00	7.88E-01
1,2-Dibromoethane (Ethylene dibromide)	12	1.33E-03	2.07E-02	4.21E-03	5.41E-03	3.06E-03
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	18	7.67E-03	4.12E-01	1.24E-01	1.20E-01	5.53E-02
1,2-Dichloroethane (Ethylene dichloride)	38	1.00E-03	3.54E+00	2.30E-01	6.67E-01	2.12E-01
1,2-Dichloroethene	1			1.11E+01		
1,2-Dichloropropane	6	7.35E-04	1.93E-01	3.86E-02	7.67E-02	6.13E-02
1,2-Diethylbenzene	9	1.38E-02	2.82E-01	6.74E-02	8.30E-02	5.42E-02
1,3,5-Trimethylbenzene	15	1.47E-01	2.20E+00	8.52E-01	6.06E-01	3.07E-01
1,3-Butadiene (Vinyl ethylene)	7	2.20E-02	6.42E-01	1.73E-01	2.32E-01	1.72E-01
1,3-Diethylbenzene	10	2.23E-02	2.07E-01	1.18E-01	6.99E-02	4.33E-02
1,4-Dichlorobutane	1			3.84E-02		
1,4-Diethylbenzene	10	8.96E-02	1.02E+00	4.93E-01	3.37E-01	2.09E-01
1,4-Dioxane (1,4-Diethylene dioxide)	5	2.03E-03	1.24E-02	7.81E-03	3.84E-03	3.37E-03
1-Butene / 2-Methylbutene	3	8.56E-01	1.42E+00	1.21E+00	3.08E-01	3.48E-01
1-Butene / 2-Methylpropene	7	3.47E-01	3.62E+00	1.18E+00	1.11E+00	8.25E-01
1-Ethyl-4-methylbenzene (4-Ethyl toluene)	13	1.14E-01	2.82E+00	9.04E-01	8.90E-01	4.84E-01
1-Ethyl-4-methylbenzene (4-Ethyl toluene) + 1,3,5-Trimethylbenzene	4	7.93E-02	9.76E-01	5.84E-01	4.26E-01	4.17E-01
1-Heptene	2	4.22E-01	8.03E-01	6.12E-01	2.69E-01	3.73E-01
1-Hexene / 2-Methyl-1-pentene	3	1.25E-02	2.19E-01	8.78E-02	1.14E-01	1.29E-01
1-Methylcyclohexene	10	1.32E-02	8.87E-02	3.42E-02	2.47E-02	1.53E-02
1-Methylcyclopentene	10	2.83E-03	6.59E-02	2.87E-02	1.92E-02	1.19E-02
1-Nonene	2	9.29E-03	3.69E-01	1.89E-01	2.54E-01	3.53E-01
1-Octene	2	1.82E-01	5.31E+00	2.74E+00	3.62E+00	5.02E+00
1-Pentene	10	2.21E-02	1.02E+00	2.09E-01	3.17E-01	1.97E-01
1-Propanethiol (n-Propyl mercaptan)	23	1.40E-04	4.73E-01	1.16E-01	1.18E-01	4.84E-02
2,2,3-Trimethylbutane	5	4.53E-03	1.39E-02	9.92E-03	3.87E-03	3.39E-03
2,2,4-Trimethylpentane	11	4.83E-02	8.03E-01	4.54E-01	2.47E-01	1.46E-01
2,2,5-Trimethylhexane	10	1.62E-02	3.85E-01	1.56E-01	1.00E-01	6.22E-02
2,2-Dimethylbutane	10	1.65E-02	2.25E-01	1.41E-01	7.30E-02	4.52E-02
2,2-Dimethylhexane	4	6.58E-03	3.48E-01	1.32E-01	1.59E-01	1.56E-01
2,2-Dimethylpentane	9	1.94E-02	1.68E-01	6.89E-02	4.58E-02	2.99E-02
2,2-Dimethylpropane	2	7.17E-03	2.70E-02	1.71E-02	1.40E-02	1.94E-02
2,3,4-Trimethylpentane	10	1.40E-02	4.66E-01	2.40E-01	1.22E-01	7.55E-02
2,3-Dimethylbutane	10	1.97E-02	3.66E-01	1.73E-01	9.16E-02	5.68E-02
2,3-Dimethylpentane	10	2.04E-02	3.70E-01	2.37E-01	1.04E-01	6.47E-02
2,4-Dimethylhexane	9	1.74E-01	1.57E+00	4.30E-01	4.79E-01	3.13E-01
2,4-Dimethylpentane	9	6.54E-02	2.72E-01	1.24E-01	6.62E-02	4.32E-02
2,5-Dimethylhexane	10	1.50E-02	1.50E+00	3.30E-01	4.44E-01	2.75E-01
2,5-Dimethylthiophene	1			6.42E-02		
2-Butanone (Methyl ethyl ketone)	8	2.73E-01	9.43E+00	4.07E+00	3.30E+00	2.29E+00
2-Ethyl-1-butene	10	9.36E-03	9.69E-02	3.45E-02	3.16E-02	1.96E-02
2-Ethylthiophene	1			6.27E-02		
2-Ethyltoluene	10	1.30E-01	1.49E+00	6.31E-01	4.78E-01	2.97E-01
2-Hexanone (Methyl butyl ketone)	2	4.41E-01	5.57E-01	4.99E-01	8.20E-02	1.14E-01

APPENDIX C. LANDFILL GAS CONSTITUENTS (UNCORRECTED CONCENTRATIONS)

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Limit (ppm)
2-Methyl-1-butene	8	5.33E-02	5.93E-01	1.96E-01	1.86E-01	1.29E-01
2-Methyl-1-propanethiol (Isobutyl mercaptan)	1			1.70E-01		
2-Methyl-2-butene	10	9.50E-02	4.07E-01	2.71E-01	9.54E-02	5.91E-02
2-Methyl-2-propanethiol (tert-Butylmercaptan)	1			3.24E-01		
2-Methylbutane	10	9.49E-02	7.23E+00	1.13E+00	2.16E+00	1.34E+00
2-Methylheptane	10	8.69E-02	1.28E+01	2.17E+00	3.92E+00	2.43E+00
2-Methylhexane	9	1.17E-01	2.52E+00	8.39E-01	6.81E-01	4.45E-01
2-Methylpentane	10	1.63E-01	2.41E+00	8.49E-01	5.97E-01	3.70E-01
2-Propanol (Isopropyl alcohol)	6	1.14E-01	6.63E+00	1.92E+00	2.44E+00	1.95E+00
3,6-Dimethyloctane	9	1.13E-01	1.50E+00	7.17E-01	3.92E-01	2.56E-01
3-Ethyltoluene	10	3.35E-01	3.13E+00	1.35E+00	9.42E-01	5.84E-01
3-Methyl-1-butene	1			6.30E-02		
3-Methyl-1-pentene	3	4.33E-03	1.03E-02	6.78E-03	3.09E-03	3.50E-03
3-Methylheptane	10	2.84E-01	1.55E+01	2.50E+00	4.71E+00	2.92E+00
3-Methylhexane	10	1.17E-01	7.34E+00	1.56E+00	2.08E+00	1.29E+00
3-Methylpentane	10	1.14E-01	2.72E+00	9.34E-01	7.08E-01	4.39E-01
3-Methylthiophene	1			9.23E-02		
4-Methyl-1-pentene	1			2.33E-02		
4-Methyl-2-pentanone (MIBK)	7	7.58E-02	2.17E+00	8.40E-01	6.91E-01	5.12E-01
4-Methylheptane	10	3.14E-02	5.03E+00	8.03E-01	1.53E+00	9.50E-01
Acetaldehyde	5	1.48E-02	1.91E-01	8.29E-02	7.61E-02	6.67E-02
Acetone	9	3.28E-01	1.55E+01	6.82E+00	5.62E+00	3.67E+00
Acetonitrile	20	1.32E-01	2.47E+00	5.32E-01	5.03E-01	2.20E-01
Acrylonitrile		**BDLa**				
Benzene	48	7.30E-02	2.13E+01	2.17E+00	3.34E+00	9.44E-01
Benzyl chloride	26	1.72E-03	2.94E-02	1.76E-02	7.77E-03	2.99E-03
Bromodichloromethane	4	2.67E-03	1.64E-01	6.80E-02	7.65E-02	7.50E-02
Bromomethane (Methyl bromide)	7	2.50E-03	4.57E-02	1.80E-02	1.62E-02	1.20E-02
Butane	15	3.12E-01	3.79E+01	4.26E+00	9.41E+00	4.76E+00
Carbon disulfide	35	2.80E-04	3.40E-01	1.40E-01	8.30E-02	2.75E-02
Carbon tetrachloride	31	8.30E-04	3.82E-02	7.62E-03	7.92E-03	2.79E-03
Carbon tetrafluoride (Freon 14)	1			1.49E-01		
Carbonyl sulfide (Carbon oxysulfide)	30	1.00E-04	2.70E-01	1.21E-01	7.09E-02	2.54E-02
Chlorobenzene	43	2.07E-02	6.76E+00	5.52E-01	1.18E+00	3.52E-01
Chlorodifluoromethane (Freon 22)	11	1.12E-01	1.48E+00	6.17E-01	4.62E-01	2.73E-01
Chloroethane (Ethyl chloride)	17	1.17E-02	3.04E+01	2.51E+00	7.31E+00	3.48E+00
Chloromethane (Methyl chloride)	14	1.79E-03	1.26E+00	2.17E-01	3.23E-01	1.69E-01
cis-1,2-Dichloroethene	23	3.97E-03	6.51E+00	1.24E+00	1.38E+00	5.66E-01
cis-1,2-Dimethylcyclohexane	9	3.03E-02	2.07E+00	3.23E-01	6.63E-01	4.33E-01
cis-1,3-Dichloropropene	5	2.27E-04	4.91E-02	1.22E-02	2.08E-02	1.82E-02
cis-1,3-Dichloropropene / trans-1,3-Dichloropropene	1			8.48E-03		
cis-1,3-Dimethylcyclohexane	10	1.69E-01	1.20E+01	1.89E+00	3.66E+00	2.27E+00
cis-1,4-Dimethylcyclohexane / trans-1,3-Dimethylcyclohexane	10	7.41E-02	6.92E+00	9.67E-01	2.11E+00	1.31E+00
cis-2-Butene	10	4.37E-02	3.30E-01	1.25E-01	8.11E-02	5.03E-02
cis-2-Heptene	4	2.44E-02	7.99E-02	4.70E-02	2.62E-02	2.57E-02
cis-2-Hexene	6	8.53E-03	2.48E-02	1.63E-02	5.52E-03	4.42E-03
cis-2-Octene	6	1.50E-03	2.74E-01	1.50E-01	1.13E-01	9.03E-02
cis-2-Pentene	9	3.43E-03	7.37E-02	3.69E-02	2.59E-02	1.69E-02
cis-3-Heptene	2	8.76E-03	1.94E-02	1.41E-02	7.49E-03	1.04E-02
cis-3-Methyl-2-pentene	7	1.18E-02	8.62E-02	2.96E-02	2.55E-02	1.89E-02
cis-4-Methyl-2-pentene	4	8.00E-03	1.00E-01	3.92E-02	4.34E-02	4.25E-02
CO	10	0.00E+00	7.70E+01	2.09E+01	2.84E+01	1.76E+01
Cyclohexane	16	8.73E-02	3.36E+00	1.12E+00	1.05E+00	5.16E-01

APPENDIX C. LANDFILL GAS CONSTITUENTS (UNCORRECTED CONCENTRATIONS)

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Limit (ppm)
Cyclohexene	9	3.95E-03	3.55E-02	1.91E-02	1.02E-02	6.66E-03
Cyclopentane	10	4.57E-03	2.34E-01	7.18E-02	7.07E-02	4.38E-02
Cyclopentene	10	7.06E-04	2.74E-02	9.40E-03	9.18E-03	5.69E-03
Decane	10	1.74E+00	7.64E+00	4.47E+00	2.30E+00	1.43E+00
Dibromochloromethane	3	8.67E-03	1.60E-02	1.35E-02	4.15E-03	4.70E-03
Dibromomethane (Methylene dibromide)	2	6.37E-04	1.03E-03	8.35E-04	2.81E-04	3.89E-04
Dichlorobenzene	74	2.86E-04	5.48E+00	7.76E-01	1.20E+00	2.73E-01
Dichlorodifluoromethane (Freon 12)	20	7.69E-02	6.38E+00	1.04E+00	1.37E+00	6.02E-01
Dichlorofluoromethane (Freon 21)	1			1.57E-02		
Dichloromethane (Methylene chloride)	50	5.08E-03	4.01E+01	5.15E+00	7.57E+00	2.10E+00
Diethyl sulfide	1			8.60E-02		
Dimethyl disulfide	26	2.20E-04	4.20E-01	1.29E-01	9.66E-02	3.71E-02
Dimethyl sulfide	30	7.20E-03	1.43E+01	5.55E+00	3.71E+00	1.33E+00
Dodecane (n-Dodecane)	10	4.32E-02	6.76E-01	2.58E-01	2.28E-01	1.41E-01
Ethane	5	4.63E+00	1.43E+01	8.85E+00	4.68E+00	4.10E+00
Ethanol	5	1.97E-02	3.94E-01	2.22E-01	1.45E-01	1.27E-01
Ethyl acetate	6	1.59E-01	4.60E+00	1.81E+00	1.59E+00	1.27E+00
Ethyl mercaptan (Ethanediol)	31	5.80E-05	8.33E-01	1.89E-01	1.88E-01	6.63E-02
Ethyl methyl sulfide	1			3.66E-02		
Ethylbenzene	22	5.76E-01	4.02E+01	7.60E+00	8.89E+00	3.72E+00
Formaldehyde	5	2.93E-03	2.73E-02	1.23E-02	1.09E-02	9.57E-03
Heptane	16	1.25E-01	9.16E+00	2.00E+00	2.36E+00	1.15E+00
Hexane	23	1.16E-01	2.84E+01	3.01E+00	5.74E+00	2.35E+00
Hexylbenzene	3	7.41E-05	1.07E-03	6.18E-04	5.06E-04	5.72E-04
Hydrogen chloride	1			3.50E+00		
Hydrogen sulfide	37	9.80E-04	3.22E+02	3.04E+01	5.35E+01	1.72E+01
Indan (2,3-Dihydroindene)	10	2.24E-02	2.76E-01	1.31E-01	9.28E-02	5.75E-02
Isobutane (2-Methylpropane)	10	5.55E-01	1.64E+01	6.20E+00	4.85E+00	3.01E+00
Isobutylbenzene	10	1.57E-02	1.37E-01	7.03E-02	4.20E-02	2.60E-02
Isoprene (2-Methyl-1,3-butadiene)	7	5.12E-03	1.27E-01	4.43E-02	4.41E-02	3.27E-02
Isopropyl mercaptan	25	3.60E-05	1.19E+00	1.68E-01	2.49E-01	9.77E-02
Isopropylbenzene (Cumene)	11	7.18E-02	3.13E+00	7.90E-01	8.94E-01	5.29E-01
Methanethiol (Methyl mercaptan)	30	9.40E-04	3.91E+00	1.34E+00	8.93E-01	3.19E-01
Methyl tert-butyl ether (MTBE)	5	3.20E-03	2.57E-01	1.06E-01	1.07E-01	9.34E-02
Methylcyclohexane	10	2.14E-01	1.15E+01	2.84E+00	3.72E+00	2.31E+00
Methylcyclopentane	10	8.74E-02	2.92E+00	9.34E-01	9.73E-01	6.03E-01
Naphthalene	10	7.91E-03	5.41E-01	1.77E-01	1.61E-01	1.00E-01
n-Butylbenzene	10	2.11E-02	2.51E-01	1.29E-01	8.03E-02	4.98E-02
Nonane	10	1.46E+00	3.27E+01	6.58E+00	9.97E+00	6.18E+00
n-Propylbenzene (Propylbenzene)	11	1.24E-01	1.33E+00	6.06E-01	3.87E-01	2.29E-01
Octane	10	2.68E-01	3.38E+01	4.69E+00	1.03E+01	6.40E+00
p-Cymene (1-Methyl-4-lsopropylbenzene)	11	4.20E-01	8.05E+00	3.38E+00	2.77E+00	1.64E+00
Pentane	15	1.72E-01	2.66E+01	3.21E+00	6.56E+00	3.32E+00
Propane	15	1.01E+00	4.00E+01	1.21E+01	1.06E+01	5.35E+00
Propene	10	4.90E-01	8.47E+00	2.88E+00	2.35E+00	1.46E+00
Propyne	2	3.75E-02	4.20E-02	3.98E-02	3.21E-03	4.44E-03
sec-Butylbenzene	10	2.49E-02	2.75E-01	1.20E-01	7.82E-02	4.85E-02
Styrene (Vinylbenzene)	20	3.93E-03	1.27E+00	3.21E-01	4.30E-01	1.89E-01
tert-Butylbenzene	4	9.58E-03	3.90E-02	2.40E-02	1.34E-02	1.32E-02
Tetrachloroethylene (Perchloroethylene)	47	1.55E-03	8.06E+00	1.78E+00	1.81E+00	5.19E-01
Tetrahydrofuran (Diethylene oxide)	7	1.53E-01	2.06E+00	9.51E-01	6.29E-01	4.66E-01
Thiophene	2	1.24E-01	5.71E-01	3.48E-01	3.16E-01	4.38E-01
Toluene (Methyl benzene)	47	1.30E+00	1.08E+02	3.02E+01	2.49E+01	7.11E+00

APPENDIX C. LANDFILL GAS CONSTITUENTS (UNCORRECTED CONCENTRATIONS)

Compound	Number of Test Reports	Minimum (ppm)	Maximum (ppm)	Mean (ppm)	Standard Deviation (ppm)	95% Confidence Limit (ppm)
trans-1,2-Dichloroethene	13	3.00E-03	8.67E-02	3.67E-02	2.32E-02	1.26E-02
trans-1,2-Dimethylcyclohexane	10	1.26E-01	7.98E+00	1.25E+00	2.42E+00	1.50E+00
trans-1,3-Dichloropropene	5	3.20E-04	3.27E-02	9.88E-03	1.31E-02	1.15E-02
trans-1,4-Dimethylcyclohexane	10	4.37E-02	5.69E+00	8.45E-01	1.74E+00	1.08E+00
trans-2-Butene	9	2.85E-02	3.80E-01	1.25E-01	1.04E-01	6.80E-02
trans-2-Heptene	2	2.49E-03	1.71E-02	9.82E-03	1.04E-02	1.44E-02
trans-2-Hexene	6	1.11E-02	3.24E-02	2.20E-02	8.15E-03	6.52E-03
trans-2-Octene	7	1.10E-01	1.46E+01	2.74E+00	5.36E+00	3.97E+00
trans-2-Pentene	10	5.72E-03	7.43E-02	3.18E-02	2.58E-02	1.60E-02
trans-3-Heptene	3	2.57E-03	1.54E-01	8.06E-02	7.60E-02	8.60E-02
trans-3-Methyl-2-pentene	7	4.07E-03	7.32E-02	2.26E-02	2.31E-02	1.71E-02
Tribromomethane (Bromoform)	4	4.23E-04	2.61E-02	1.29E-02	1.08E-02	1.06E-02
Trichloroethylene (Trichloroethene)	49	1.95E-03	3.10E+00	7.55E-01	6.55E-01	1.83E-01
Trichlorofluoromethane (Freon 11)	22	6.90E-03	6.95E-01	2.14E-01	1.95E-01	8.15E-02
Trichloromethane (Chloroform)	36	1.46E-03	7.43E-01	6.67E-02	1.52E-01	4.95E-02
Undecane	10	6.08E-01	3.11E+00	1.76E+00	8.73E-01	5.41E-01
Vinyl acetate	6	2.37E-02	6.86E-01	1.92E-01	2.55E-01	2.04E-01
Vinyl chloride (Chloroethene)	48	6.20E-03	1.56E+01	1.23E+00	2.43E+00	6.88E-01
Xylenes (o-, m-, p-, mixtures)	92	3.00E-01	1.08E+02	1.06E+01	1.39E+01	2.83E+00

[a] All tests below detection limit. The method detection limits are available for three tests, and are as follows: 2.00E-04, 4.00E-03, and 2.00E-02 ppm

Appendix D
Background Data for VOC Emission Factor Calculation

Summary Statistics

Count	**34**
Mean	**0.997**
Min	**0.95**
Max	**1.00**
StDev	**0.01**
95% CI	**0.00**

Test Report ID	Compound Synonym	Corrected Average Concentration (ppm)	VOC Fraction	Carbons	Compound as hexane (ppm)
TR-145	NMOC (as C6H8)	6.35E+02			
TR-145	1,1,1-Trichloroethane	2.02E-01		2	6.74E-02
TR-145	Acetone	6.48E+00		3	3.24E+00
	VOC Fraction		**0.99**		
TR-165	NMOC (as C6H8)	7.13E+02			
TR-165	1,1,1-Trichloroethane	9.83E-03		2	3.28E-03
	VOC Fraction		**1.00**		
TR-167	NMOC (as C6H8)	6.73E+02			
TR-167	1,1,1-Trichloroethane	8.05E-03		2	2.68E-03
	VOC Fraction		**1.00**		
TR-168	1,1,1-Trichloroethane	1.94E-01		2	6.47E-02
TR-168	NMOC (as C6H8)	1.31E+03			
	VOC Fraction		**1.00**		
TR-169	1,1,1-Trichloroethane	2.18E-01		2	7.27E-02
TR-169	NMOC (as C6H8)	1.39E+03			
	VOC Fraction		**1.00**		
TR-171	NMOC (as C6H8)	1.02E+03			
TR-171	1,1,1-Trichloroethane	5.21E-01		2	1.74E-01
	VOC Fraction		**1.00**		
TR-173	NMOC (as C6H8)	1.43E+03			
TR-173	1,1,1-Trichloroethane	6.82E-02		2	2.27E-02
	VOC Fraction		**1.00**		
TR-175	NMOC (as C6H8)	1.61E+02			
TR-175	1,1,1-Trichloroethane	9.12E-02		2	3.04E-02
	VOC Fraction		**1.00**		
TR-176	NMOC (as C6H8)	6.23E+02			
TR-176	1,1,1-Trichloroethane	3.02E-02		2	1.01E-02
	VOC Fraction		**1.00**		
TR-178	NMOC (as C6H8)	1.95E+03			
TR-178	1,1,1-Trichloroethane	3.31E-02		2	1.10E-02
	VOC Fraction		**1.00**		
TR-181	NMOC (as C6H8)	6.49E+02			
TR-181	1,1,1-Trichloroethane	2.68E-01		2	8.94E-02
	VOC Fraction		**1.00**		
TR-182	NMOC (as C6H8)	5.96E+02			
TR-182	1,1,1-Trichloroethane	2.52E-01		2	8.38E-02
	VOC Fraction		**1.00**		
TR-183	1,1,1-Trichloroethane	2.56E-02		2	8.54E-03
TR-183	NMOC (as C6H8)	7.34E+02			
	VOC Fraction		**1.00**		
TR-187	NMOC (as C6H8)	8.70E+02			
TR-187	1,1,1-Trichloroethane	7.22E-01		2	2.41E-01
	VOC Fraction		**1.00**		

TR-196	NMOC (as C6H8)	8.89E+02			
TR-196	1,1,1-Trichloroethane	1.78E-01		2	5.94E-02
	VOC Fraction		**1.00**		
TR-205	NMOC (as C6H8)	6.47E+02			
TR-205	1,1,1-Trichloroethane	2.59E-01		2	8.63E-02
	VOC Fraction		**1.00**		
TR-207	NMOC (as C6H8)	1.39E+03			
TR-207	1,1,1-Trichloroethane	1.92E+00		2	6.40E-01
	VOC Fraction		**1.00**		
TR-209	Acetone	8.78E+00		3	4.39E+00
TR-209	NMOC (as C6H8)	5.36E+02			
	VOC Fraction		**0.99**		
TR-220	NMOC (as C6H8)	7.04E+02			
TR-220	1,1,1-Trichloroethane	3.16E-01		2	1.05E-01
	VOC Fraction		**1.00**		
TR-229	NMOC (as C6H8)	5.64E+02			
TR-229	1,1,1-Trichloroethane	2.25E-02		2	7.50E-03
	VOC Fraction		**1.00**		
TR-251	NMOC (as C6H8)	1.07E+03			
TR-251	1,1,1-Trichloroethane	2.74E-01		2	9.14E-02
	VOC Fraction		**1.00**		
TR-253	NMOC (as C6H8)	5.83E+02			
TR-253	1,1,1-Trichloroethane	1.88E-01		2	6.28E-02
	VOC Fraction		**1.00**		
TR-255	NMOC (as C6H8)	1.12E+03			
TR-255	1,1,1-Trichloroethane	1.27E-01		2	4.23E-02
	VOC Fraction		**1.00**		
TR-259	NMOC (as C6H8)	1.35E+03			
TR-259	1,1,1-Trichloroethane	5.59E-01		2	1.86E-01
	VOC Fraction		**1.00**		
TR-260	1,1,1-Trichloroethane	5.74E-01		2	1.91E-01
TR-260	NMOC (as C6H8)	1.35E+03			
	VOC Fraction		**1.00**		
TR-261	NMOC (as C6H8)	1.32E+03			
TR-261	1,1,1-Trichloroethane	5.91E-01		2	1.97E-01
	VOC Fraction		**1.00**		
TR-264	NMOC (as C6H8)	5.37E+02			
TR-264	1,1,1-Trichloroethane	1.61E-01		2	5.36E-02
	VOC Fraction		**1.00**		
TR-266	NMOC (as C6H8)	2.45E+02			
TR-266	1,1,1-Trichloroethane	5.70E-03		2	1.90E-03
	VOC Fraction		**1.00**		
TR-272	Ethane	6.35E+00		2	2.12E+00
TR-272	Acetone	3.38E-01		3	1.69E-01
TR-272	NMOC (as C6H8)	3.86E+02			
TR-272	1,1,1-Trichloroethane	5.15E-03		2	1.72E-03
	VOC Fraction		**0.99**		

TR-273	1,1,1-Trichloroethane	4.59E-02		2	1.53E-02
TR-273	NMOC (as C6H8)	5.26E+02			
TR-273	Ethane	6.87E+00		2	2.29E+00
TR-273	Acetone	2.38E+00		3	1.19E+00
	VOC Fraction		**1.00**		
TR-284	Acetone	1.07E+01		3	5.37E+00
TR-284	NMOC (as C6H8)	5.39E+03			
TR-284	Ethane	1.32E+01		2	4.38E+00
	VOC Fraction		**1.00**		
TR-287	NMOC (as C6H8)	8.68E+02			
TR-287	Ethane	4.83E+00		2	1.61E+00
TR-287	Acetone	1.11E+01		3	5.53E+00
	VOC Fraction		**0.99**		
TR-290	NMOC (as C6H8)	9.72E+02			
TR-290	1,1,1-Trichloroethane	7.99E-01		2	2.66E-01
	VOC Fraction		**1.00**		
TR-292	NMOC (as C6H8)	2.42E+02			
TR-292	Ethane	1.40E+01		2	4.68E+00
TR-292	Acetone	1.61E+01		3	8.06E+00
	VOC Fraction		**0.95**		

Appendix E
Raw Landfill Gas Data Plots and Statistics

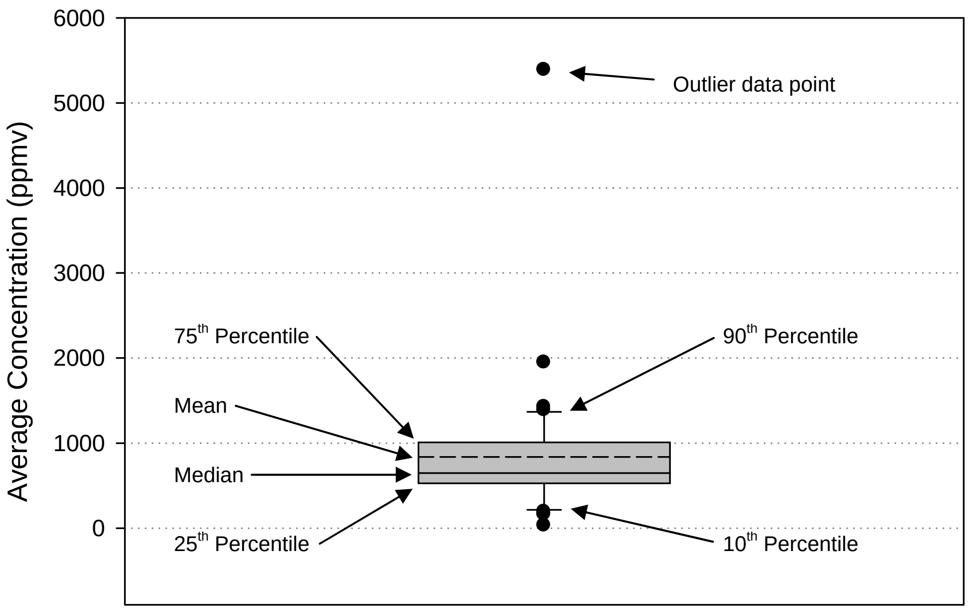
Appendix E
Table of Contents

Introduction and Explanation

The data presented in this appendix for raw landfill gas constituents are organized according to chemical similarity (NMOC, benzene-toluene-ethylbenzene-xylenes (BTEX), chlorinated compounds, sulfur compounds, and mercury compounds). Pollutants in each grouping with similar average concentration ranges were included on the same plot.

The statistical summary plots graph data as a box representing statistical values for the data set. A solid line within the box marks the median while a dashed line marks the mean. The boundary of the box closest to zero indicates the 25th percentile and the boundary of the box farthest from zero indicates the 75th percentile. Error bars above and below the box indicate the 90th and 10th percentiles, respectively. The percentiles indicate the average concentration (ppmv) values at which a certain percentage of the data points fall below the respective percentile value. For example, if the 75th percentile is 1,000 ppmv, then 75 percent of the data points in the set have concentration values less than 1,000 ppmv. All outlying data points are indicated by solid dots. For the data contained in this report, all statistical outliers were included in the calculations to determine the default concentrations (ppmv) for all raw landfill gas constituents because no datum should be rejected solely on the basis of statistical tests since there is a risk of rejecting an emission rate that represents actual emissions.

Figure 1. Example Statistical Data Plot



A minimum number of data points is required to compute each set of percentiles. At least three points are required to compute the 25th and 75th percentiles.

The Standard method was used to calculate percentile values for the statistical summary box plots. For the data values $x_1, x_2, \ldots, x_n$, the Standard method utilizes linear interpolation to determine the data percentile value (v) and is calculated as follows[1]:

[1] *SigmaPlot® 10.0 User's Guide*. Systat Software, Inc. Point Richmond, CA. 2006.

(Eq. A-1) $$v = (f)(x_i k) + 1 + (1 - f)(x_i k)$$

where,

(Eq. A-2) $$f = \frac{(n+1)p}{100} - k\,,$$

p = percentile value (i.e., 10, 25, 75, 90), and

(Eq. A-3) $$k = \text{the largest integer} \leq \frac{(n+1)p}{100}$$

The statistical data plots graph the mean, median, percentile values, and outlier data points for each pollutant data set. The data plots graph the entire pollutant data set including the mean and the upper and lower bounds of the 95 percent confidence interval. For all graphs, ordinate axis values $\leq 10^{-4}$ or $\geq 10^{4}$ were plotted in scientific notation.

A table containing the number of data points (sample size), minimum and maximum values, and data set statistics accompanies each pollutant data plot. The following statistics were calculated for each data set: mean, standard deviation, standard error, and 95% confidence interval.

The arithmetic mean (x) was calculated as:

(Eq. A-4) $$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

The sample standard deviation (s) was calculated as the square root of the mean of the square of differences from their mean of the data points (x_i):

(Eq. A-5) $$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

The standard error is the standard deviation of the mean. It is calculated as the sample standard deviation divided by the square root of the number of data points.

(Eq. A-6) $$E_s = \frac{s}{\sqrt{n}}$$

The upper and lower confidence intervals (μ) were calculated using the sample standard deviation, the t-statistic for ∞ degrees of freedom (z = 1.96 for 95% confidence, and z = 2.576 for 99% confidence), and the square root of the number of data points.

(Eq. A-7) $$\mu = \pm \frac{ts}{\sqrt{n}}$$

Group A: NMOC Data and Statistics

Figure A-1. NMOC Statistical Data Plot

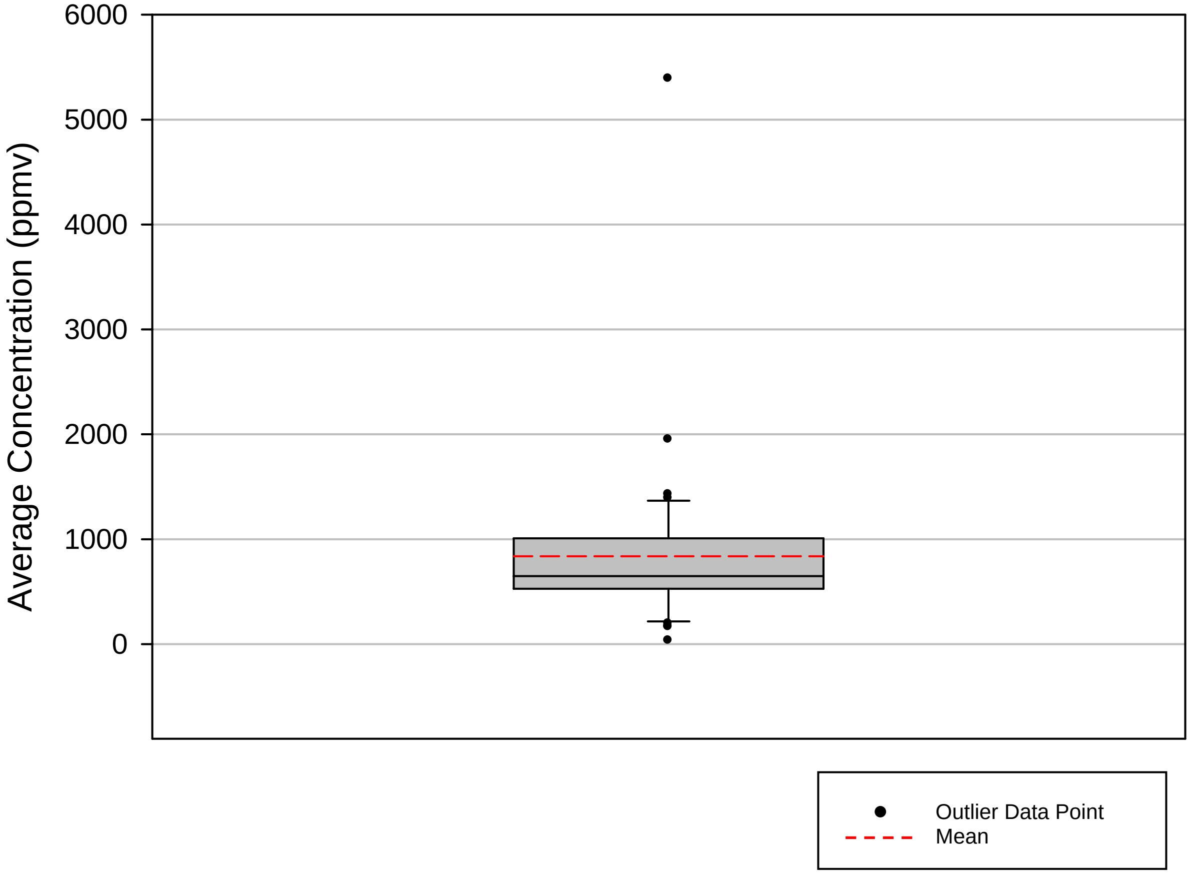


Figure A-2. NMOC Scatter Plot

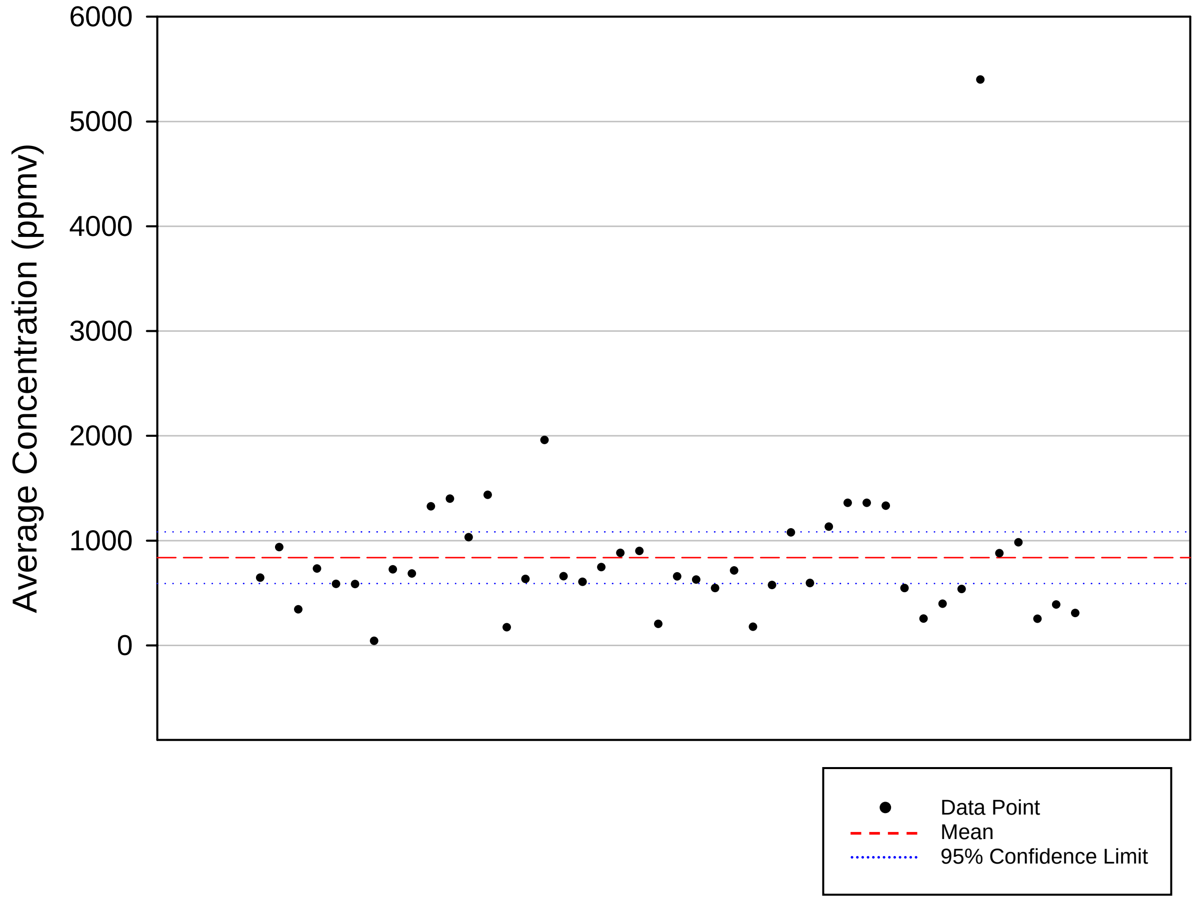


Table A-1. NMOC Data Statistics

Number of Data Points	44
Minimum (ppmv)	31
Maximum (ppmv)	5387
Mean (ppmv)	838
Median (ppmv)	648
Standard Deviation (ppmv)	811
Standard Error (ppmv)	122
95% Confidence Interval (+/- ppmv)	247
99% Confidence Interval (+/- ppmv)	330

Group B: Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) Data and Statistics

Figure B-1. BTEX Statistical Data Plot

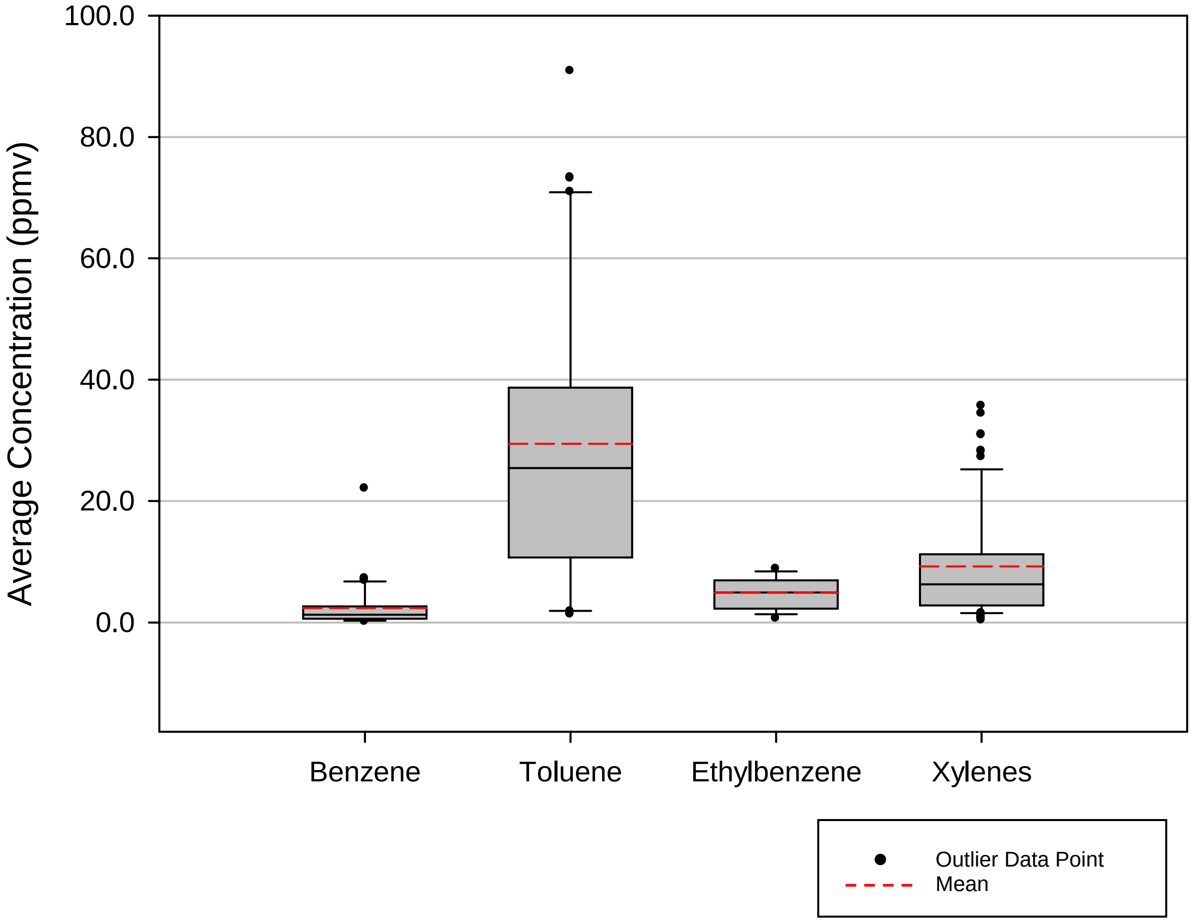


Figure B-2. Benzene Scatter Plot

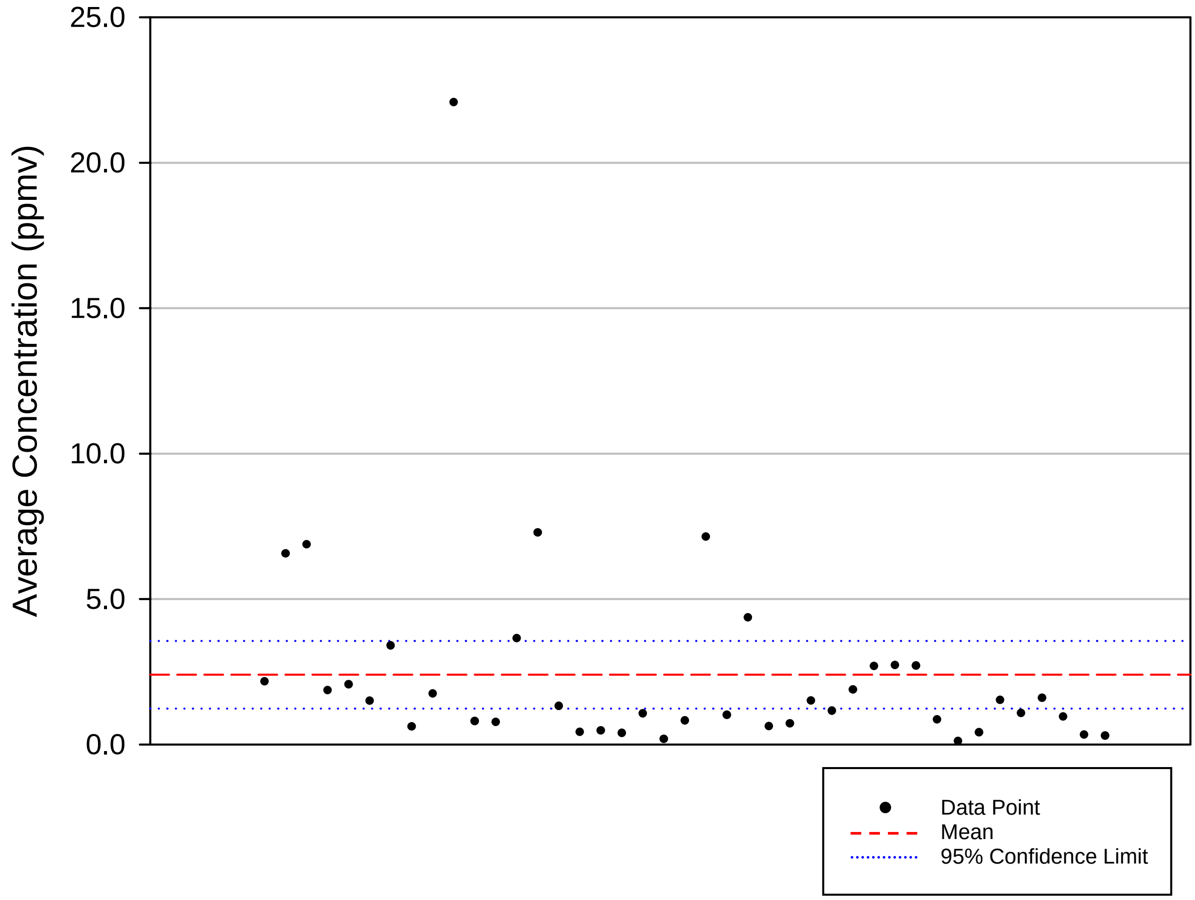


Table B-1. Benzene Data Statistics

Number of Data Points	41
Minimum (ppmv)	7.52E-02
Maximum (ppmv)	2.20E+01
Mean (ppmv)	2.40E+00
Median (ppmv)	1.28E+00
Standard Deviation (ppmv)	3.69E+00
Standard Error (ppmv)	5.77E-01
95% Confidence Interval (+/- ppmv)	1.17E+00
99% Confidence Interval (+/- ppmv)	1.56E+00

Figure B-3. Toluene Scatter Plot

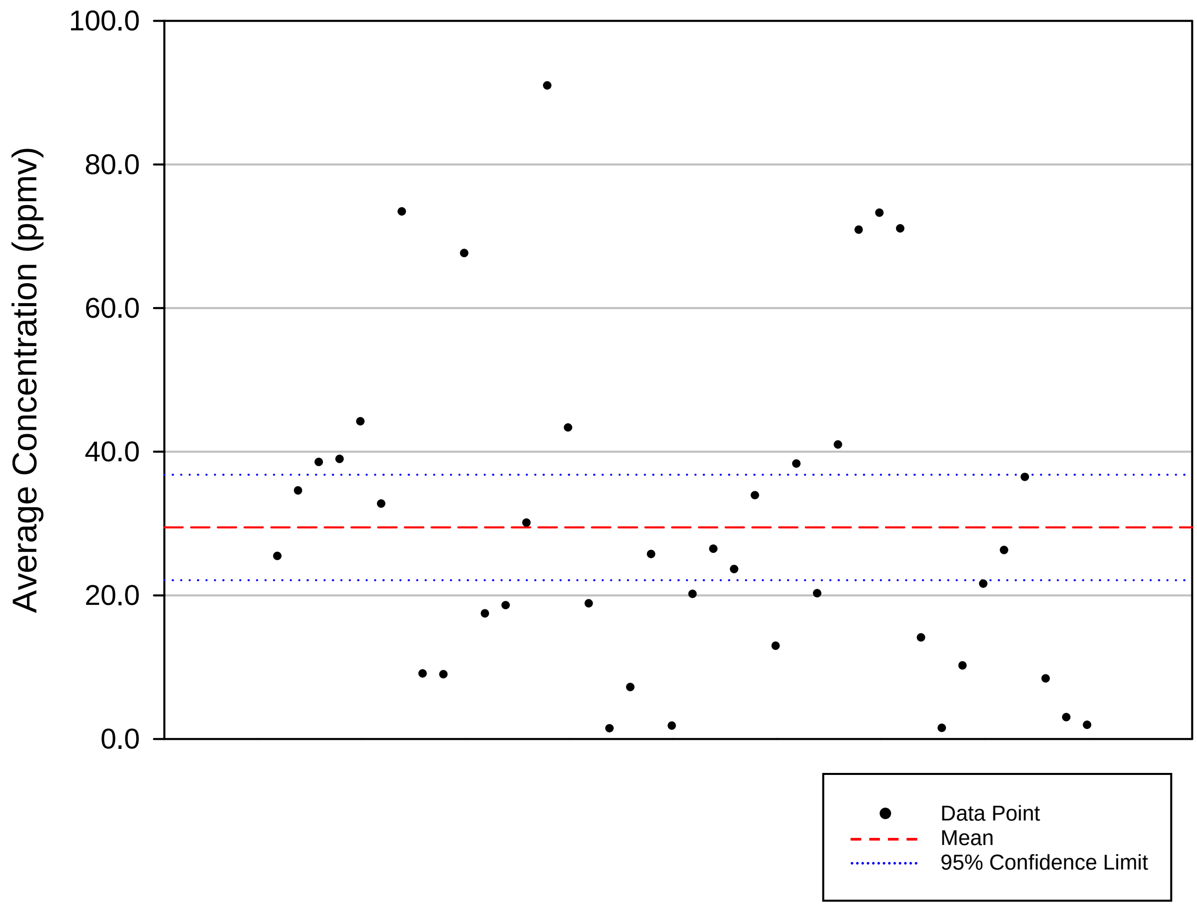


Table B-2. Toluene Data Statistics

Number of Data Points	40
Minimum (ppmv)	1.30E+00
Maximum (ppmv)	9.08E+01
Mean (ppmv)	2.95E+01
Median (ppmv)	2.54E+01
Standard Deviation (ppmv)	2.30E+01
Standard Error (ppmv)	3.63E+00
95% Confidence Interval (+/- ppmv)	7.34E+00
99% Confidence Interval (+/- ppmv)	9.83E+00

Figure B-4. Ethylbenzene Data Plot

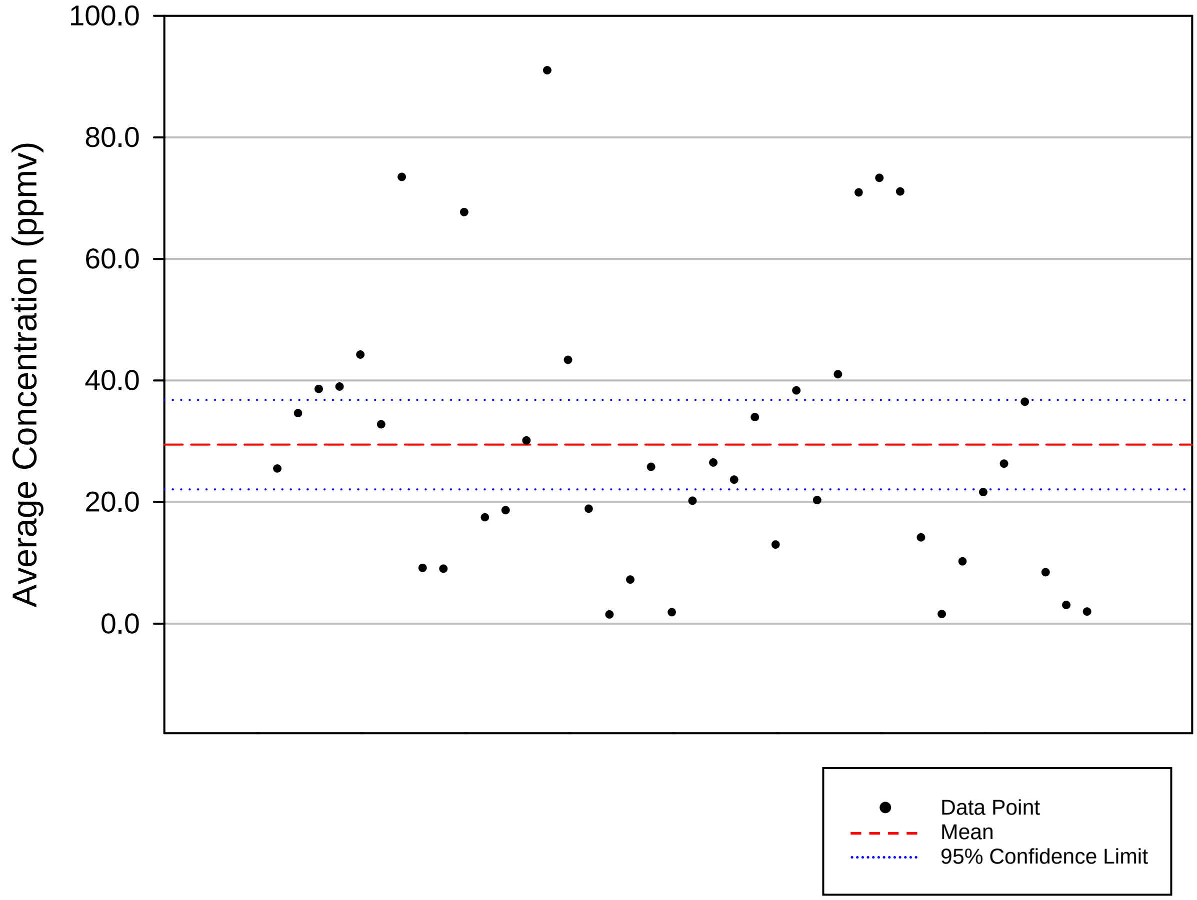


Table B-3. Ethylbenzene Data Statistics

Number of Data Points	16
Minimum (ppmv)	5.93E-01
Maximum (ppmv)	8.80E+00
Mean (ppmv)	4.86E+00
Median (ppmv)	4.95E+00
Standard Deviation (ppmv)	2.58E+00
Standard Error (ppmv)	6.46E-01
95% Confidence Interval (+/- ppmv)	1.38E+00
99% Confidence Interval (+/- ppmv)	1.90E+00

Figure B-5. Xylenes (o-, m-, p-, mixtures) Data Plot

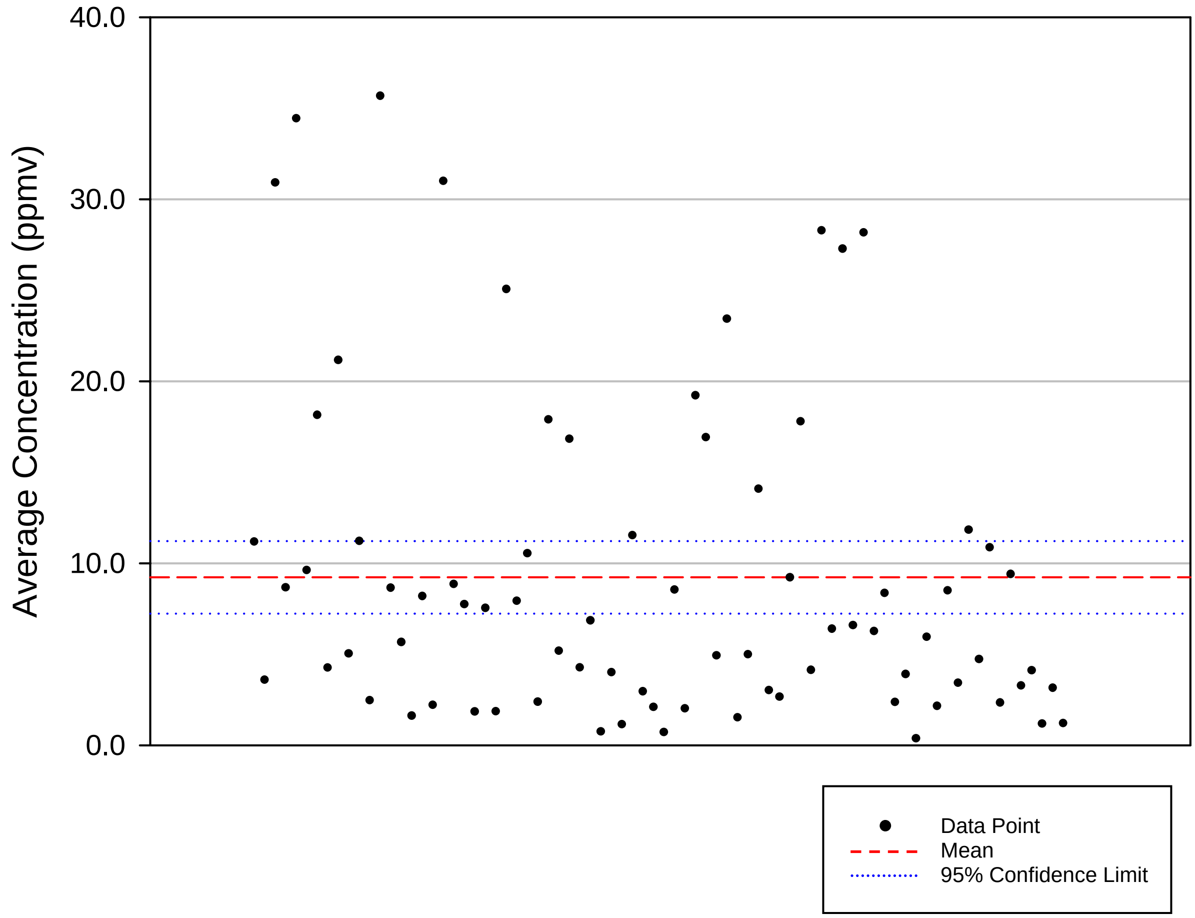


Table B-4. Xylenes (o-, m-, p-, mixtures) Data Statistics

Number of Data Points	78
Minimum (ppmv)	3.09E-01
Maximum (ppmv)	3.56E+01
Mean (ppmv)	9.23E+00
Median (ppmv)	6.27E+00
Standard Deviation (ppmv)	8.84E+00
Standard Error (ppmv)	1.00E+00
95% Confidence Interval (+/- ppmv)	1.99E+00
99% Confidence Interval (+/- ppmv)	2.64E+00

Group C: Chlorinated Compounds Data and Statistics

Figure C-1. Dichlorobenzene, Trichloroethylene, and Tetrachloroethylene Statistical Data Plot

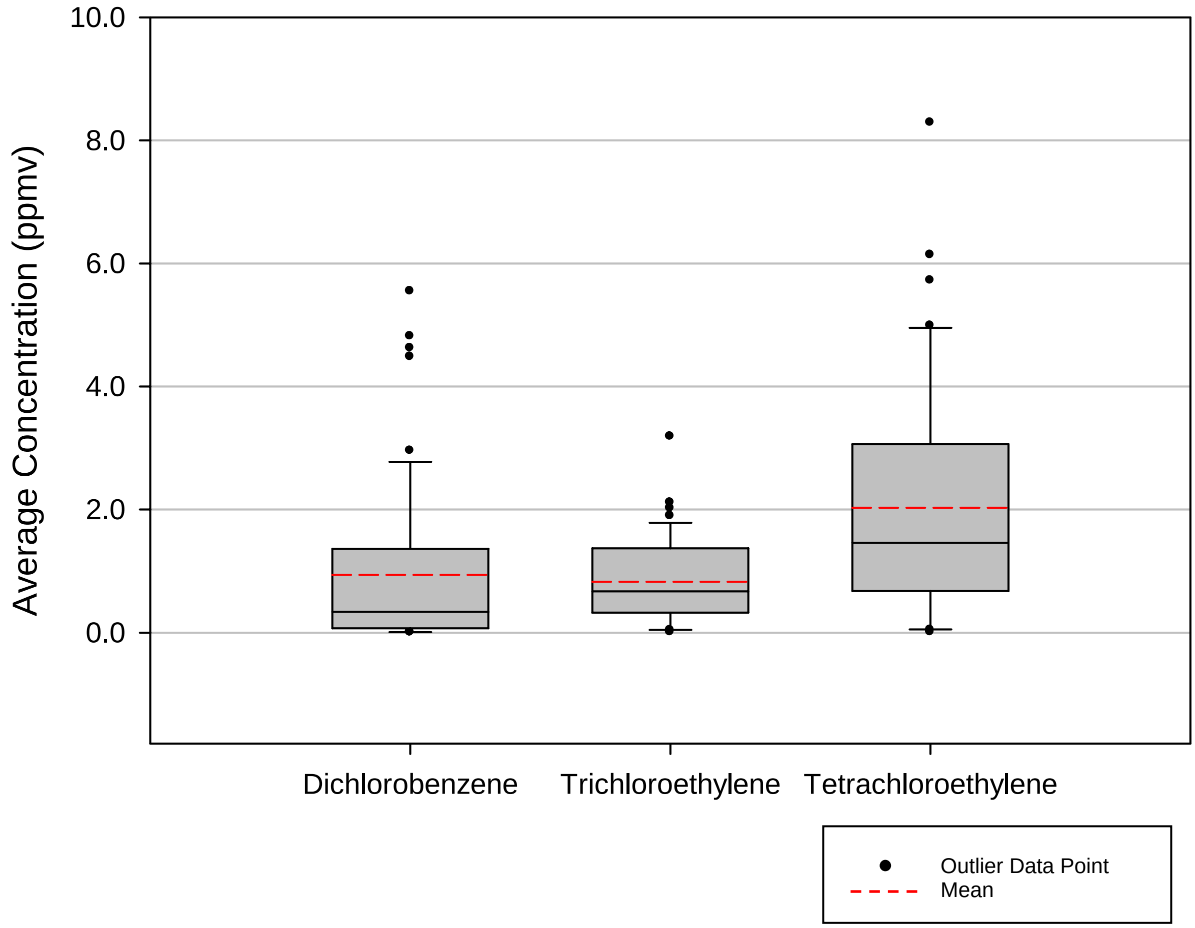


Figure C-2. Vinyl chloride and 1,1-Dichloroethane Statistical Data Plot

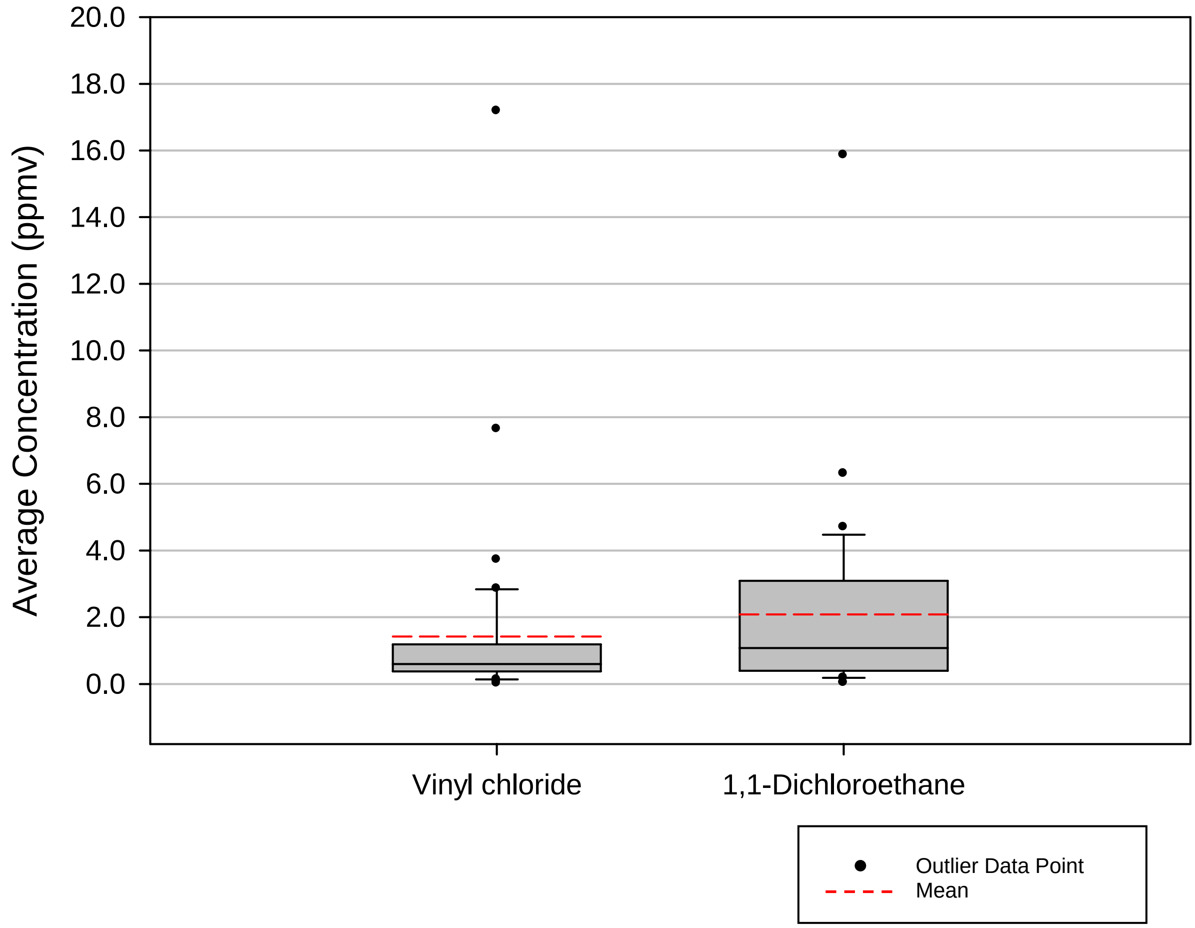


Figure C-3. 1,1-Dichloroethene, Trichloromethane, and 1,1,1-Trichloroethane Statistical Data Plot

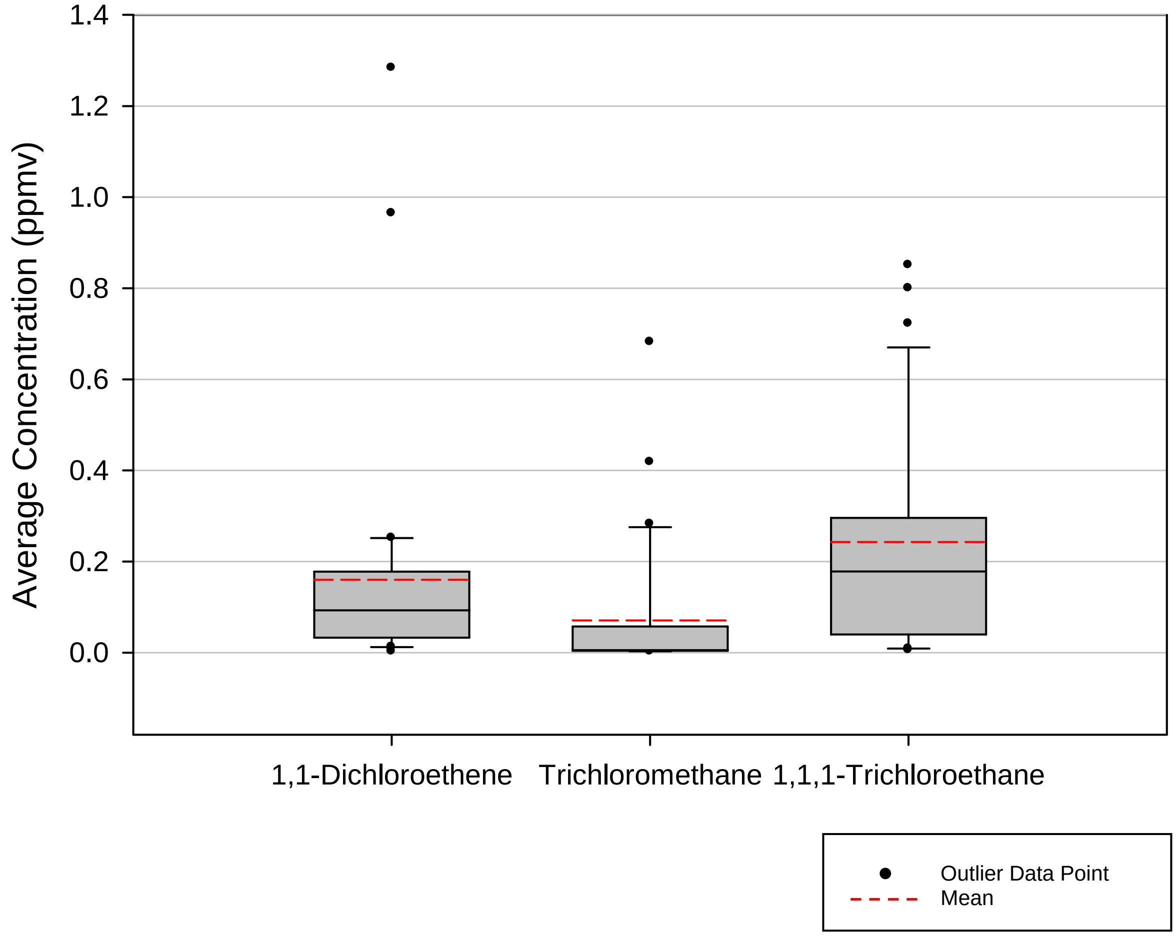


Figure C-4. Dichloromethane Statistical Data Plot

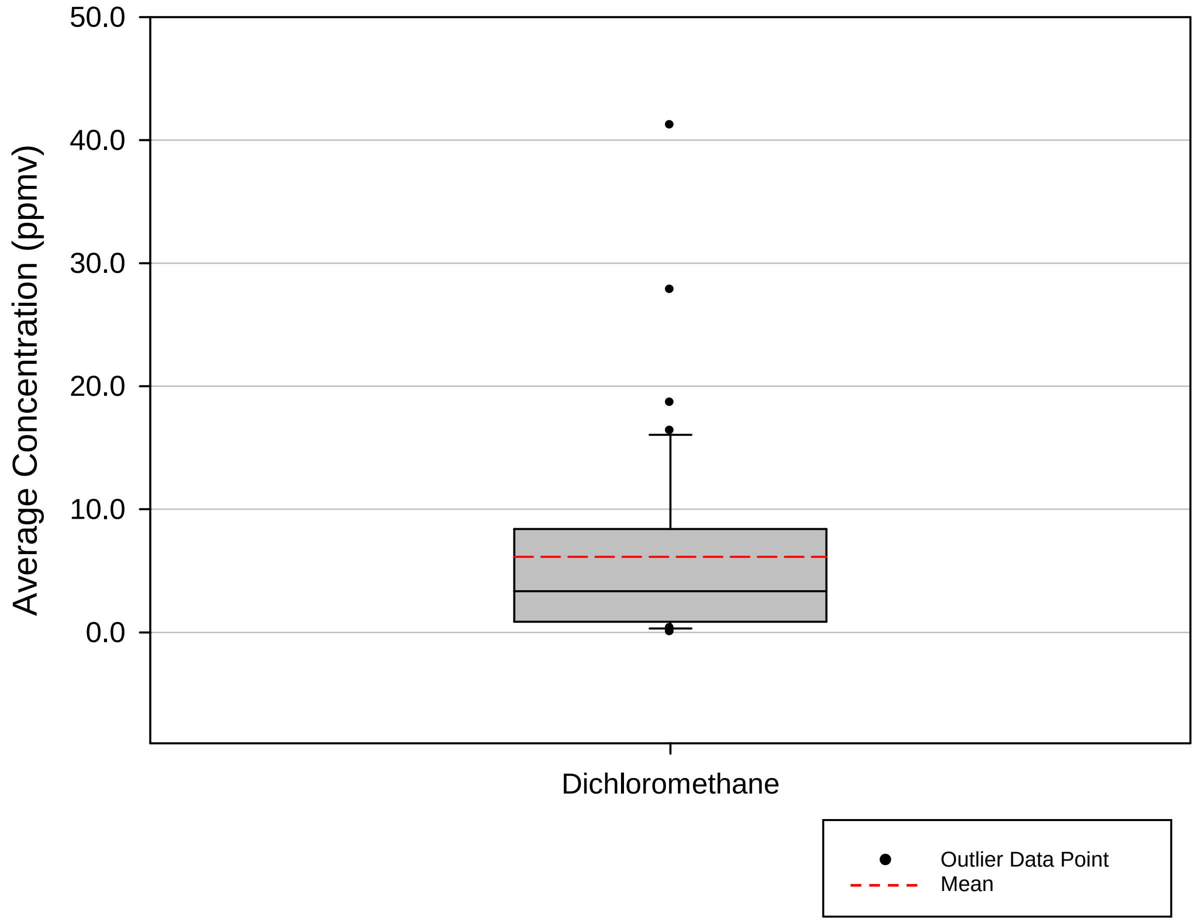


Figure C-5. Chlorobenzene Statistical Data Plot

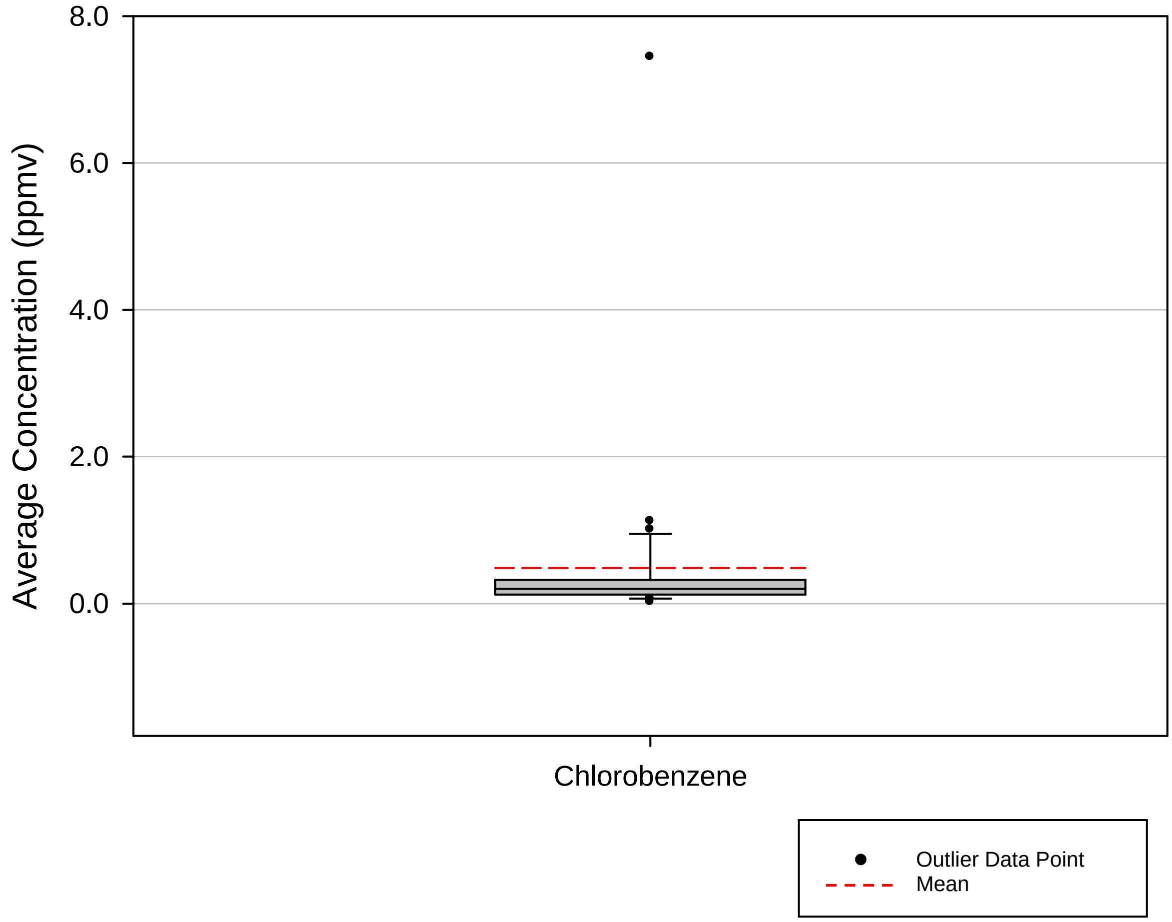


Figure C-6. 1,2-Dichloroethane Statistical Data Plot

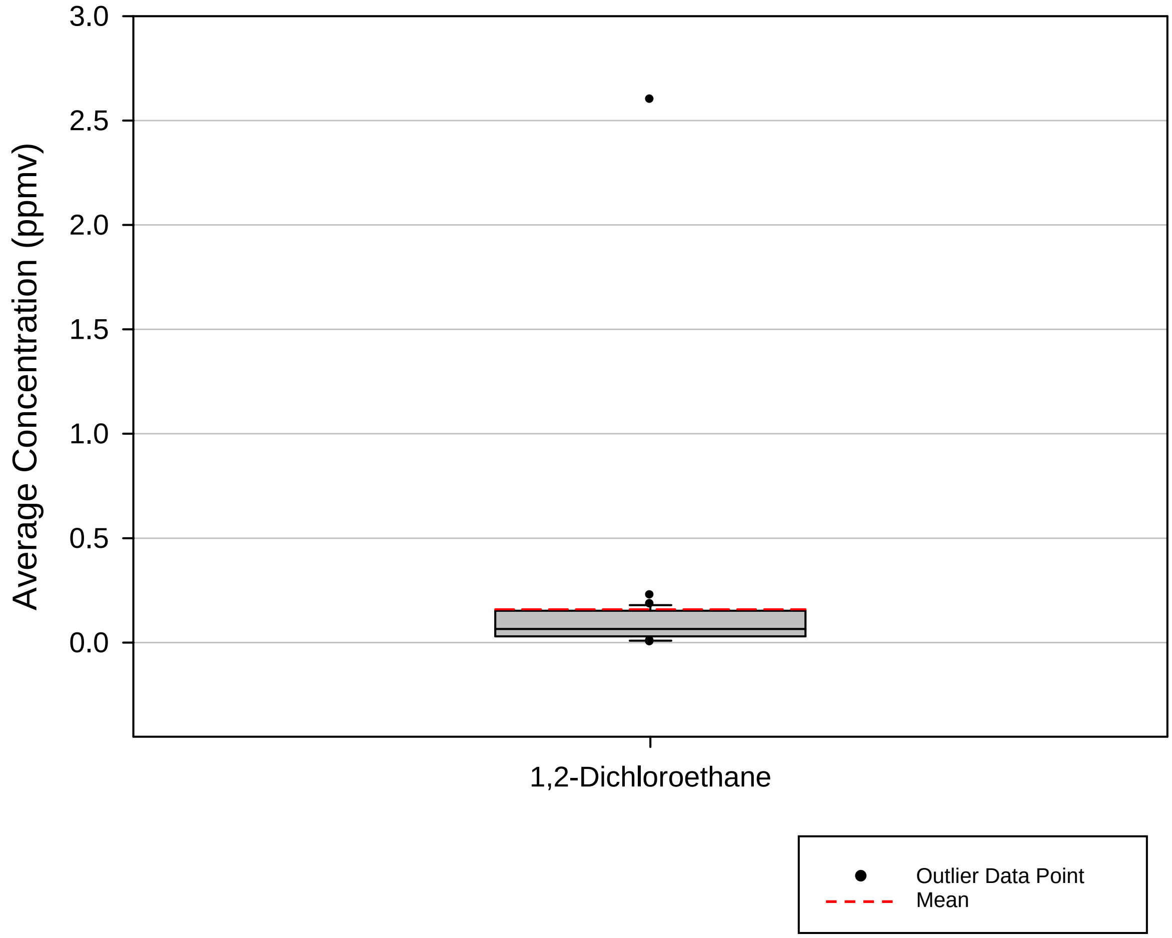


Figure C-7. Carbon Tetrachloride Statistical Data Plot

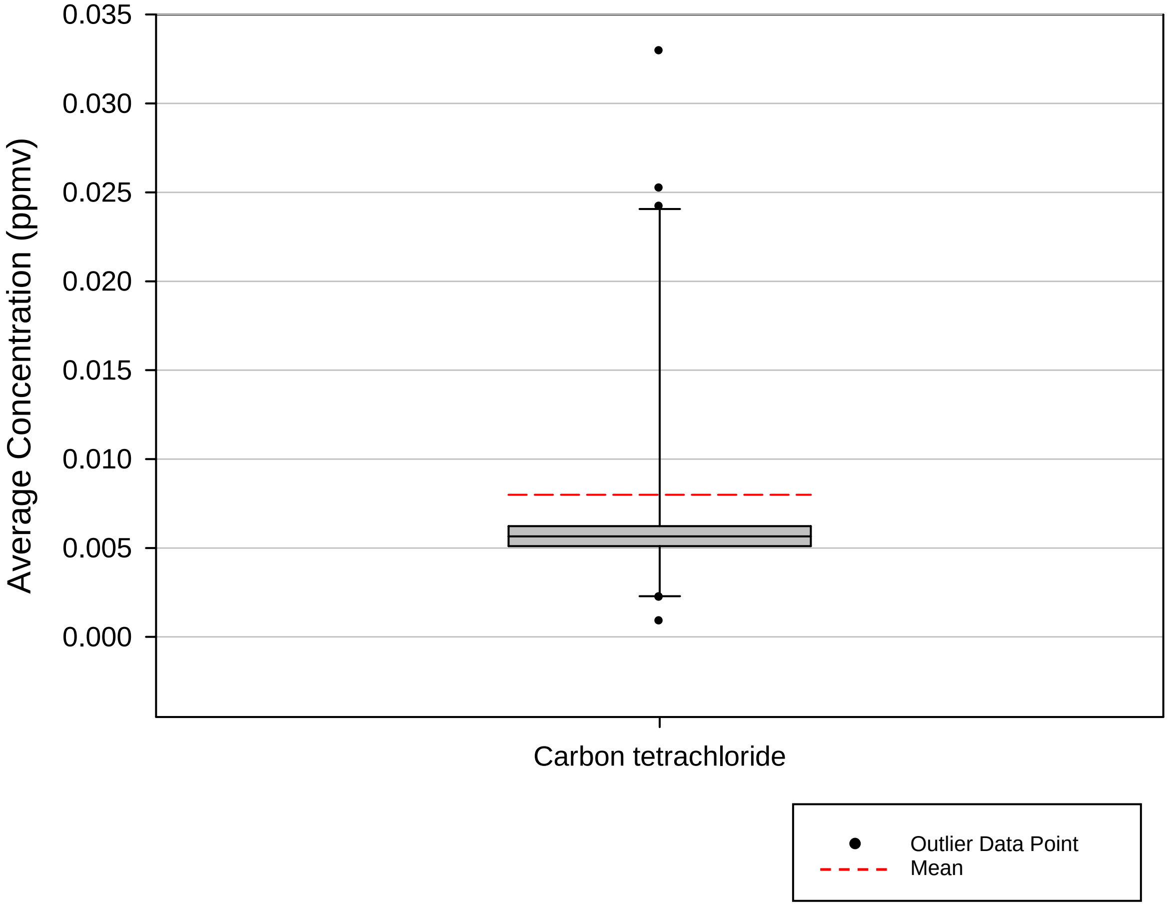


Figure C-8. Dichlorobenzene Data Plot

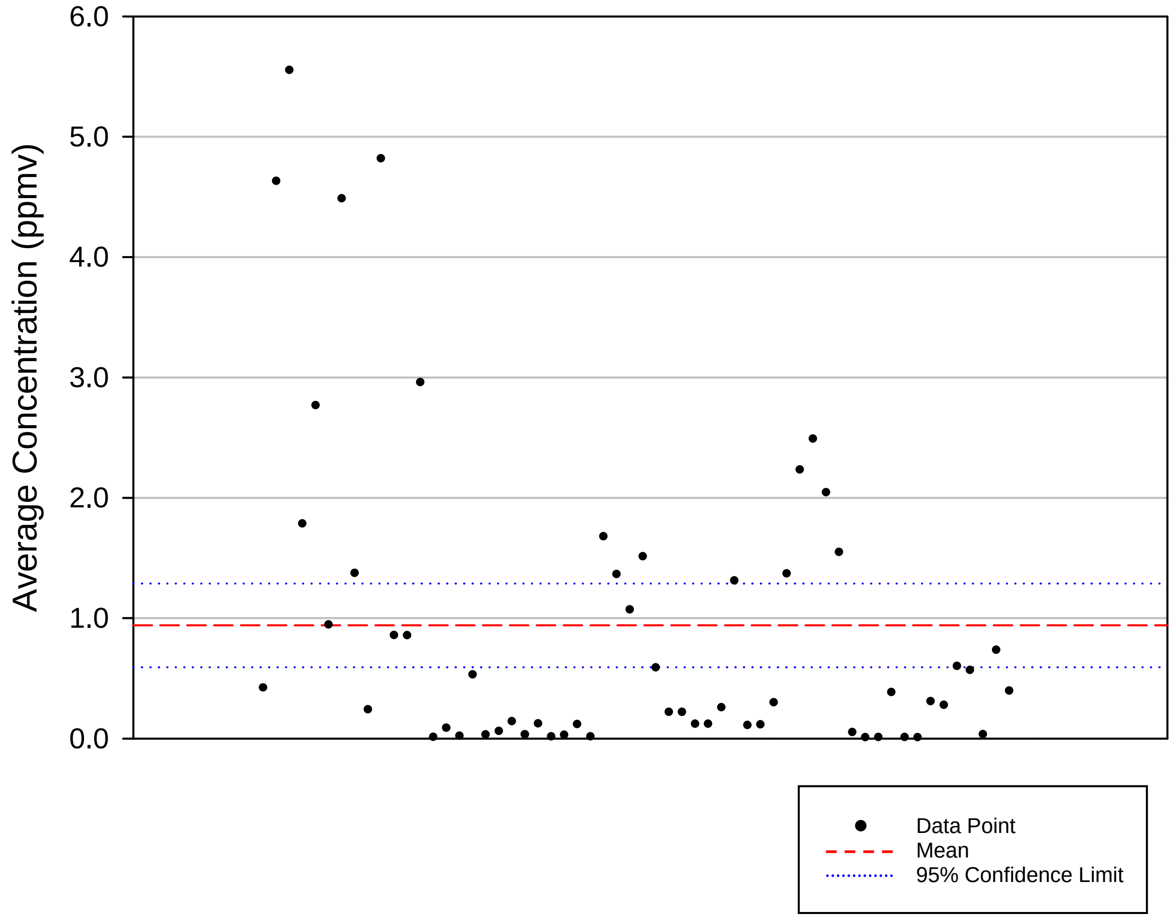


Table C-1. Dichlorobenzene Data Statistics

Number of Data Points	58
Minimum (ppmv)	4.84E-04
Maximum (ppmv)	5.54E+00
Mean (ppmv)	9.40E-01
Median (ppmv)	3.39E-01
Standard Deviation (ppmv)	1.32E+00
Standard Error (ppmv)	1.74E-01
95% Confidence Interval (+/- ppmv)	3.48E-01
99% Confidence Interval (+/- ppmv)	4.63E-01

Figure C-9. Dichloromethane Data Plot

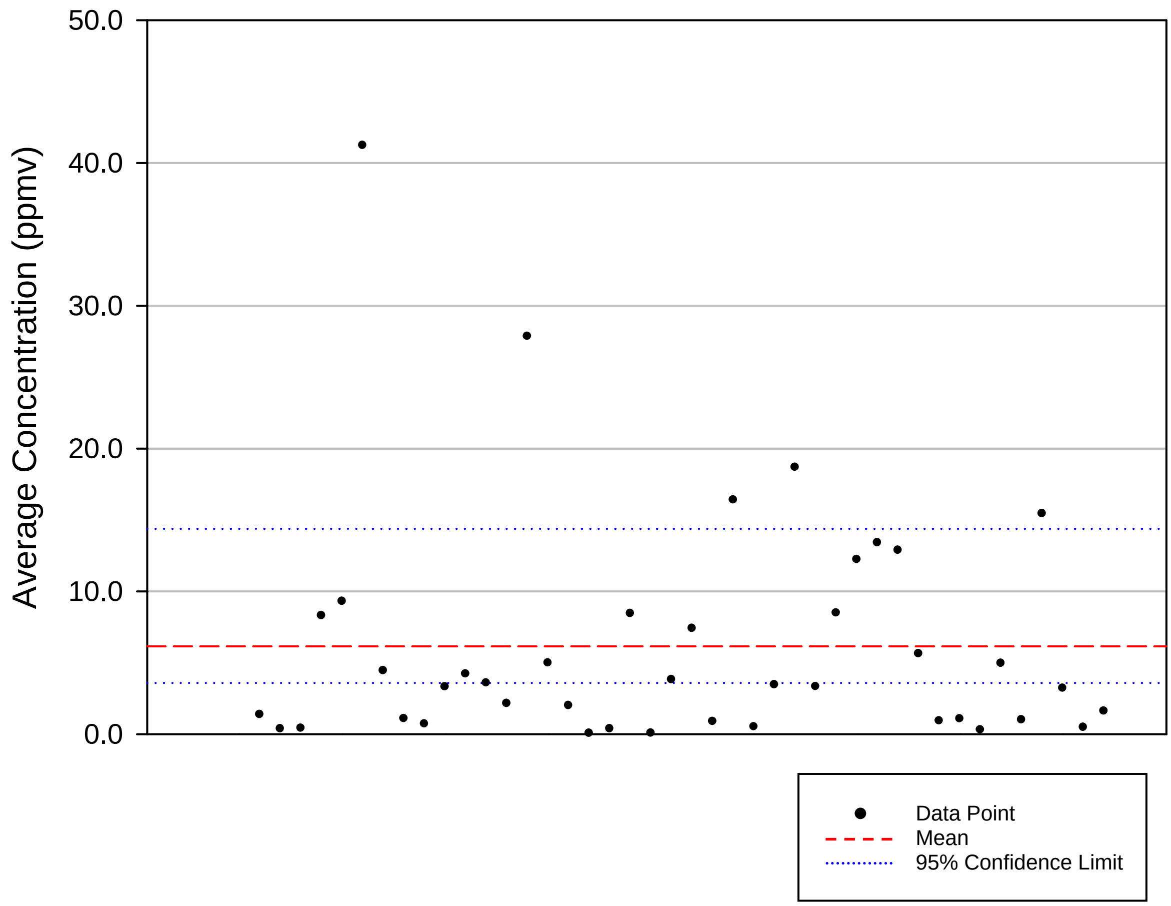


Table C-2. Dichloromethane Data Statistics

Number of Data Points	42
Minimum (ppmv)	5.09E-03
Maximum (ppmv)	4.12E+01
Mean (ppmv)	6.15E+00
Median (ppmv)	3.34E+00
Standard Deviation (ppmv)	8.23E+00
Standard Error (ppmv)	1.27E+00
95% Confidence Interval (+/- ppmv)	2.56E+00
99% Confidence Interval (+/- ppmv)	3.43E+00

Figure C-9. Trichloroethylene Data Plot

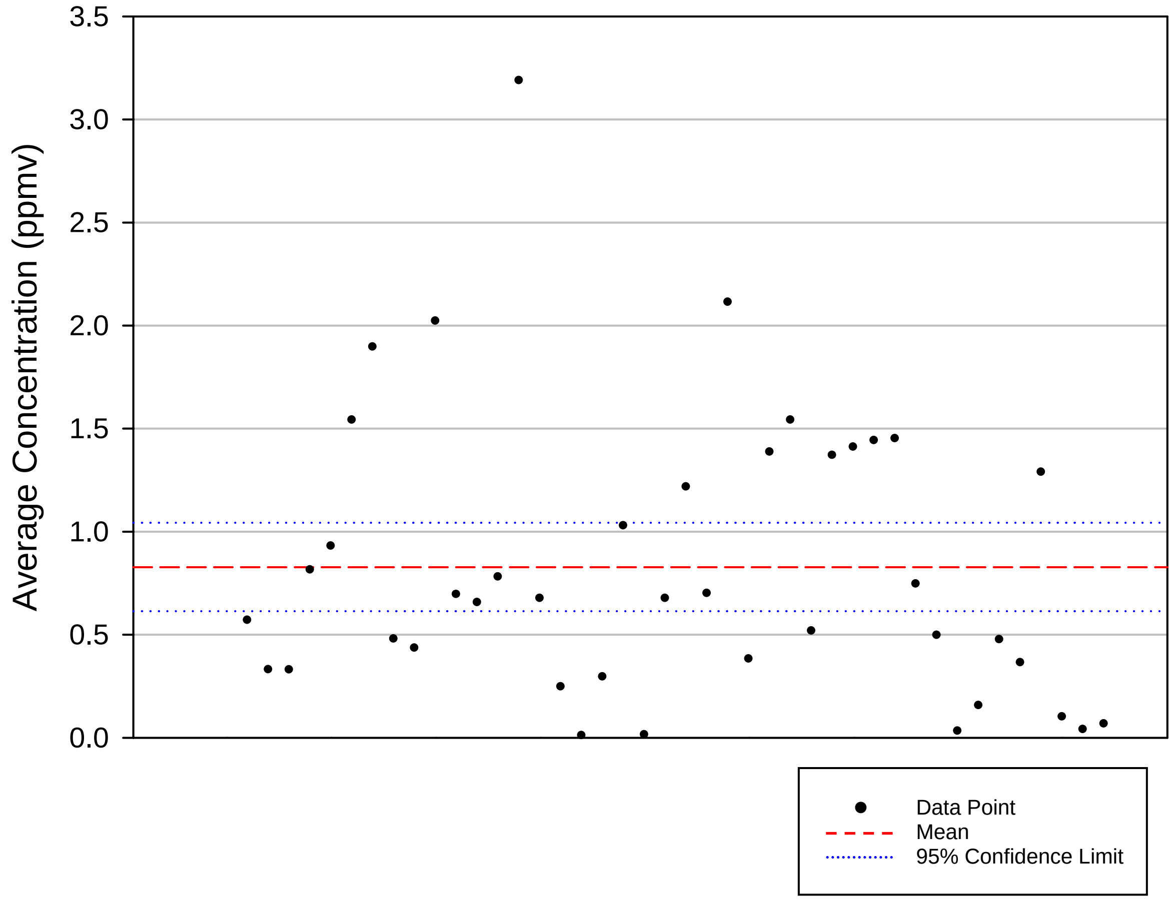


Table C-3. Trichloroethylene Data Statistics

Number of Data Points	42
Minimum (ppmv)	6.55E-03
Maximum (ppmv)	3.18E+00
Mean (ppmv)	8.28E-01
Median (ppmv)	6.72E-01
Standard Deviation (ppmv)	6.88E-01
Standard Error (ppmv)	1.06E-01
95% Confidence Interval (+/- ppmv)	2.14E-01
99% Confidence Interval (+/- ppmv)	2.87E-01

Figure C-10. Tetrachloroethylene Data Plot

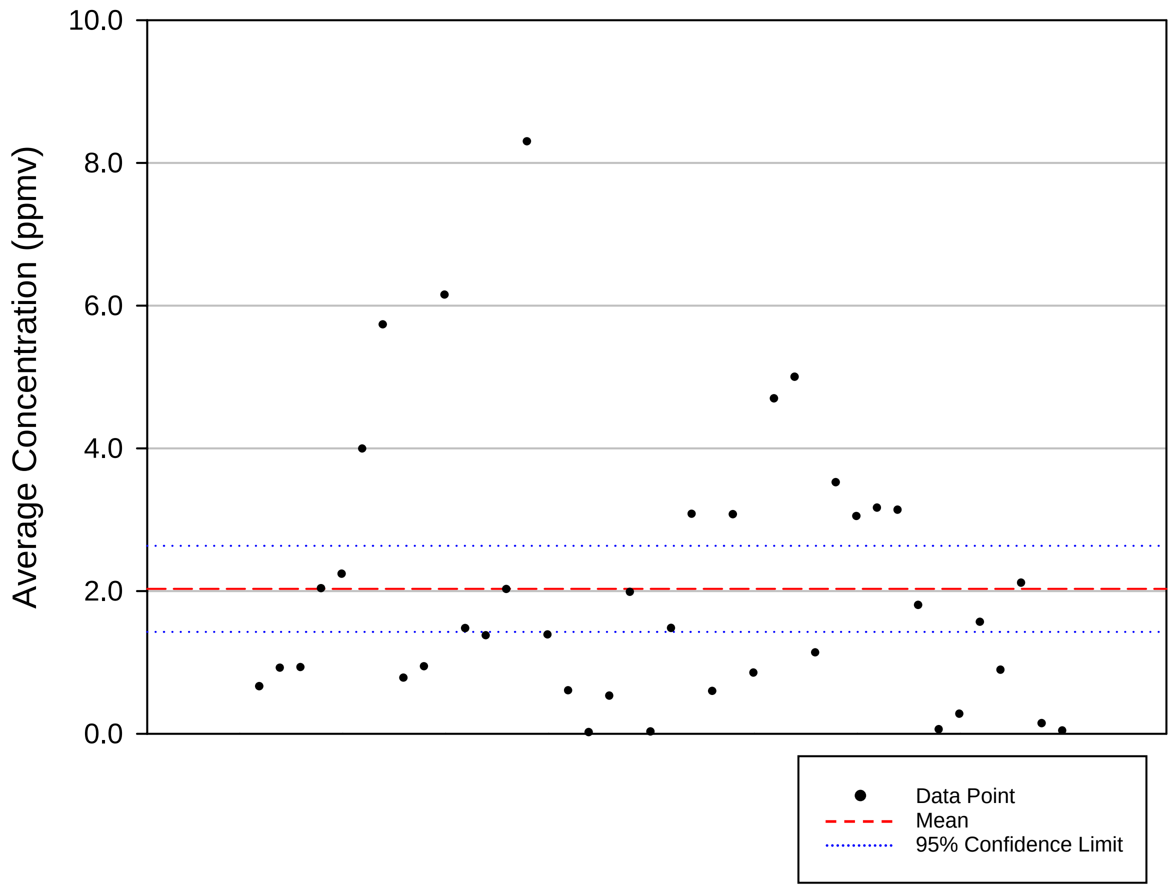


Table C-4. Tetrachloroethylene Data Statistics

Number of Data Points	40
Minimum (ppmv)	5.12E-03
Maximum (ppmv)	8.28E+00
Mean (ppmv)	2.03E+00
Median (ppmv)	1.46E+00
Standard Deviation (ppmv)	1.89E+00
Standard Error (ppmv)	2.98E-01
95% Confidence Interval (+/- ppmv)	6.04E-01
99% Confidence Interval (+/- ppmv)	8.08E-01

Figure C-11. Vinyl Chloride Data Plot

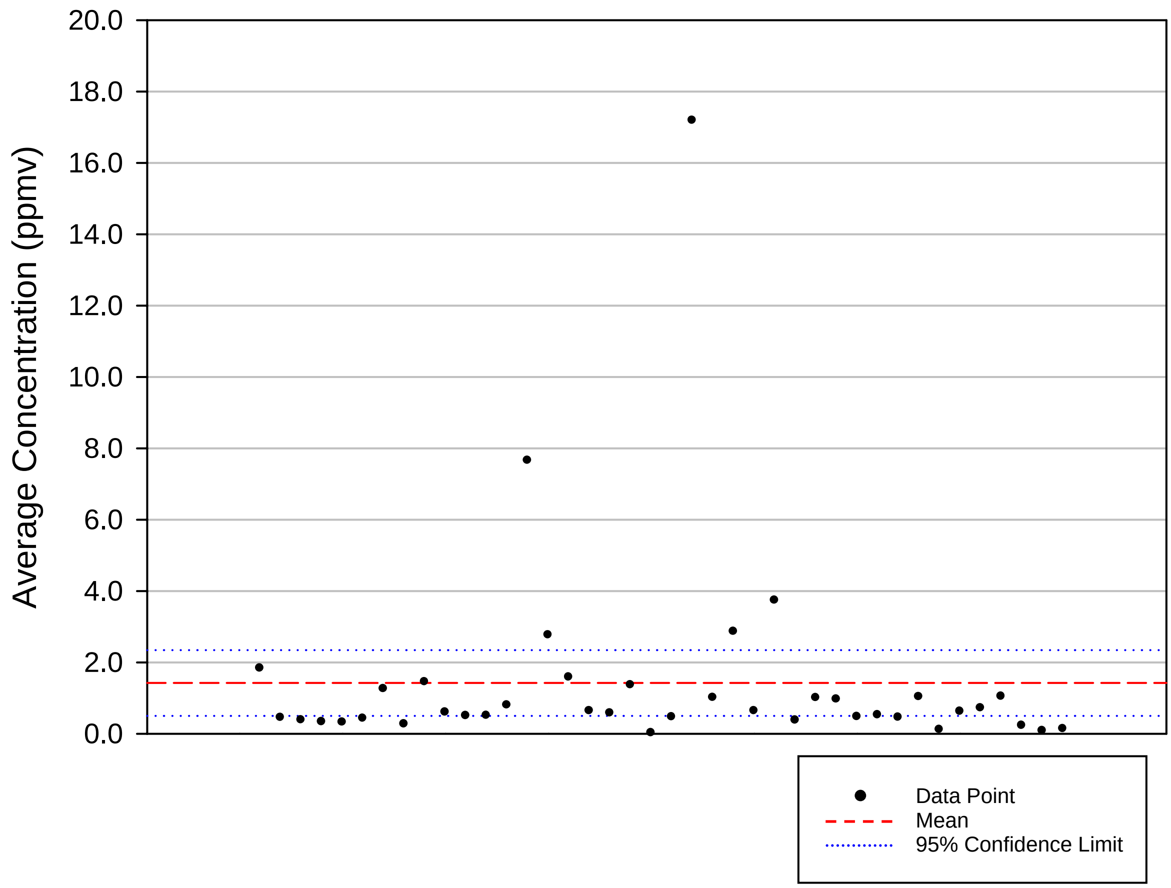


Table C-5. Vinyl Chloride Data Statistics

Number of Data Points	40
Minimum (ppmv)	6.78E-03
Maximum (ppmv)	1.72E+01
Mean (ppmv)	1.42E+00
Median (ppmv)	5.96E-01
Standard Deviation (ppmv)	2.88E+00
Standard Error (ppmv)	4.55E-01
95% Confidence Interval (+/- ppmv)	9.21E-01
99% Confidence Interval (+/- ppmv)	1.23E+00

Figure C-12. Chlorobenzene Data Plot

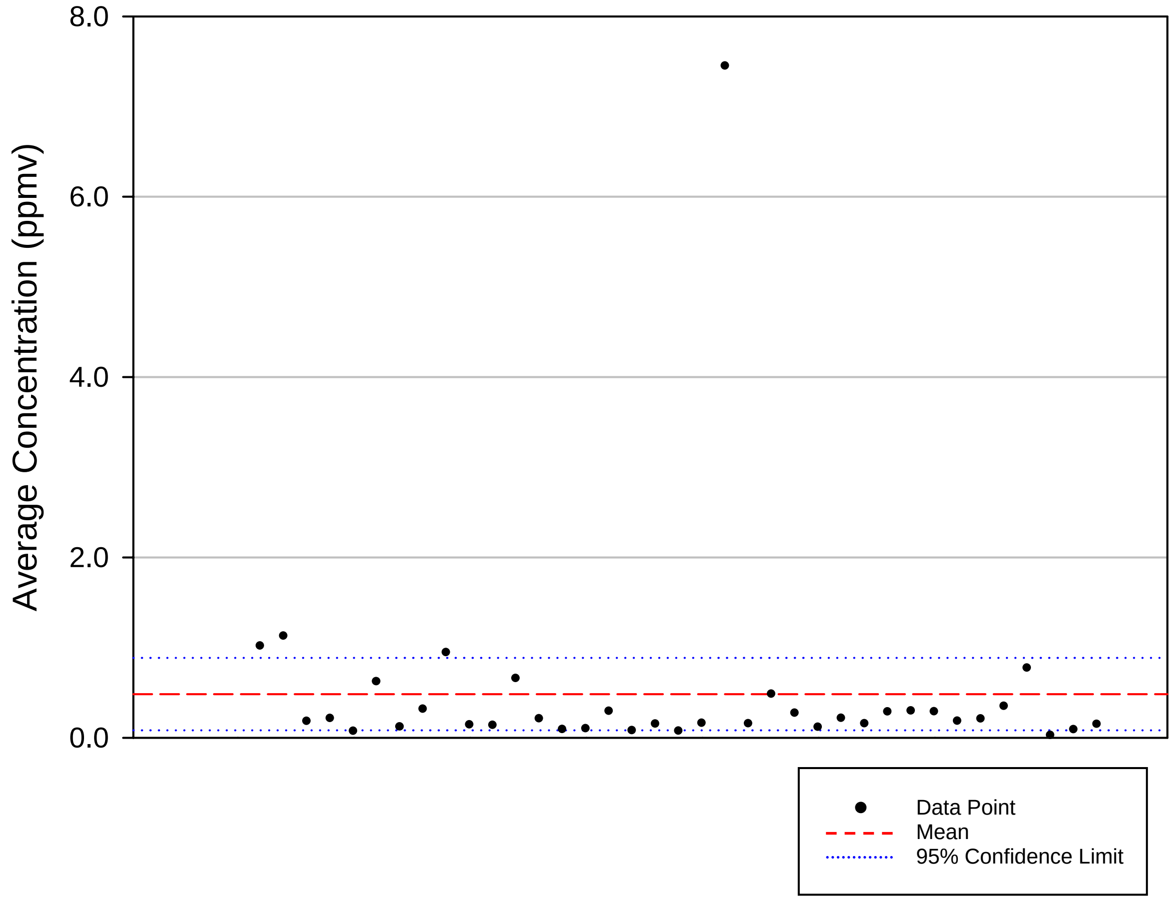


Table C-6. Chlorobenzene Data Statistics

Number of Data Points	37
Minimum (ppmv)	1.79E-02
Maximum (ppmv)	7.44E+00
Mean (ppmv)	4.84E-01
Median (ppmv)	2.00E-01
Standard Deviation (ppmv)	1.21E+00
Standard Error (ppmv)	1.99E-01
95% Confidence Interval (+/- ppmv)	4.03E-01
99% Confidence Interval (+/- ppmv)	5.40E-01

Figure C-13. 1,1-Dichloroethane Data Plot

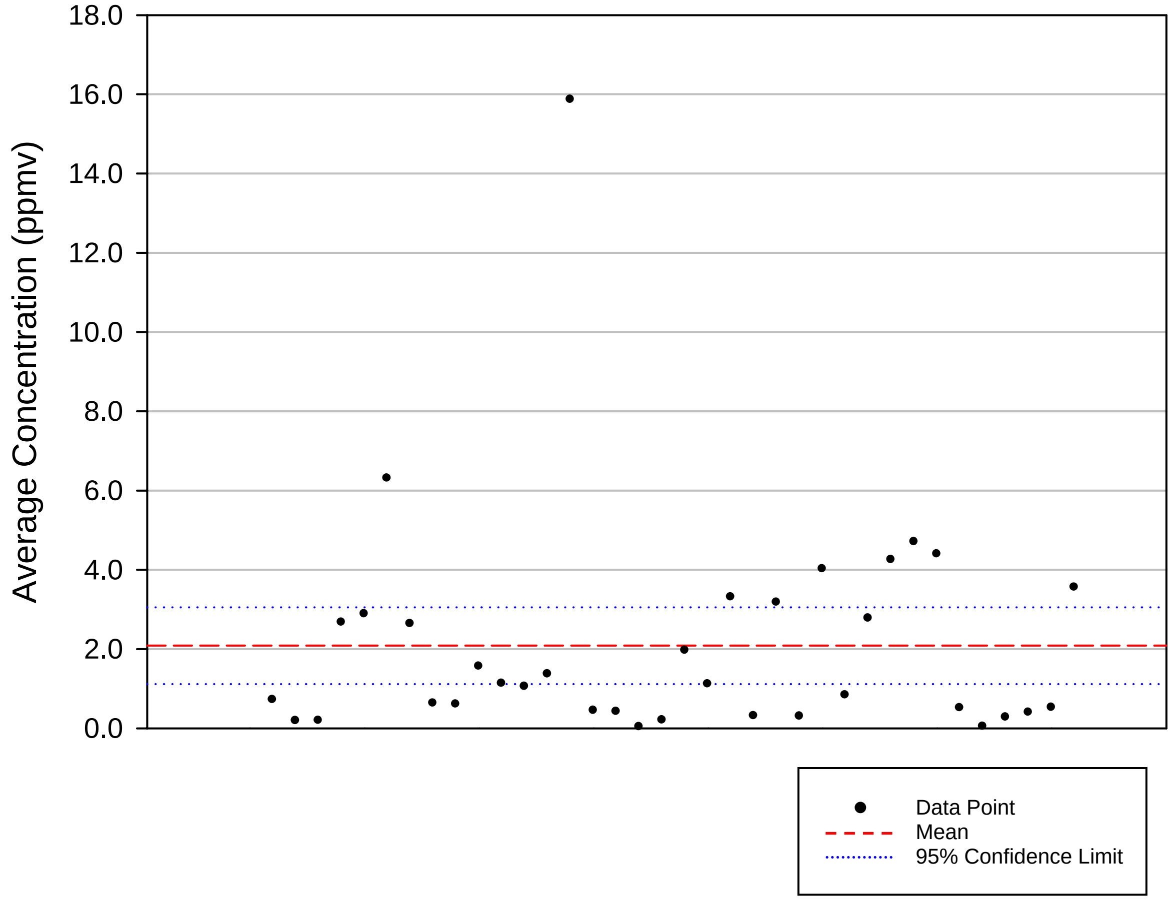


Table C-7. 1,1-Dichloroethane Data Statistics

Number of Data Points	36
Minimum (ppmv)	2.56E-02
Maximum (ppmv)	1.59E+01
Mean (ppmv)	2.08E+00
Median (ppmv)	1.07E+00
Standard Deviation (ppmv)	2.87E+00
Standard Error (ppmv)	4.78E-01
95% Confidence Interval (+/- ppmv)	9.71E-01
99% Confidence Interval (+/- ppmv)	1.30E+00

Figure C-14. 1,1-Dichloroethene Data Plot

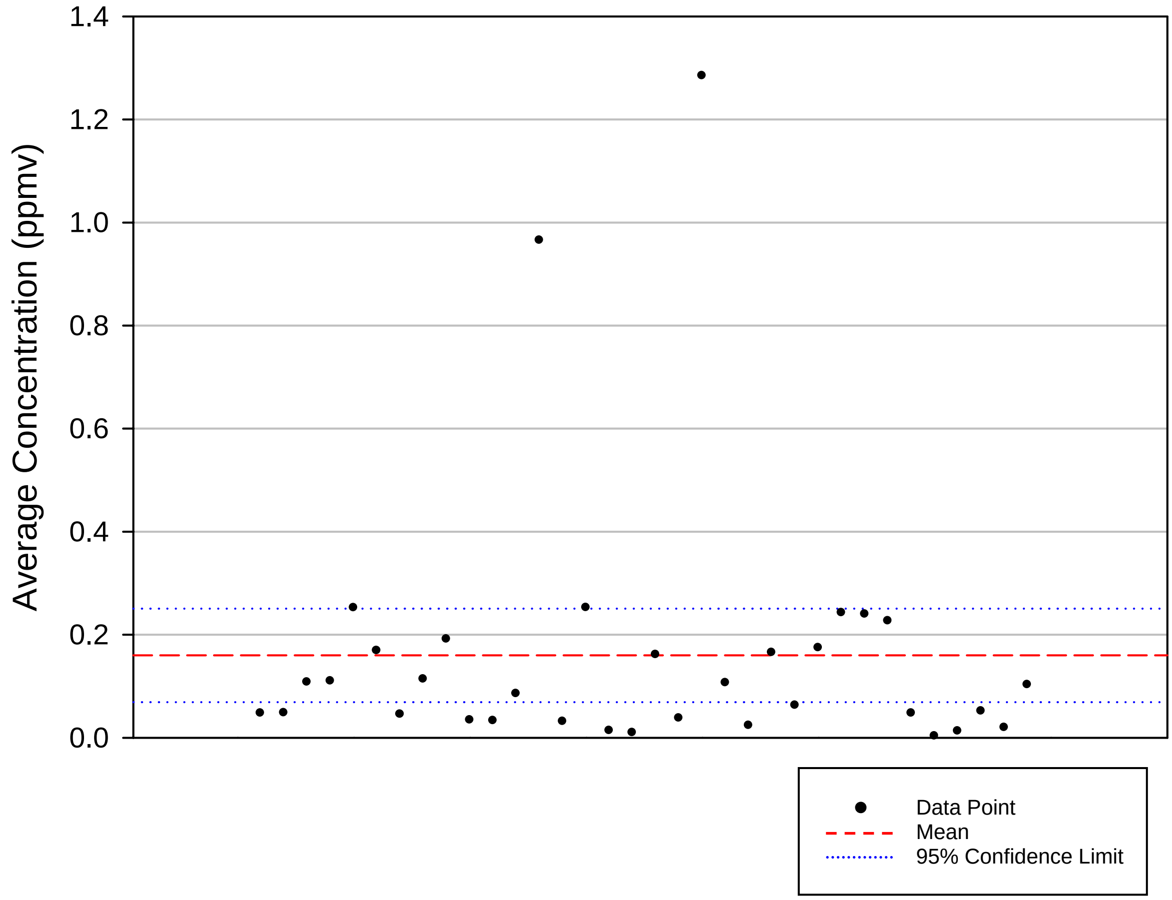


Table C-8. 1,1-Dichloroethene Data Statistics

Number of Data Points	34
Minimum (ppmv)	2.06E-03
Maximum (ppmv)	1.28E+00
Mean (ppmv)	1.60E-01
Median (ppmv)	9.30E-02
Standard Deviation (ppmv)	2.60E-01
Standard Error (ppmv)	4.46E-02
95% Confidence Interval (+/- ppmv)	9.07E-02
99% Confidence Interval (+/- ppmv)	1.22E-01

Figure C-15. 1,2-Dichloroethane Data Plot

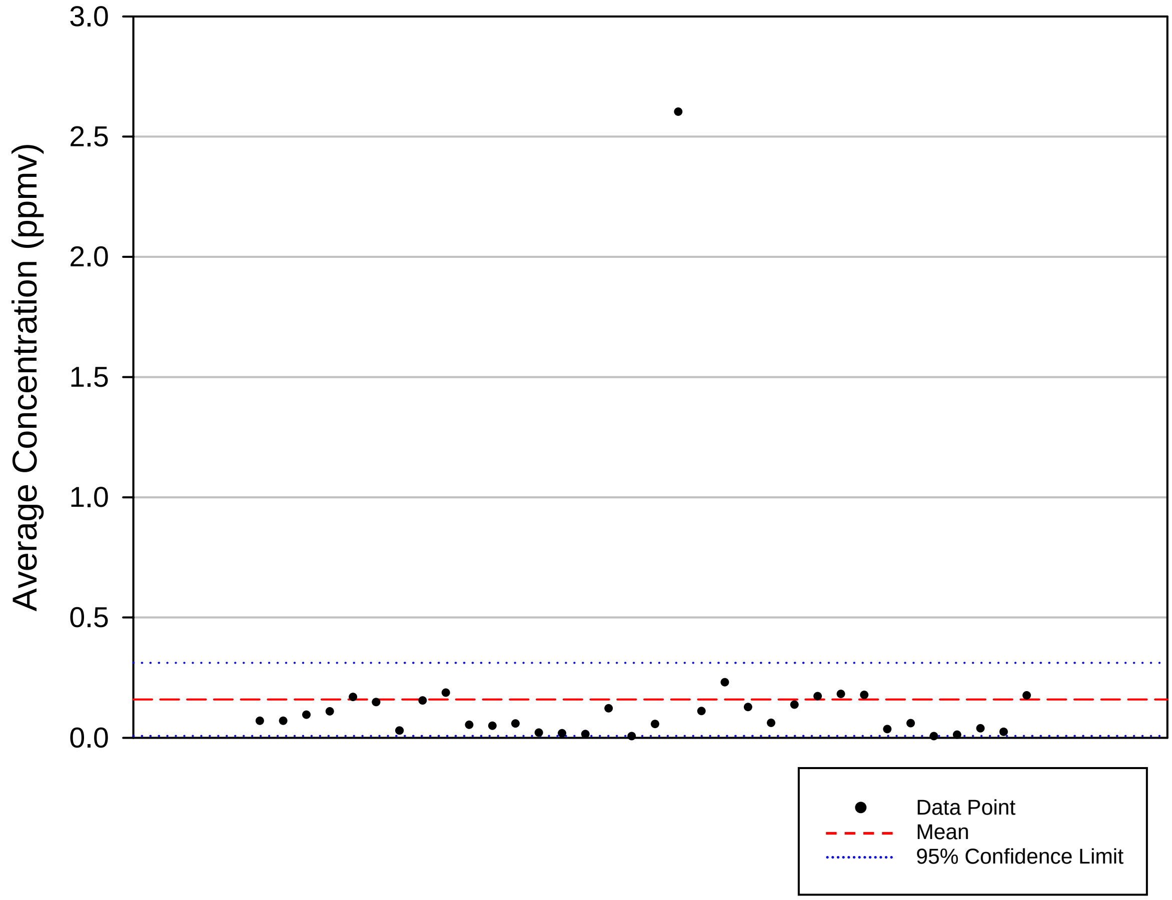


Table C-9. 1,2-Dichloroethane Data Statistics

Number of Data Points	34
Minimum (ppmv)	1.03E-03
Maximum (ppmv)	2.60E+00
Mean (ppmv)	1.59E-01
Median (ppmv)	6.48E-02
Standard Deviation (ppmv)	4.36E-01
Standard Error (ppmv)	7.47E-02
95% Confidence Interval (+/- ppmv)	1.52E-01
99% Confidence Interval (+/- ppmv)	2.04E-01

Figure C-16. Trichloromethane Data Plot

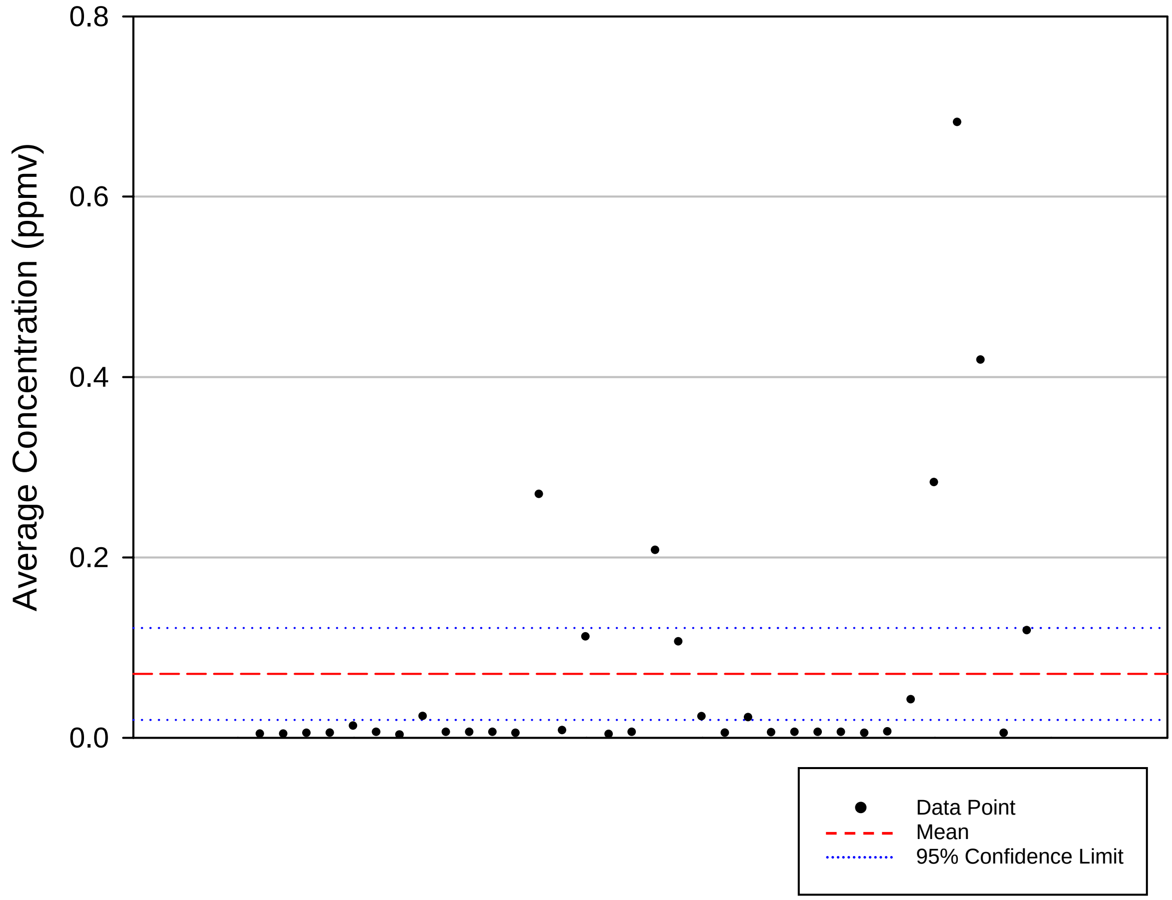


Table C-10. Trichloromethane Data Statistics

Number of Data Points	34
Minimum (ppmv)	2.21E-03
Maximum (ppmv)	6.82E-01
Mean (ppmv)	7.08E-02
Median (ppmv)	5.20E-03
Standard Deviation (ppmv)	1.46E-01
Standard Error (ppmv)	2.51E-02
95% Confidence Interval (+/- ppmv)	5.10E-02
99% Confidence Interval (+/- ppmv)	6.85E-02

Figure C-17. 1,1,1-Trichloroethane Data Plot

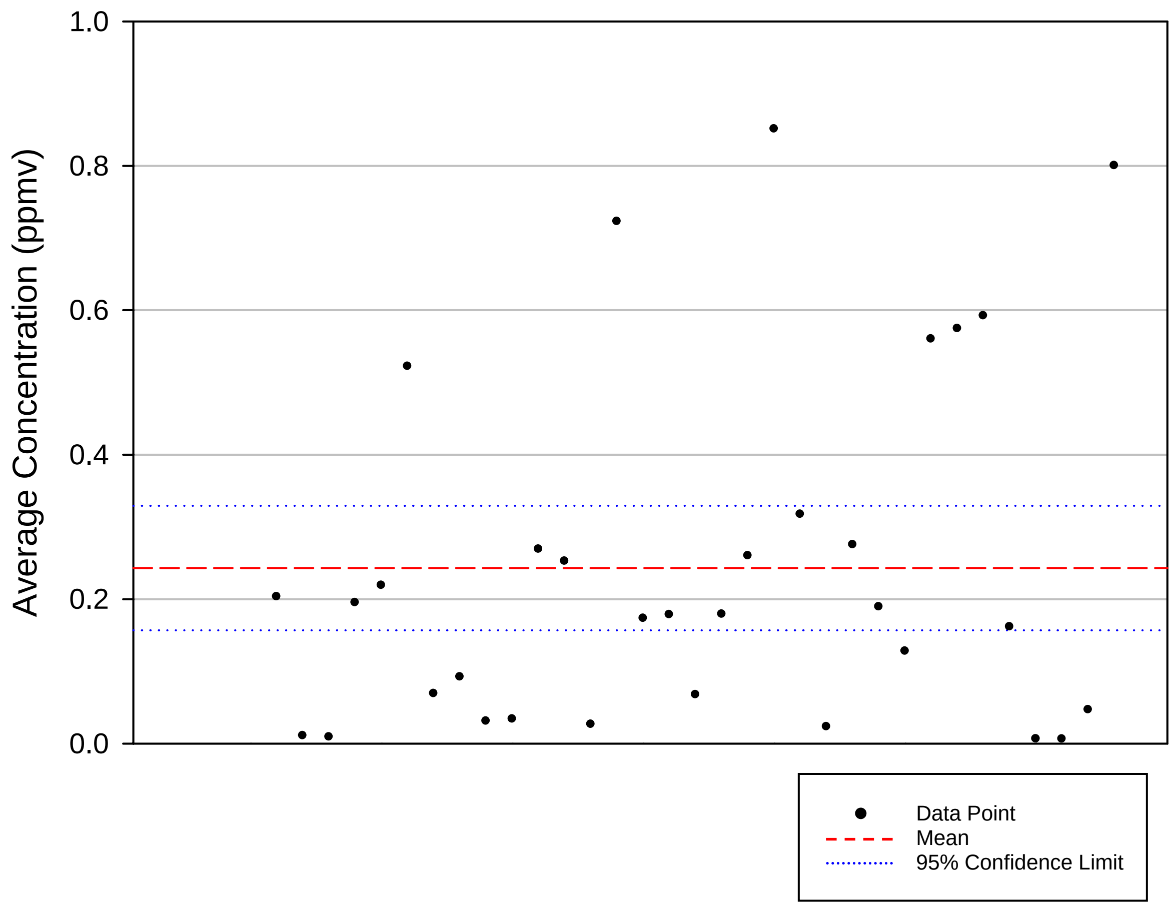


Table C-11. 1,1,1-Trichloroethane Data Statistics

Number of Data Points	33
Minimum (ppmv)	5.15E-03
Maximum (ppmv)	8.50E-01
Mean (ppmv)	2.43E-01
Median (ppmv)	1.78E-01
Standard Deviation (ppmv)	2.43E-01
Standard Error (ppmv)	4.24E-02
95% Confidence Interval (+/- ppmv)	8.63E-02
99% Confidence Interval (+/- ppmv)	1.16E-01

Figure C-18. Carbon Tetrachloride Data Plot

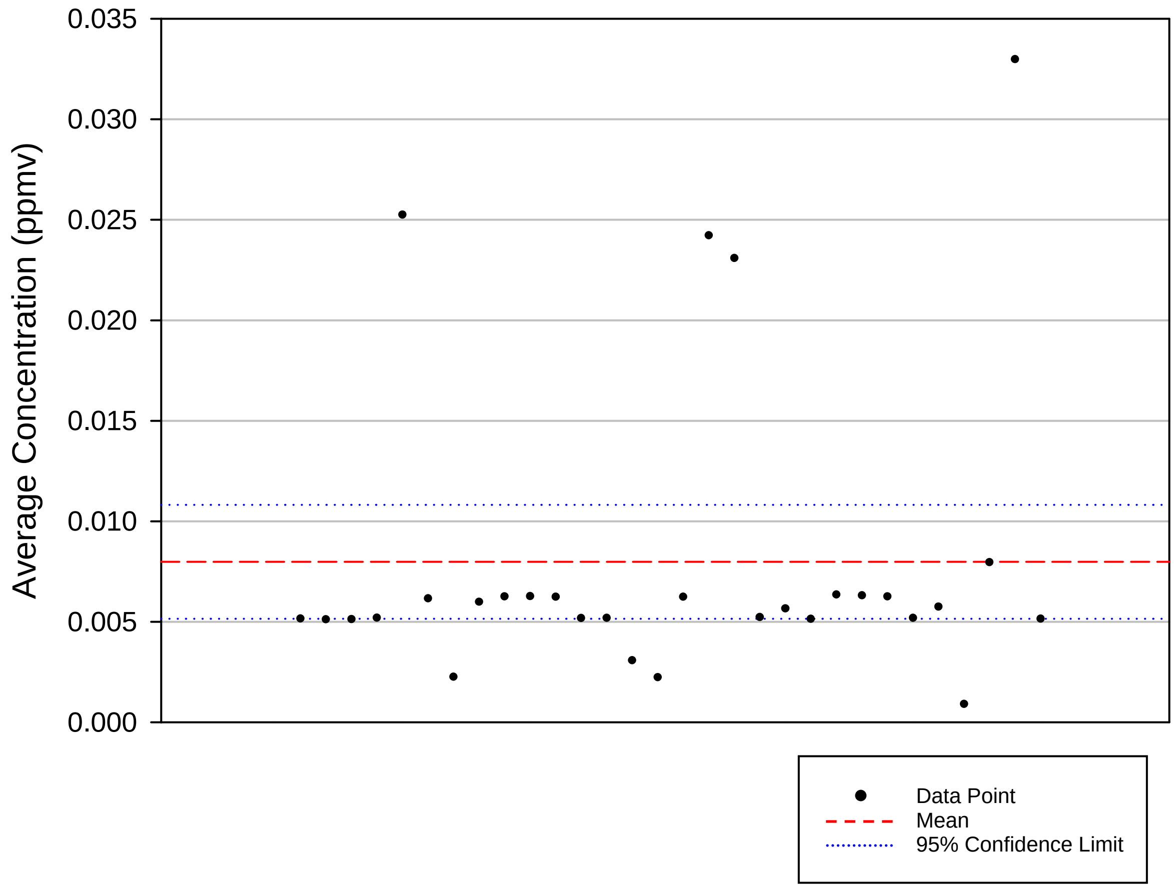


Table C-12. Carbon Tetrachloride Data Statistics

Number of Data Points	30
Minimum (ppmv)	8.55E-04
Maximum (ppmv)	3.29E-02
Mean (ppmv)	7.98E-03
Median (ppmv)	5.65E-03
Standard Deviation (ppmv)	7.59E-03
Standard Error (ppmv)	1.39E-03
95% Confidence Interval (+/- ppmv)	2.84E-03
99% Confidence Interval (+/- ppmv)	3.82E-03

Group D: Sulfur Compounds Data and Statistics

Figure D-1. Hydrogen Sulfide Data Statistics Plot

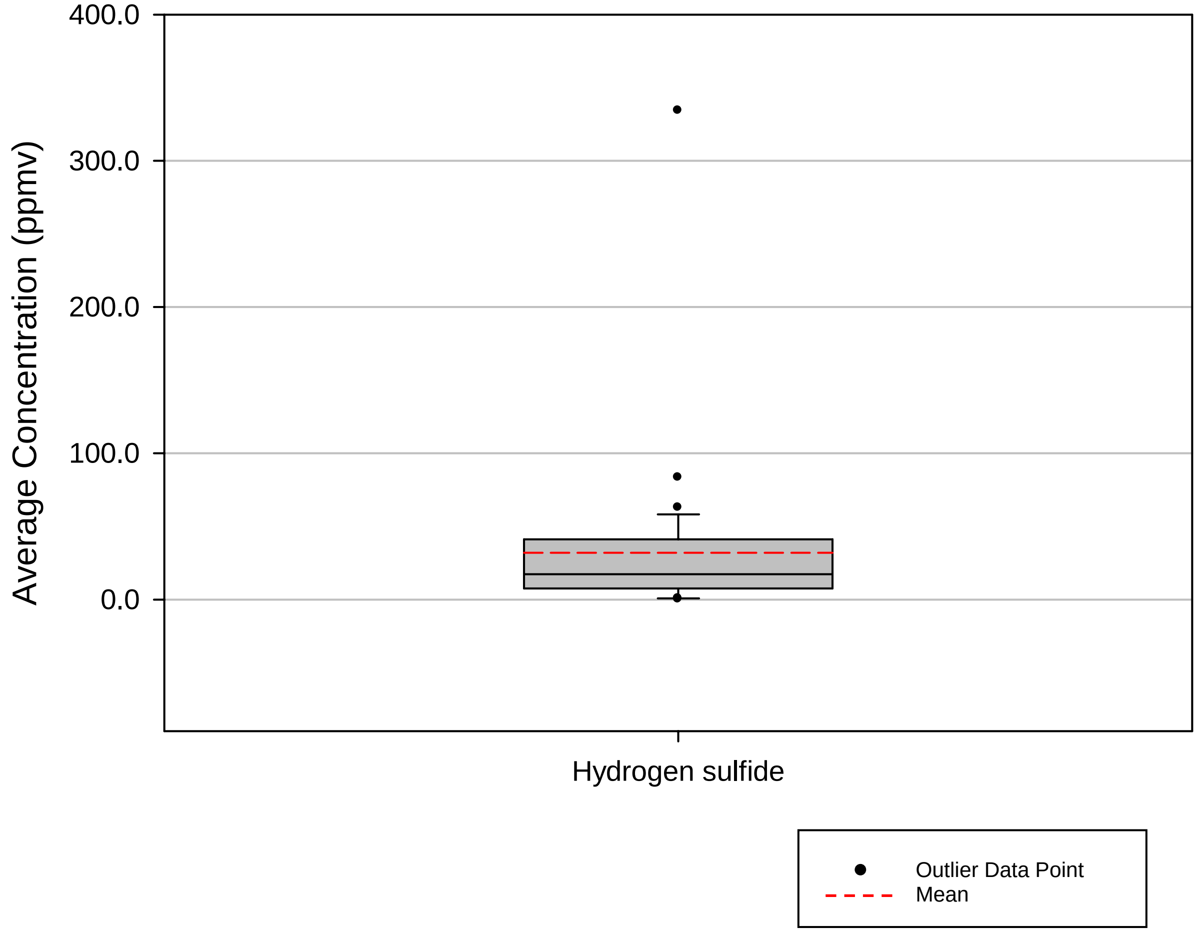


Figure D-2. Carbon Disulfide, Carbonyl Sulfide, and Ethyl Mercaptan Data Statistics Plot

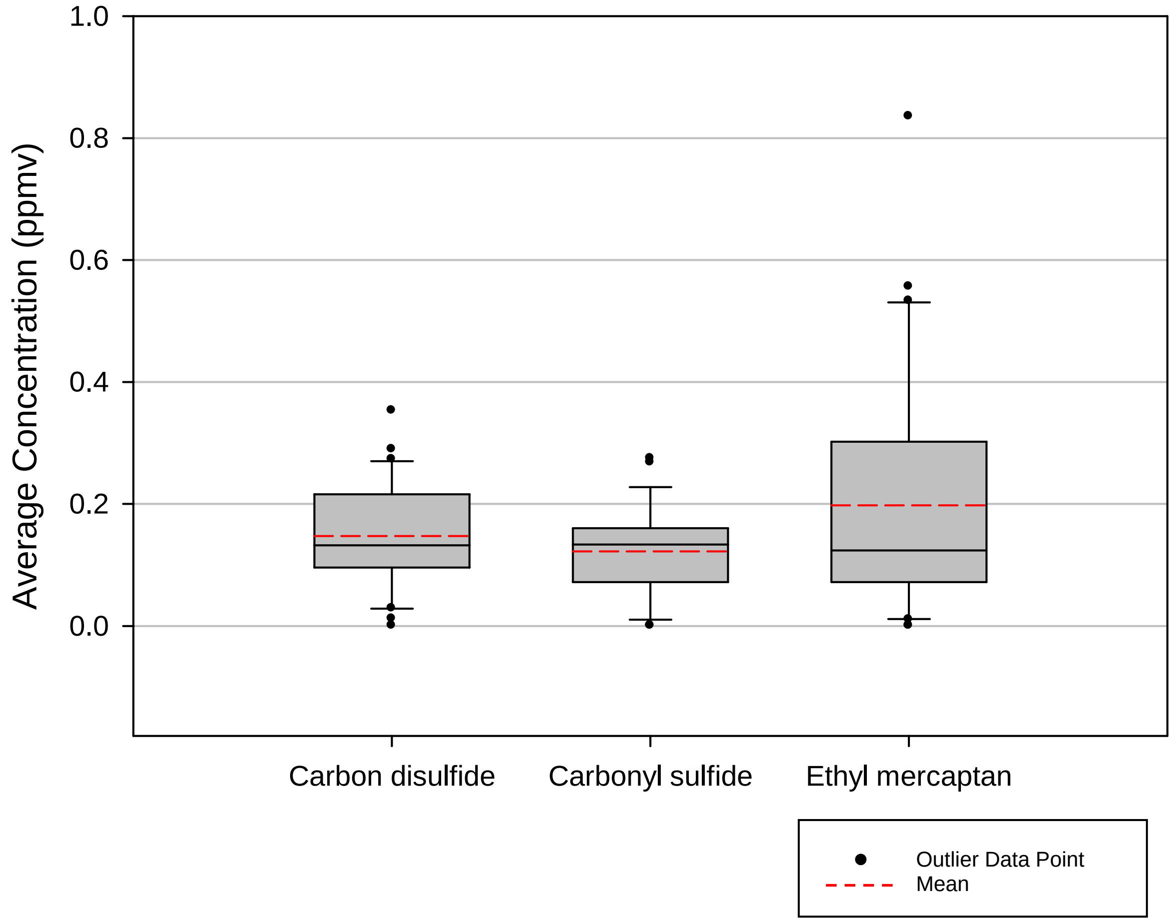


Figure D-3. Methyl Mercaptan and Dimethyl Sulfide Data Statistics Plot

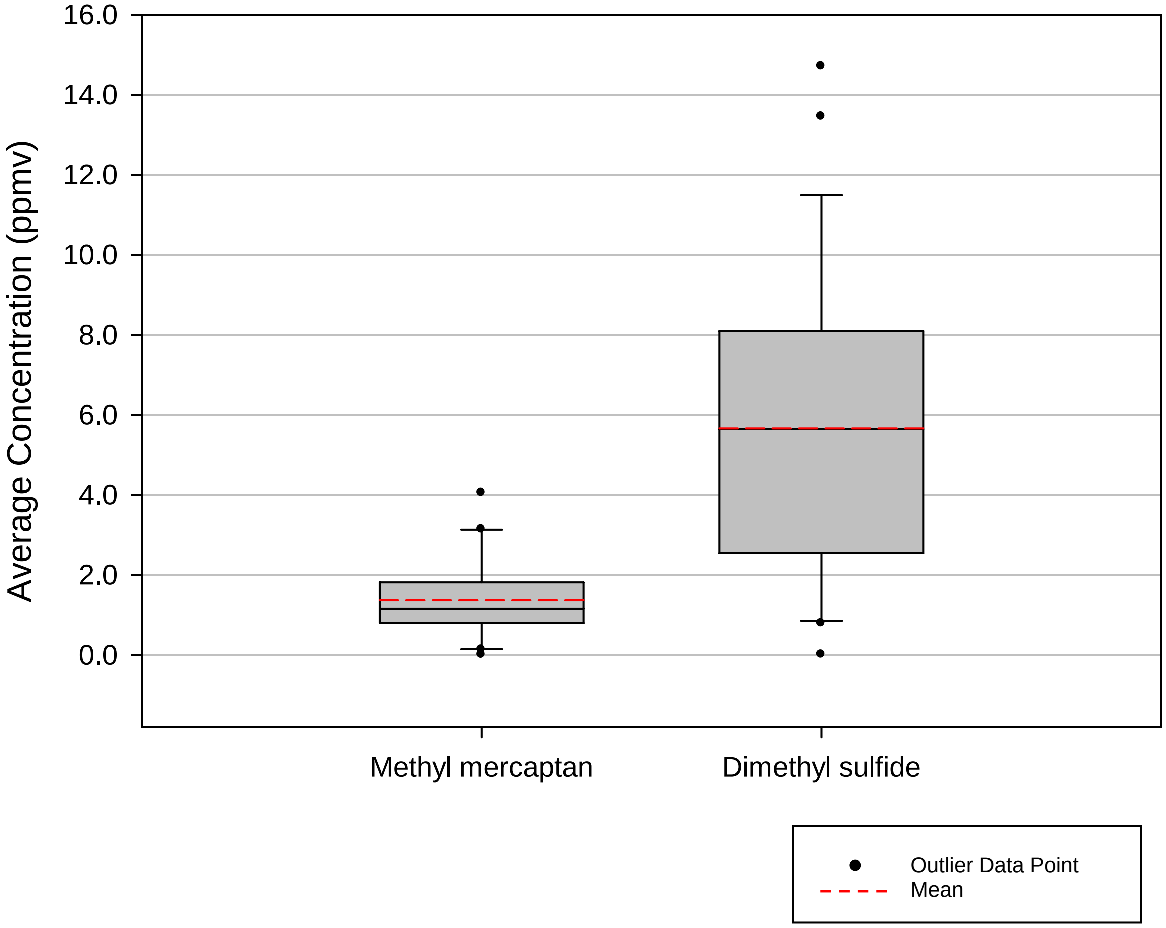


Figure D-4. Dimethyl Disulfide Data Statistics Plot

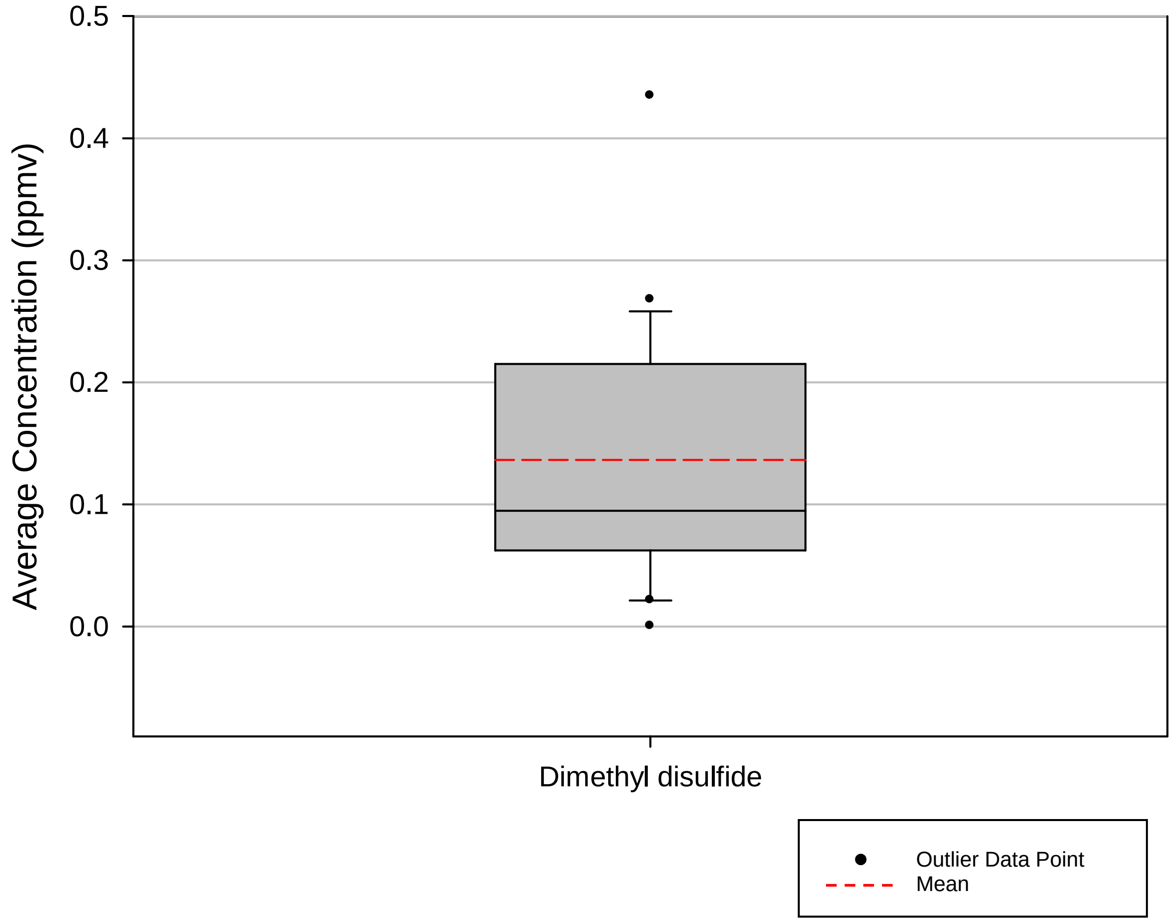


Figure D-5. Hydrogen Sulfide Data Plot

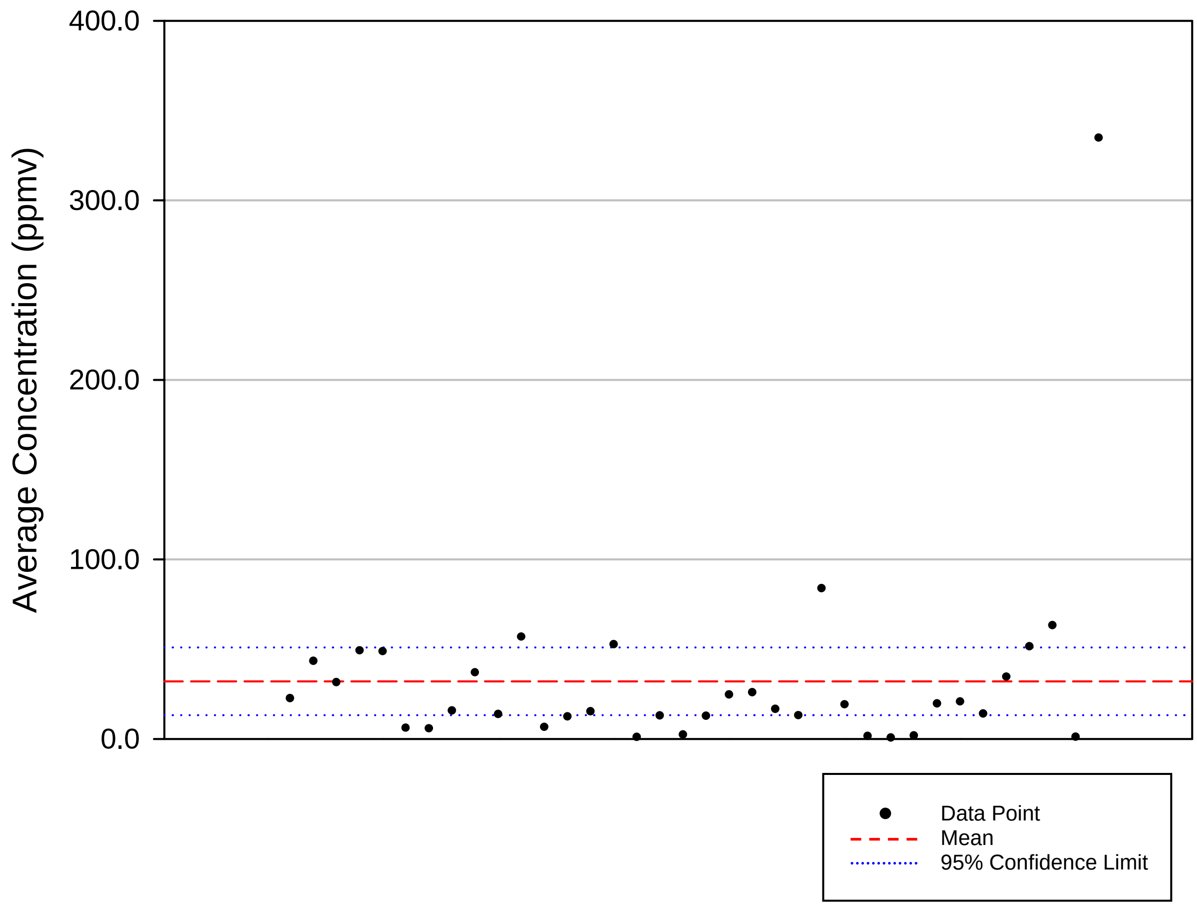


Table D-1. Hydrogen Sulfide Data Statistics

Number of Data Points	36
Minimum (ppmv)	1.02E-03
Maximum (ppmv)	3.34E+02
Mean (ppmv)	3.20E+01
Median (ppmv)	1.73E+01
Standard Deviation (ppmv)	5.57E+01
Standard Error (ppmv)	9.29E+00
95% Confidence Interval (+/- ppmv)	1.89E+01
99% Confidence Interval (+/- ppmv)	2.53E+01

Figure D-6. Carbon Disulfide Data Plot

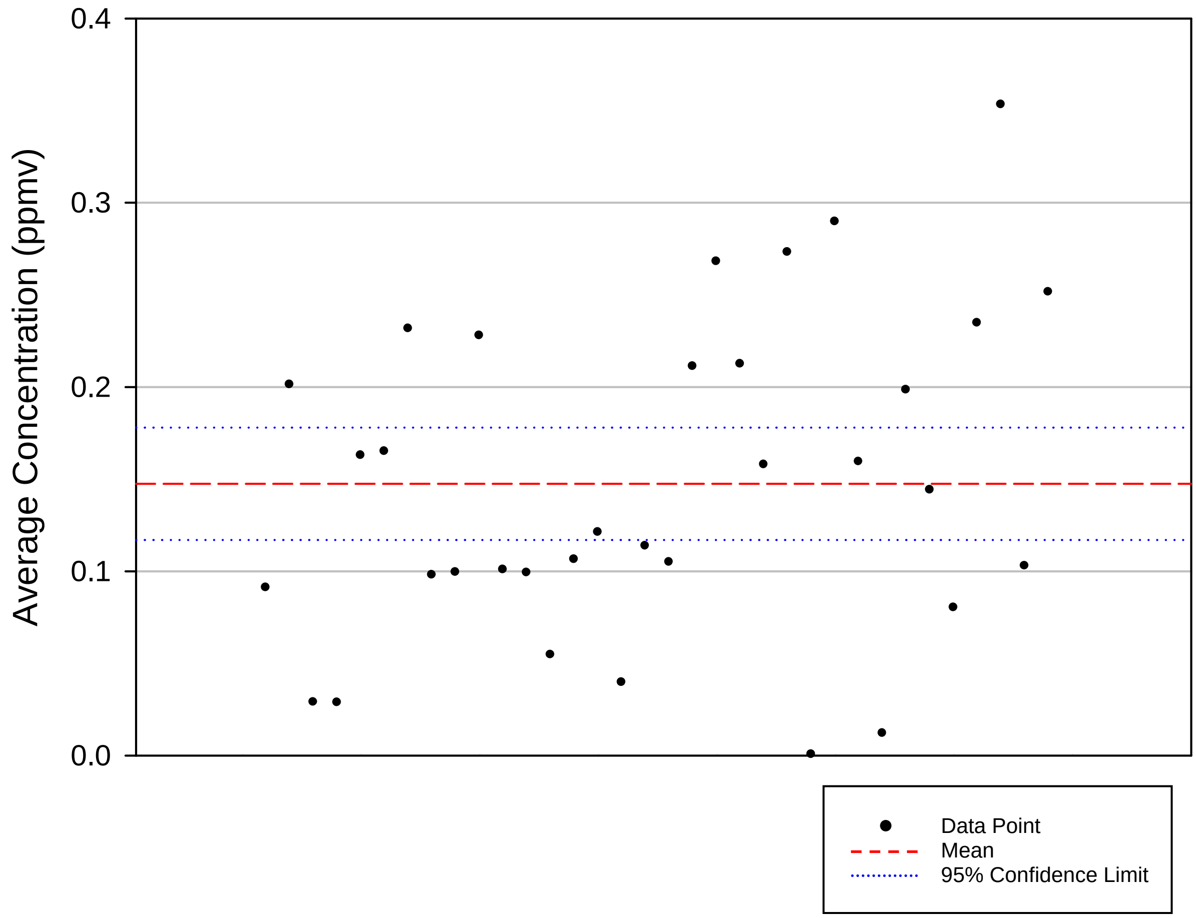


Table D-2. Carbon Disulfide Data Statistics

Number of Data Points	34
Minimum (ppmv)	2.92E-04
Maximum (ppmv)	3.53E-01
Mean (ppmv)	1.47E-01
Median (ppmv)	1.32E-01
Standard Deviation (ppmv)	8.74E-02
Standard Error (ppmv)	1.50E-02
95% Confidence Interval (+/- ppmv)	3.05E-02
99% Confidence Interval (+/- ppmv)	4.10E-02

Figure D-7. Carbonyl Sulfide Data Plot

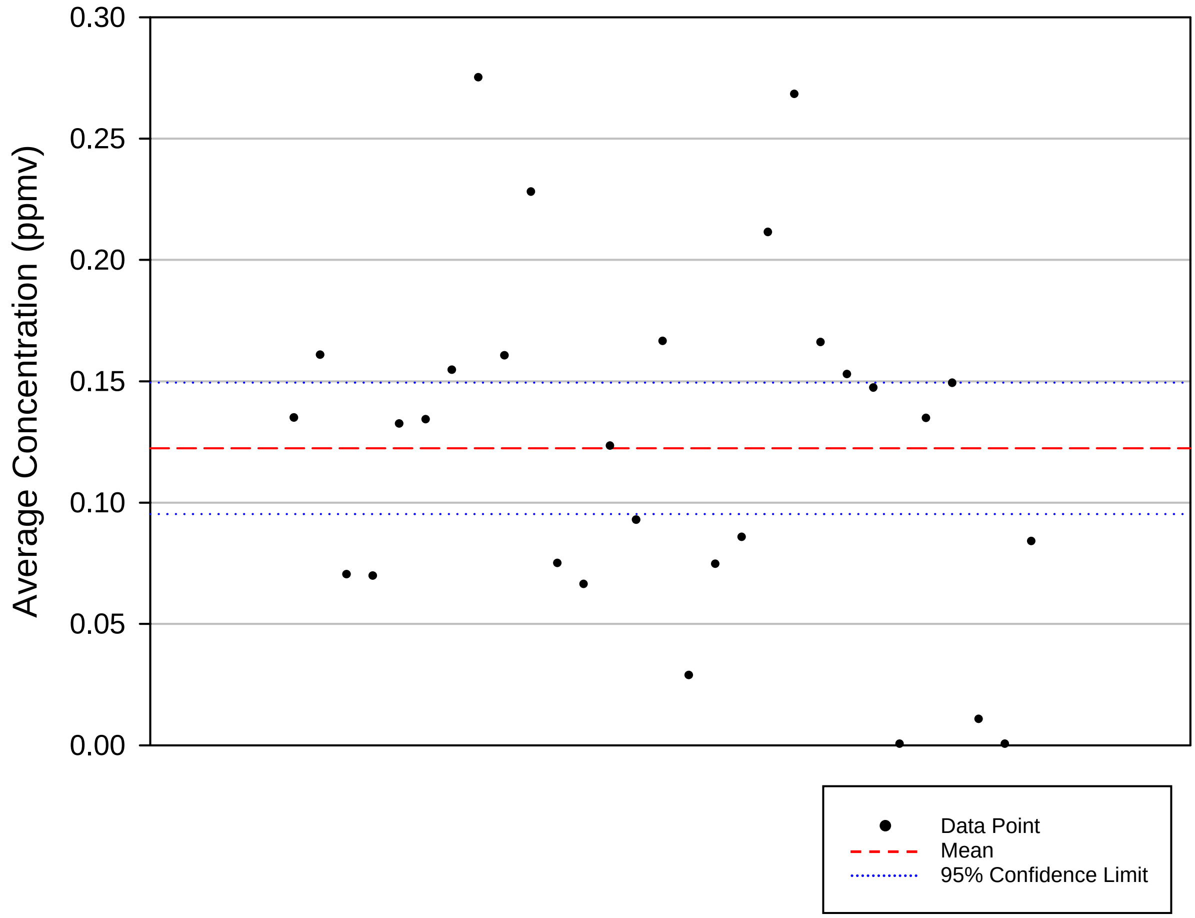


Table D-3. Carbonyl Sulfide Data Statistics

Number of Data Points	29
Minimum (ppmv)	1.04E-04
Maximum (ppmv)	2.75E-01
Mean (ppmv)	1.22E-01
Median (ppmv)	1.34E-01
Standard Deviation (ppmv)	7.12E-02
Standard Error (ppmv)	1.32E-02
95% Confidence Interval (+/- ppmv)	2.71E-02
99% Confidence Interval (+/- ppmv)	3.66E-02

Figure D-8. Methyl Mercaptan Data Plot

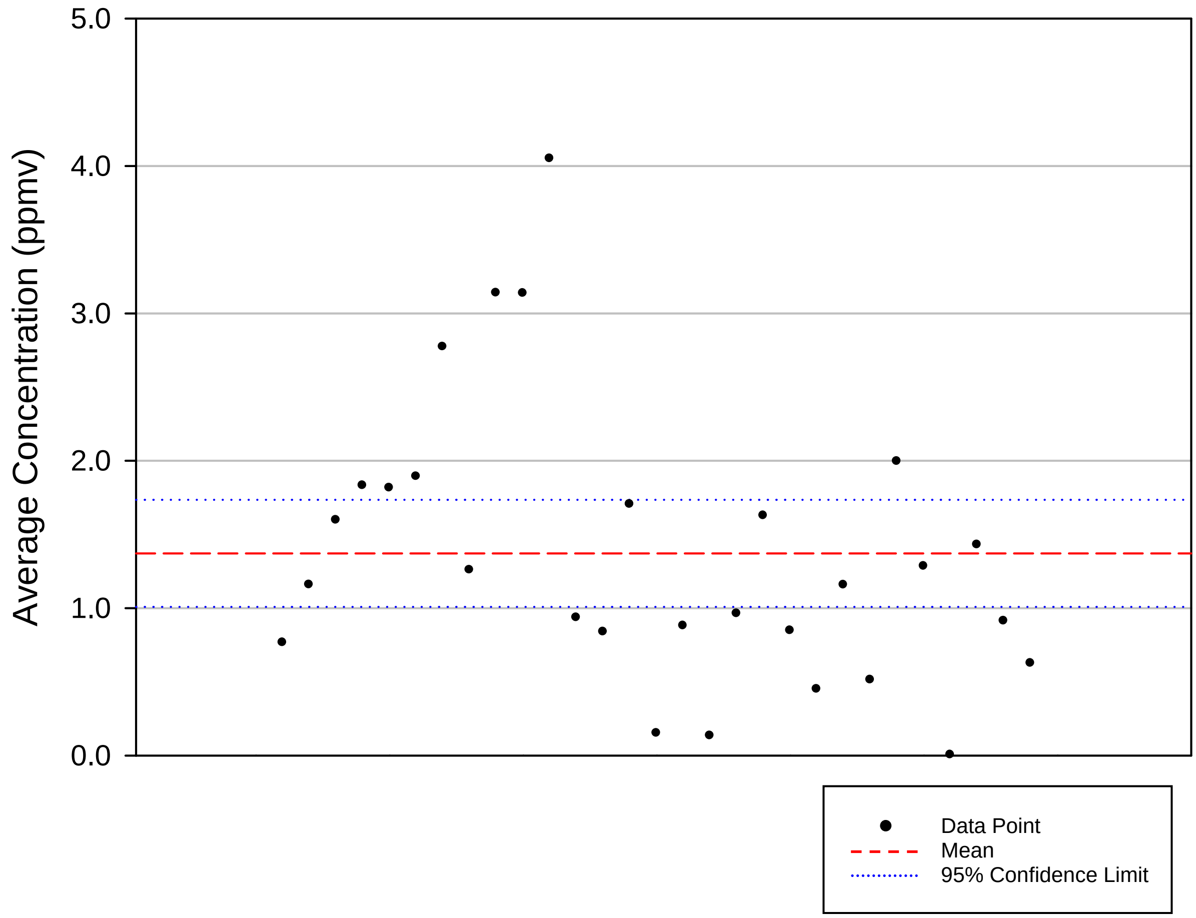


Table D-4. Methyl Mercaptan Data Statistics

Number of Data Points	29
Minimum (ppmv)	9.80E-04
Maximum (ppmv)	4.05E+00
Mean (ppmv)	1.37E+00
Median (ppmv)	1.16E+00
Standard Deviation (ppmv)	9.55E-01
Standard Error (ppmv)	1.77E-01
95% Confidence Interval (+/- ppmv)	3.63E-01
99% Confidence Interval (+/- ppmv)	4.90E-01

Figure D-9. Ethyl Mercaptan Data Plot

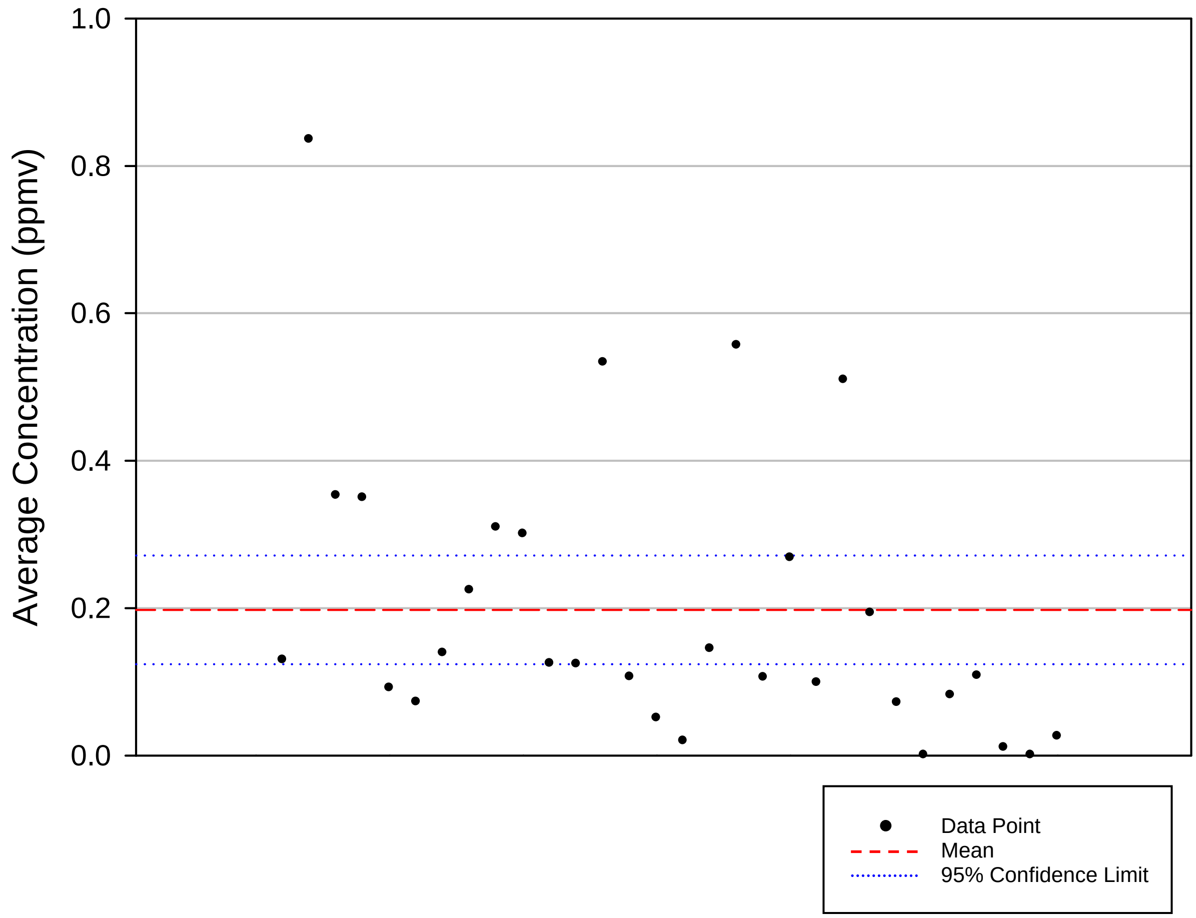


Table D-5. Ethyl Mercaptan Data Statistics

Number of Data Points	30
Minimum (ppmv)	6.05E-05
Maximum (ppmv)	8.35E-01
Mean (ppmv)	1.98E-01
Median (ppmv)	1.24E-01
Standard Deviation (ppmv)	1.97E-01
Standard Error (ppmv)	3.60E-02
95% Confidence Interval (+/- ppmv)	7.37E-02
99% Confidence Interval (+/- ppmv)	9.93E-02

Figure D-10. Dimethyl Sulfide Data Plot

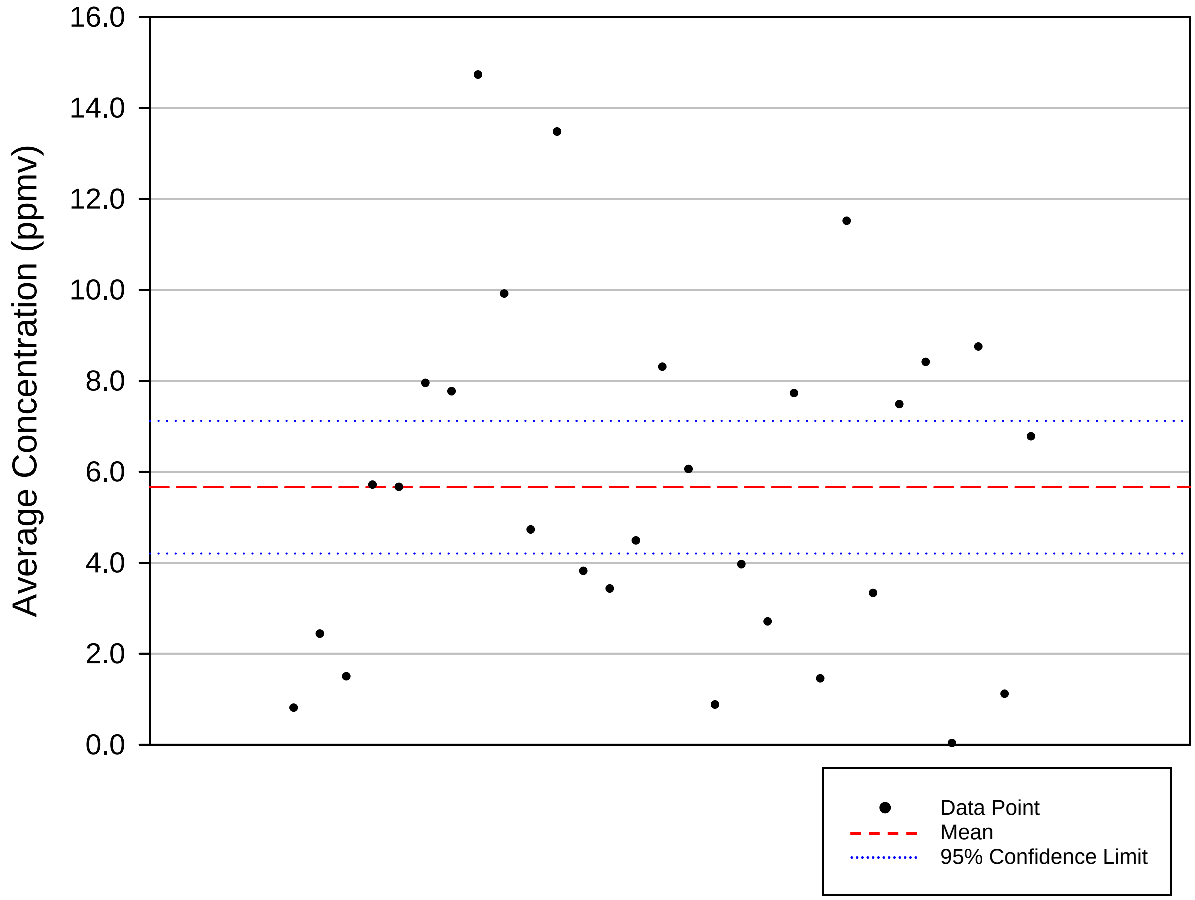


Table D-6. Dimethyl Sulfide Data Statistics

Number of Data Points	29
Minimum (ppmv)	7.51E-03
Maximum (ppmv)	1.47E+01
Mean (ppmv)	5.66E+00
Median (ppmv)	5.64E+00
Standard Deviation (ppmv)	3.83E+00
Standard Error (ppmv)	7.11E-01
95% Confidence Interval (+/- ppmv)	1.46E+00
99% Confidence Interval (+/- ppmv)	1.96E+00

Figure D-11. Dimethyl Disulfide Data Plot

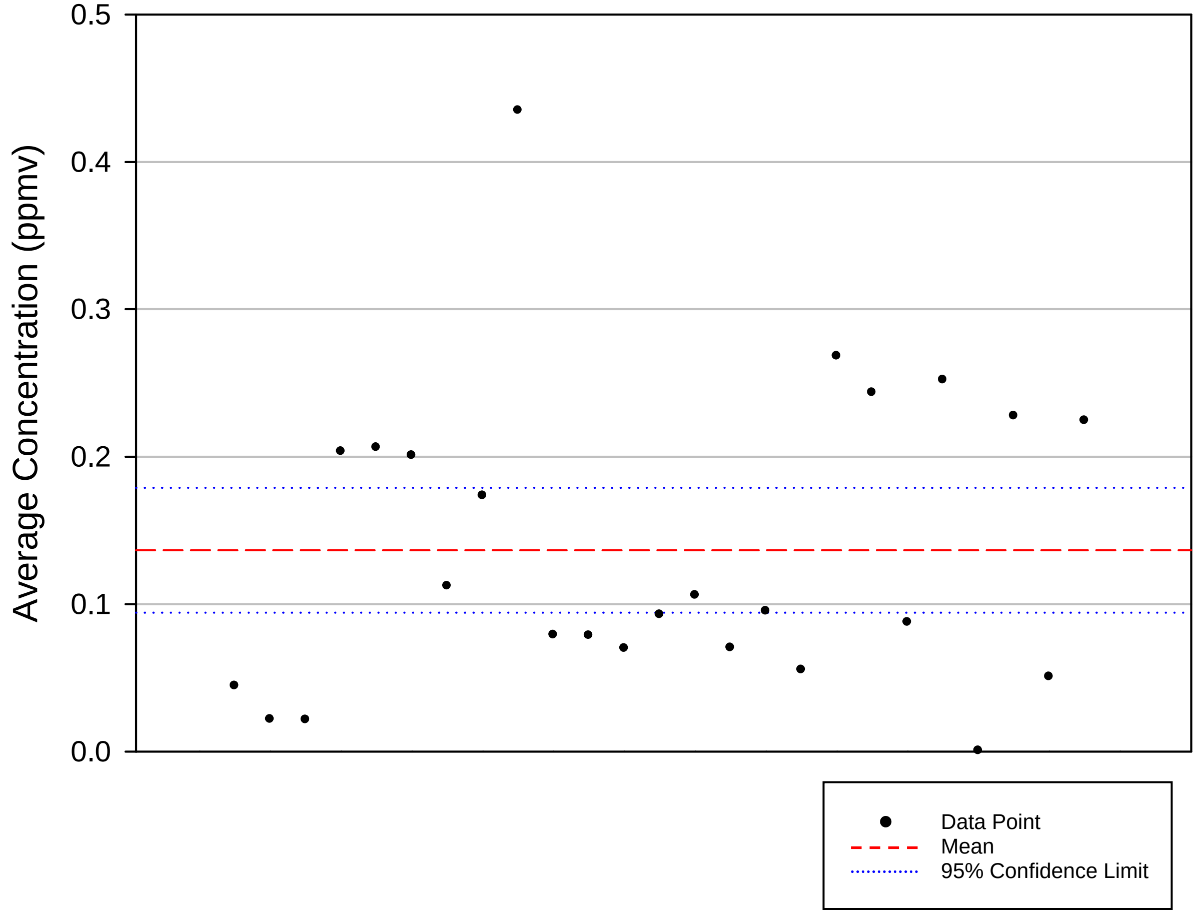


Table D-7. Dimethyl Disulfide Data Statistics

Number of Data Points	25
Minimum (ppmv)	2.29E-04
Maximum (ppmv)	4.35E-01
Mean (ppmv)	1.37E-01
Median (ppmv)	9.49E-02
Standard Deviation (ppmv)	1.03E-01
Standard Error (ppmv)	2.05E-02
95% Confidence Interval (+/- ppmv)	4.23E-02
99% Confidence Interval (+/- ppmv)	5.74E-02

Group E: Mercury Compounds Data and Statistics

Figure E-19. Total Mercury and Elemental Mercury Data Statistics Plot

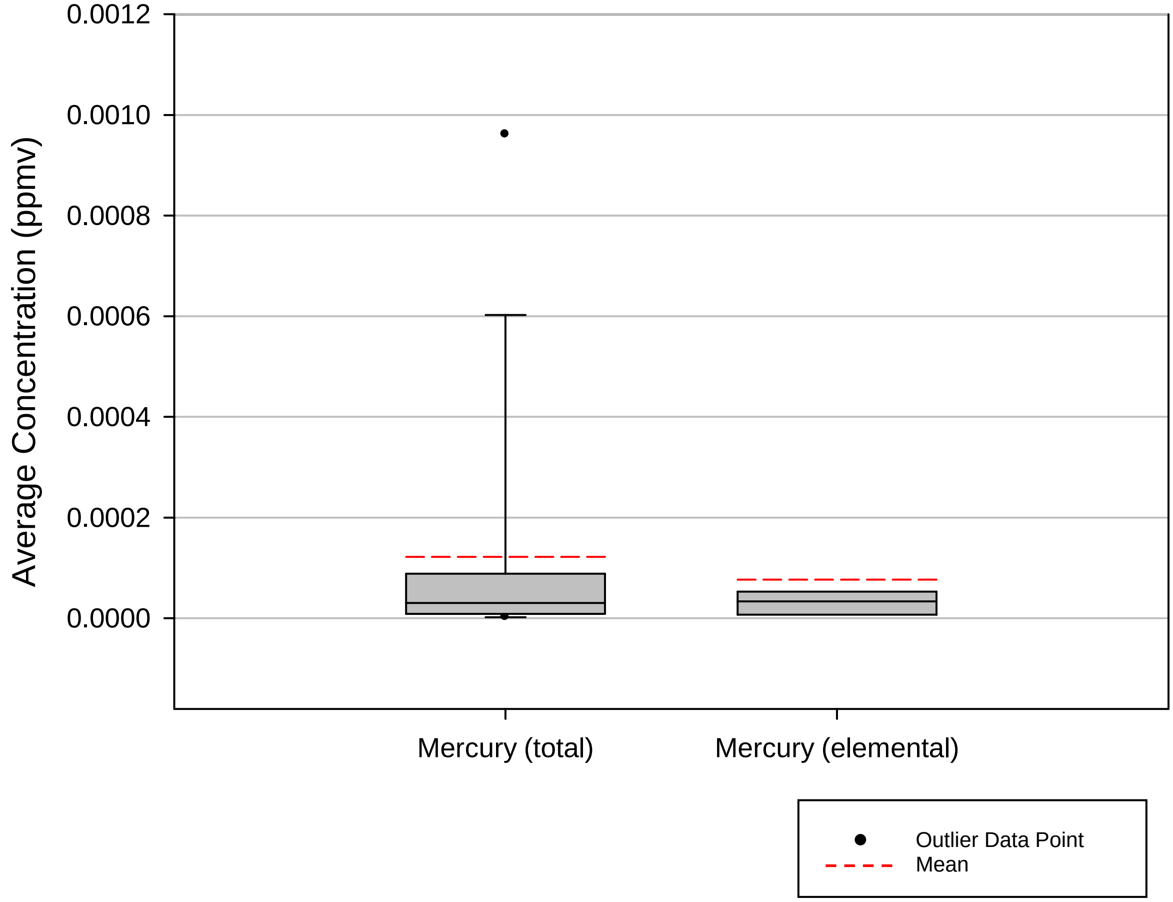


Figure E-2. Monomethyl Mercury and Dimethyl Mercury Data Statistics Plot

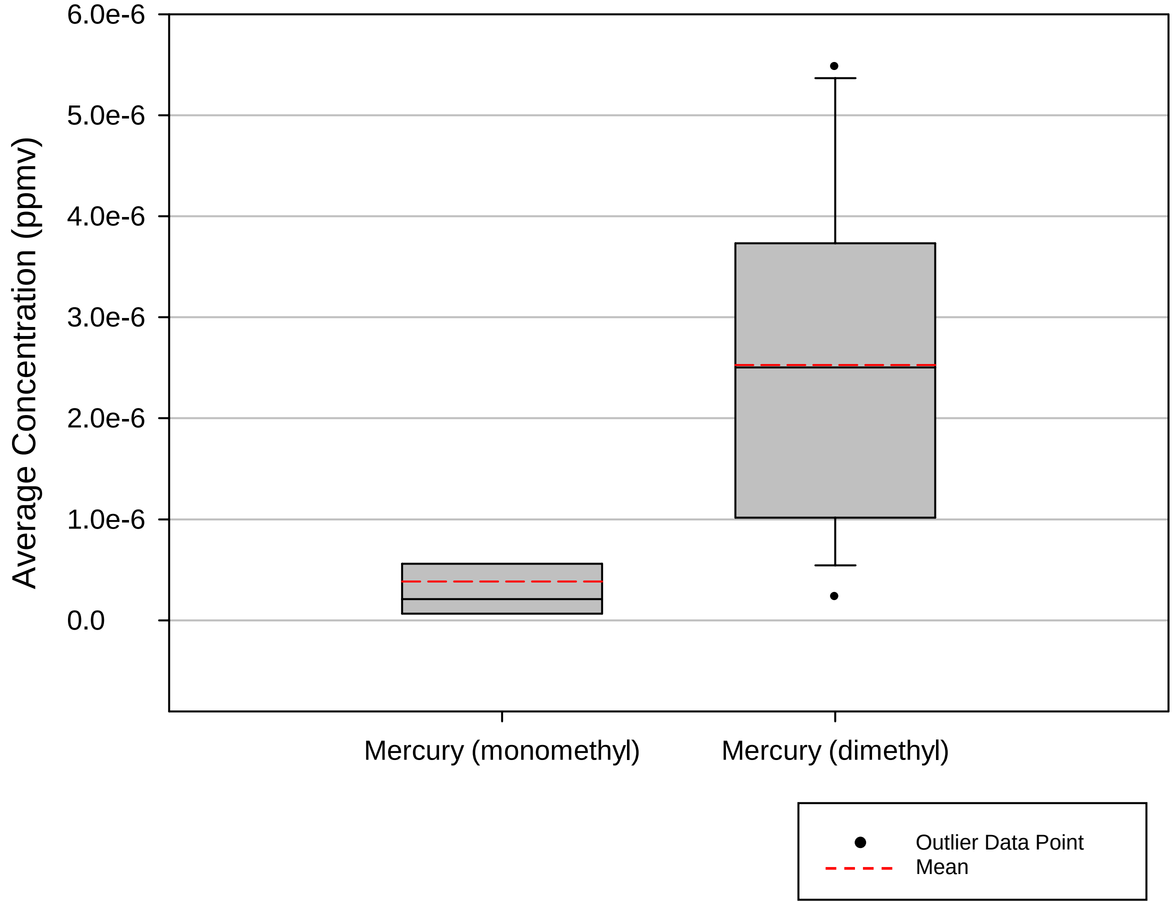


Figure E-3. Total Mercury Data Plot

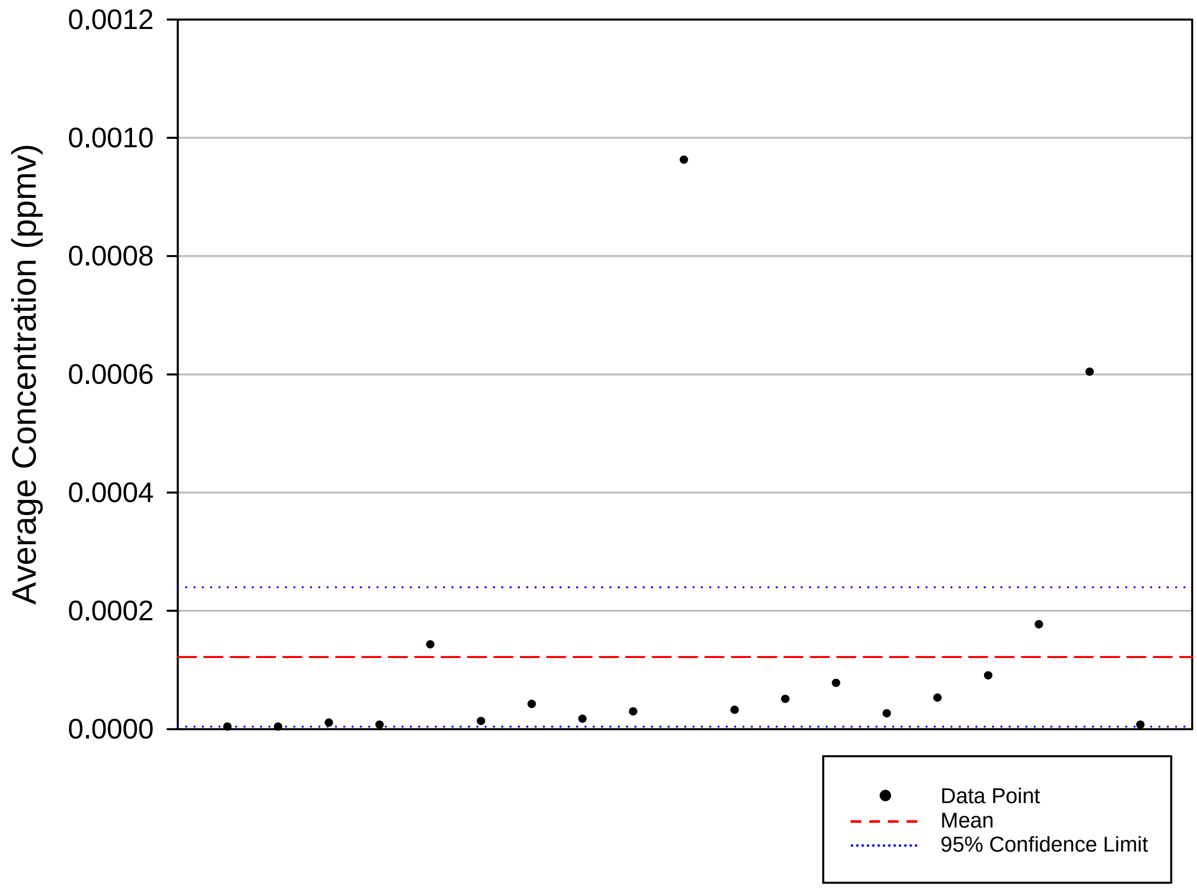


Table E-1. Total Mercury Data Statistics

Number of Data Points	19
Minimum (ppmv)	1.98E-06
Maximum (ppmv)	9.61E-04
Mean (ppmv)	1.22E-04
Median (ppmv)	3.03E-05
Standard Deviation (ppmv)	2.45E-04
Standard Error (ppmv)	5.61E-05
95% Confidence Interval (+/- ppmv)	1.18E-04
99% Confidence Interval (+/- ppmv)	1.62E-04

Figure E-4. Elemental Mercury Data Plot

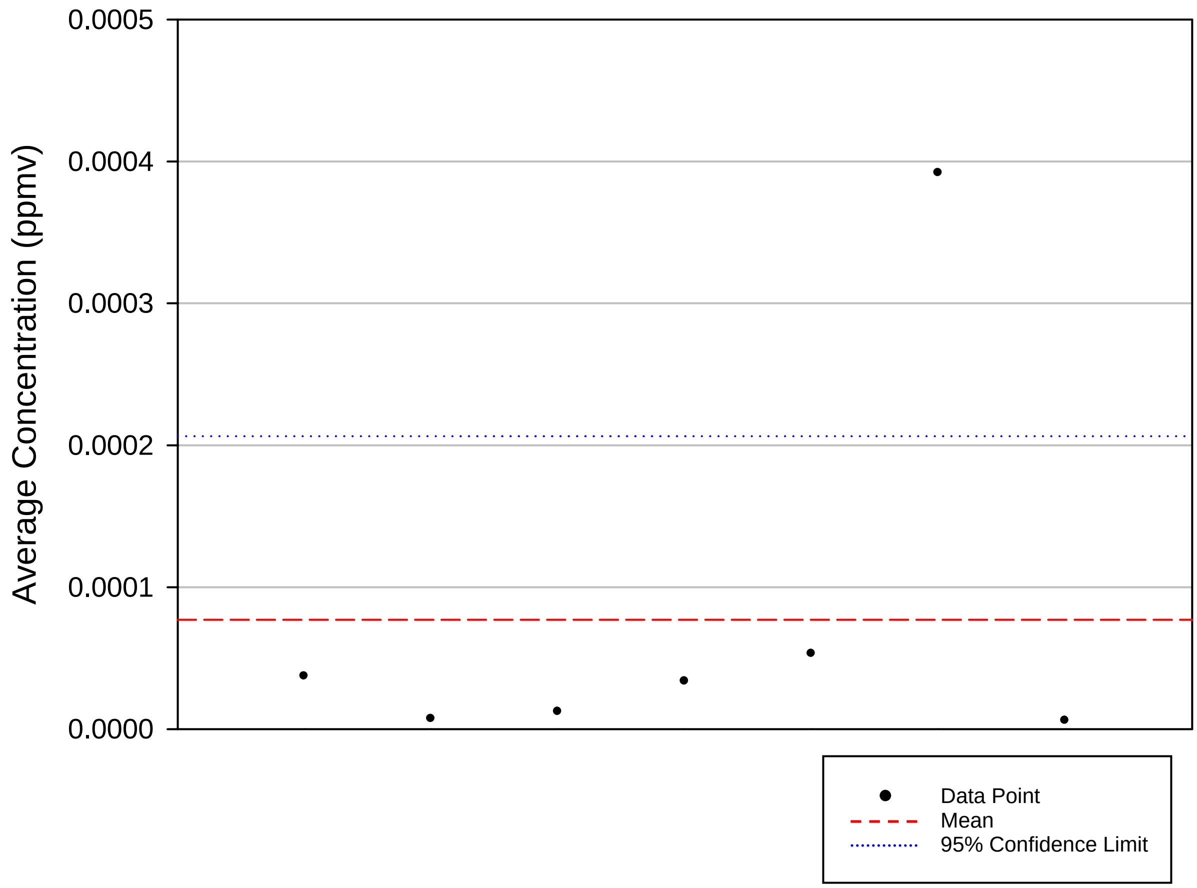


Table E-2. Elemental Mercury Data Statistics

Number of Data Points	7
Minimum (ppmv)	5.64E-06
Maximum (ppmv)	3.92E-04
Mean (ppmv)	7.70E-05
Median (ppmv)	3.33E-05
Standard Deviation (ppmv)	1.40E-04
Standard Error (ppmv)	5.29E-05
95% Confidence Interval (+/- ppmv)	1.29E-04
99% Confidence Interval (+/- ppmv)	1.96E-04

Figure E-5. Monomethyl Mercury Data Plot

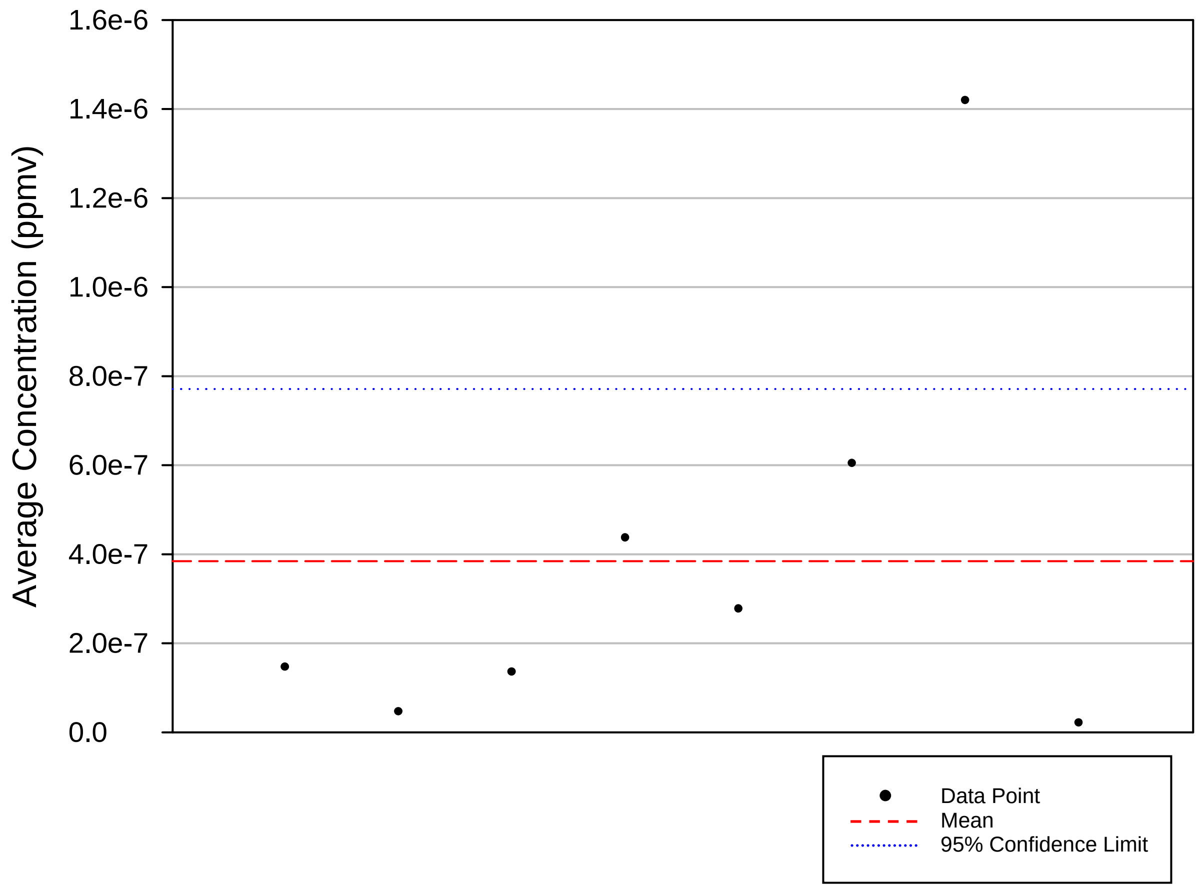


Table E-3. Monomethyl Mercury Data Statistics

Number of Data Points	8
Minimum (ppmv)	1.96E-08
Maximum (ppmv)	1.42E-06
Mean (ppmv)	3.84E-07
Median (ppmv)	2.10E-07
Standard Deviation (ppmv)	4.63E-07
Standard Error (ppmv)	1.64E-07
95% Confidence Interval (+/- ppmv)	3.87E-07
99% Confidence Interval (+/- ppmv)	5.72E-07

Figure E-6. Dimethyl Mercury Data Plot

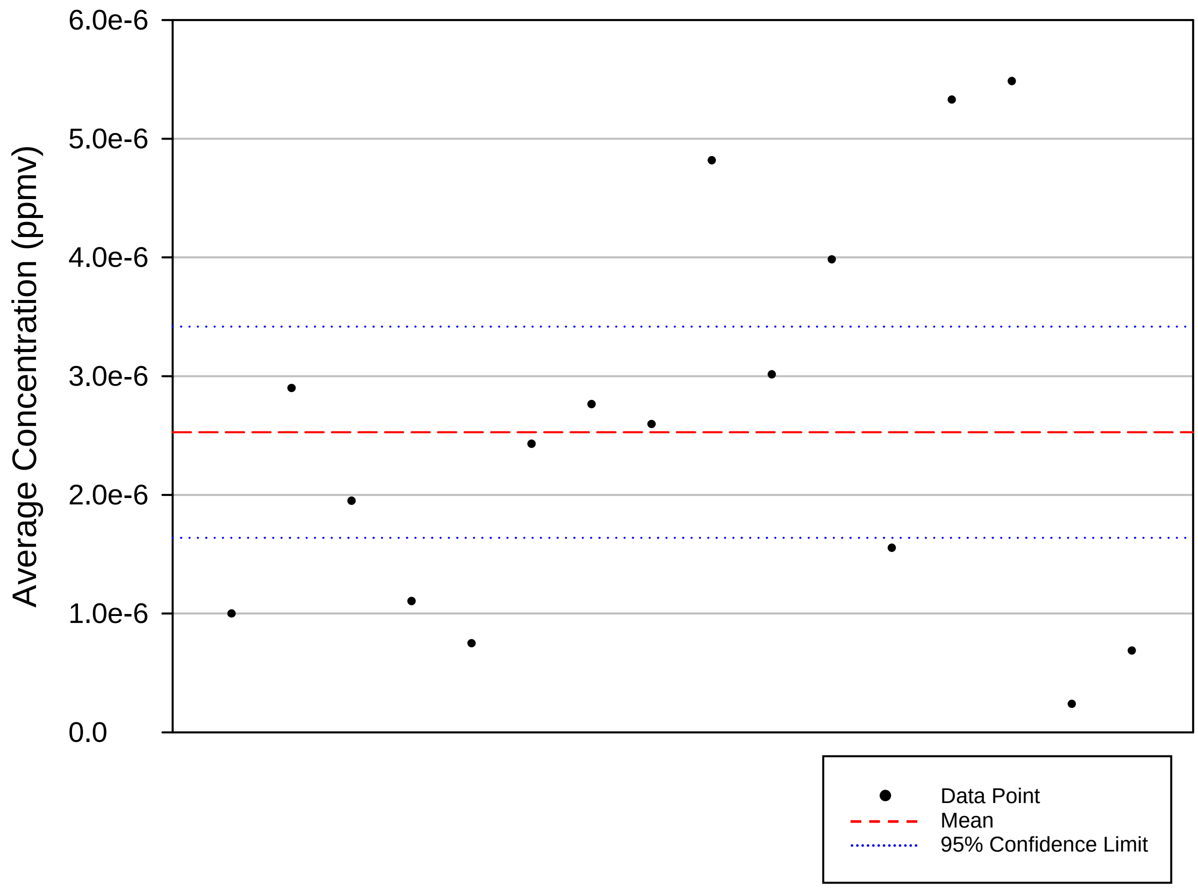


Table E-4. Dimethyl Mercury Data Statistics

Number of Data Points	16
Minimum (ppmv)	2.29E-07
Maximum (ppmv)	5.48E-06
Mean (ppmv)	2.53E-06
Median (ppmv)	2.50E-06
Standard Deviation (ppmv)	1.67E-06
Standard Error (ppmv)	4.17E-07
95% Confidence Interval (+/- ppmv)	8.90E-07
99% Confidence Interval (+/- ppmv)	1.23E-06

Appendix F
Control Device Efficiency Data and Analysis

Appendix F: BOILERS
Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	AP-42 Ref.#	Date mo/yr	Landfill Name	Control/ Utilization	Compound	Molecular Weight	Flow Rate (dscfm)	Conc. In (ppm)	Conc. Out (ppm)	Flow Rate (dscfm)	Rate (lbs/hr)	Rate (lbs/hr)	> <	Control Efficiency	EF Rating	Comments
56	39	6/91	Coyote Canyon	Boiler	TGNMO (as hexane)	86	9950	1150.00	3.8300	122657	155.77591	6.39544	=	95.89%	C	Lacking Backup Data
					Benzene	78.12	9950	1.73	0.0459	122657	0.21287	0.06962	=	67.29%	C	data point excluded
					1,2-Dichlorobenzene	98.96	9950	0.10	0.0011	122657	0.01590	0.00214	=	86.52%	C	
					Perchloroethylene	165.83	9950	8.55	0.0179	122657	2.23323	0.05764	=	97.42%	C	
					Toluene	92.13	9950	62.50	0.1220	122657	9.06954	0.21824	=	97.59%	C	
					Xylenes	106.16	9950	32.02	0.0205	122657	5.35410	0.04226	=	99.21%	C	
					Avg. Halo.									91.97%		
					Avg. Non-Halo.									88.03%		
70	53	9/93	Puente Hills	Boiler #400	Benzene	78.12	10870	4.60	0.0015	69770	0.61834	0.00129	=	99.79%	D	
					Toluene	92.13	10870	33.00	0.0037	69770	5.23149	0.00376	=	99.93%	D	
					Xylenes	106.16	10870	17.00	0.0018	69770	3.10542	0.00211	=	99.93%	D	
						Average								99.88%		
					Perchloroethylene	165.83	10870	1.70	0.0001	69770	0.48509	0.00018	>	99.96%	D	Lacking Backup Data; CE is >99.93
					Methylene Chloride	84.94	10870	5.40	0.0003	69770	0.78925	0.00028	=	99.96%	D	
					Dichlorobenzene	98.96	10870	0.50	0.0001	69770	0.08514	0.00011	>	99.87%	D	Lacking Backup Data; CE is >99.75
						Average								99.93%		
102	68	11/95	Puente Hills	Boiler #300	Benzene	78.12	10895	3.30	0.0008	64847	0.44462	0.00064	=	99.86%	D	
					Toluene	92.13	10895	16.00	0.0026	64847	2.54231	0.00246	=	99.90%	D	
					Xylenes	106.16	10895	12.00	0.0006	64847	2.19710	0.00065	>	99.97%	D	Lacking Backup Data; CE is >99.95
						Average								99.91%		
					Perchloroethylene	165.83	10895	1.60	0.0005	64847	0.45761	0.00085	>	99.81%	D	
					Methylene Chloride	84.94	10895	1.60	0.0016	64847	0.23439	0.00140	=	99.40%	D	
					Dichlorobenzene	98.96	ND	ND	ND	ND	ND	ND		ND	ND	
						Average								99.61%		
102	68	12/92	Palos Verdes	Boiler #1	TGNMO (as hexane)	86	3557	1200.00	2.6800	14615	58.10914	0.53323	=	99.08%	D	Lacking Backup Data
					Benzene	78.12	3557	11.00	0.0002	14615	0.48386	0.00004	=	99.99%	D	
					Toluene	92.13	3557	24.00	0.0005	14615	1.24502	0.00011	>	99.99%	D	Lacking Backup Data; CE is >99.98
					Xylenes	106.16	3557	21.00	0.0001	14615	1.25529	0.00002	=	99.99%	D	Lacking Backup Data; CE is >99.99
						Average								99.99%		
					Perchloroethylene	165.83	3557	0.40	0.0001	14615	0.03735	0.00004	>	99.90%	D	Lacking Backup Data; CE is >99.80
					Methylene Chloride	84.94	3557	0.20	0.0001	14615	0.00957	0.00002	>	99.79%	D	Lacking Backup Data; CE is >99.59
					Dichlorobenzene	98.96	3557	1.30	0.0001	14615	0.07244	0.00002	>	99.97%	D	Lacking Backup Data; CE is >99.94
						Average								99.89%		

Appendix F: BOILERS
Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	AP-42 Ref.#	Date mo/yr	Landfill Name	Control/ Utilization	Compound	Molecular Weight	Flow Rate (dscfm)	Conc. In (ppm)	Conc. Out (ppm)	Flow Rate (dscfm)	Rate (lbs/hr)	Rate (lbs/hr)	> <	Control Efficiency	EF Rating	Comments
102	68	12/94	Palos Verdes	Boiler #1	TGNMO (as hexane)	86	3296	827.00	0.3330	13578	37.10839	0.06155	>	99.83%	D	Lacking Backup Data; CE is >99.83
				Boiler Average										99.46%		
102	68	11/93	Palos Verdes	Boiler #2	TGNMO (as hexane)	86	3504	499.00	1.3400	12847	23.80367	0.23436	=	99.02%	D	Lacking Backup Data
102	68	12/95	Palos Verdes	Boiler #2	TGNMO (as hexane)	86	3404	833.00	0.9680	12774	38.60237	0.16834	=	99.56%	D	Lacking Backup Data
					Benzene	78.12	3404	11.00	0.0028	12774	0.46305	0.00044	>	99.90%	D	
					Toluene	92.13	3404	28.00	0.0100	12774	1.39005	0.00186	>	99.87%	D	
					Xylenes	106.16	3404	22.00	0.0021	12774	1.25850	0.00045	>	99.96%	D	
						Average								99.91%		
					Perchloroethylene	165.83	3404	0.17	0.0005	12774	0.01519	0.00017	=	98.90%	D	Lacking Backup Data; CE is >99.69
					Methylene Chloride	84.94	3404	0.11	0.0005	12774	0.00503	0.00009	=	98.29%	D	Lacking Backup Data; CE is >99.69
					Dichlorobenzene	98.96	3404	0.31	0.0001	12774	0.01653	0.00002	=	99.88%	D	Lacking Backup Data; CE is >99.78
						Average								99.02%		
														99.29%		
					Benzene	78.12	3137	4.00	0.0060	13430	0.15517	0.00100	=	99.36%	D	
					Toluene	92.13	3137	32.00	0.0011	13430	1.46402	0.00022	=	99.99%	D	
					Xylenes	106.16	3137	20.90	0.0002	13430	1.10180	0.00005	=	100.00%	D	Lacking Backup Data; CE is >99.99
						Average								99.78%		
					Perchloroethylene	165.83	3137	4.00	0.0001	13430	0.32940	0.00004	>	99.99%	D	Lacking Backup Data; CE is >99.98
					Methylene Chloride	84.94	3137	22.00	0.0001	13430	0.92796	0.00002	=	100.00%	D	Lacking Backup Data; CE is >100.00
					Dichlorobenzene	98.96	ND	ND	ND	ND	ND	ND		ND	ND	
						Average								99.99%		
102	68	8/91	Spadra	Boiler	TNMHC (as hexane)	86	3240	698.00	0.7950	16410	30.78788	0.17760	=	99.42%	D	Lacking Backup Data
102	68	8/92	Spadra	Boiler	TNMHC (as hexane)	86	3137	1320.00	1.9300	13430	56.37257	0.35287	=	99.37%	D	Lacking Backup Data
102	68	9/93	Spadra	Boiler	TNMHC (as hexane)	86	3752	527.00	0.3330	19720	26.91862	0.08940	>	99.67%	D	Lacking Backup Data; CE is >99.67
102	68	12/94	Spadra	Boiler	TNMHC (as hexane)	86	3926	603.00	0.3330	19720	32.22901	0.08940	>	99.72%	D	Lacking Backup Data; CE is >99.72
102	68	12/95	Spadra	Boiler	TNMHC (as hexane)	86	3953	833.00	9.5000	17357	44.82819	2.24480	=	94.99%	D	Lacking Backup Data
														98.64%		
			Overall Boiler Average NMOC CE											98.00%		
			Stdev											1.87%		
			95% Conf											2.11%		
			Overall Boiler Halo CE											98.40%		
			Overall Boiler Non-Halo CE											97.92%		

Appendix F: GAS TURBINES
Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	AP-42 Ref.#	Date mo/yr	Landfill Name	Control/ Utilization	Compound	Molecular Weight	Flow Rate (scfm)	Conc. In (ppm)	Conc. Out (ppm)	Flow Rate (dscfm)	Rate (lbs/hr)	Rate (lbs/hr)	> <	Control Efficiency	EF Rating	Comments
				Gas Turbine (#1)	Average									#DIV/0!		
				Gas Turbine (#2)	Average									#DIV/0!		
102	68	5/90	Puente Hills	Gas Turbine (#1)	Benzene	78.12	1852	2.30	0.0013	30559	0.05268	0.00049	=	99.07%	D	
102	68	9/93	Puente Hills	Gas Turbine (#1)	Benzene	78.12	1215	0.20	0.0002	30559	0.00301	0.00008	=	97.48%	D	
														98.28%		
102	68	7/90	Puente Hills	Gas Turbine (#2)	Benzene	78.12	1398	2.20	0.0047	20415	0.03803	0.00119	=	96.88%	D	
102	68	11/91	Puente Hills	Gas Turbine (#2)	Benzene	78.12	1301	4.10	0.0080	22937	0.06596	0.00227	=	96.56%	D	
102	68	9/93	Puente Hills	Gas Turbine (#2)	Benzene	78.12	1215	4.00	0.0059	20180	0.06010	0.00147	=	97.55%	D	
102	68	11/94	Puente Hills	Gas Turbine (#2)	Benzene	78.12	1311	2.90	0.0029	21151	0.04702	0.00076	=	98.39%	D	
														97.34%		
														97.81%		
				Gas Turbine (#1)	Dichlorobenzene	98.96	1852	0.20	0.0002	30559	0.00580	0.00010	=	98.35%	D	Lacking Backup Data
				Gas Turbine (#2)	Dichlorobenzene	98.96	1398	1.30	0.0001	20415	0.02847	0.00003	>	99.89%	D	Lacking Backup Data; CE is >99.82
														99.12%		
				Gas Turbine (#1)	Methylene Chloride	84.94	1852	4.90	0.0001	30559	0.12202	0.00004	>	99.97%	D	Lacking Backup Data; CE is >99.93
102	68	3/95	Puente Hills	Gas Turbine (#1)	Methylene Chloride	106.16	1481	2.20	0.0016	30895	0.05475	0.00083	=	98.48%	D	
														99.22%		
				Gas Turbine (#2)	Methylene Chloride	84.94	1398	5.10	0.0001	20415	0.09587	0.00003	>	99.97%	D	Lacking Backup Data; CE is >99.95
102	68	9/93	Puente Hills	Gas Turbine (#2)	Methylene Chloride	84.94	1215	5.70	0.0003	20180	0.09312	0.00008	=	99.91%	D	
														99.94%		
														99.58%		
				Gas Turbine (#1)	Perchloroethylene	165.83	1852	3.10	0.0001	30559	0.15071	0.00008	>	99.95%	D	Lacking Backup Data; CE is >99.89
				Gas Turbine (#2)	Perchloroethylene	165.83	1398	4.10	0.0002	20415	0.15046	0.00008	=	99.95%	D	Lacking Backup Data; CE is >99.91
														99.95%		
102	68	9/93	Puente Hills	Gas Turbine (#1)	TGNMO (as hexane)	86	1475	447.50	1.0650	27450	8.98596	0.39799	=	95.57%	D	
102	68	3/95	Puente Hills	Gas Turbine (#1)	TGNMO (as hexane)	86	1481	512.50	0.1670	30895	10.33304	0.07024	>	99.32%	D	TGNMO were ND in exhaust (<1ppm), so CE is >99.32
102	68	11/95	Puente Hills	Gas Turbine (#1)	TGNMO (as hexane)	86	1902	610.00	0.3670	30748	15.79500	0.15363	=	99.03%	D	
102	68	5/90	Puente Hills	Gas Turbine (#1)	TNMHC (as hexane)	86	1852	625.70	0.1700	30559	15.77562	0.07072	>	99.55%	D	All Ref. 102 Tests are lacking backup data; summary data only; Eff is >99.95%
102	68	12/90	Puente Hills	Gas Turbine (#1)	TNMHC (as hexane)	86	1751	516.70	1.5830	30012	12.31697	0.64678	=	94.75%	D	
102	68	8/91	Puente Hills	Gas Turbine (#1)	TNMHC (as hexane)	86	1195	785.00	1.0570	28684	12.77077	0.41276	=	96.77%	D	
102	68	10/92	Puente Hills	Gas Turbine (#1)	TNMHC (as hexane)	86	1522	700.00	1.4880	29625	14.50414	0.60012	=	95.86%	D	
														97.26%		
102	68	11/91	Puente Hills	Gas Turbine (#2)	TNMHC (as hexane)	86	1301	824.10	4.6330	22937	14.59609	1.44670	=	90.09%	D	
102	68	9/93	Puente Hills	Gas Turbine (#2)	TGNMO (as hexane)	86	1215	474.00	2.0170	20180	7.84032	0.55412	=	92.93%	D	
														91.51%		

BID Ref.	AP-42 Ref.#	Date mo/yr	Landfill Name	Control/ Utilization	Compound	Molecular Weight	Flow Rate (scfm)	Conc. In (ppm)	Conc. Out (ppm)	Flow Rate (dscfm)	Rate (lbs/hr)	Rate (lbs/hr)	> <	Control Efficiency	EF Rating	Comments
				Gas Turbine (#1)	Toluene	92.13	1852	29.00	0.0770	30559	0.78329	0.03432	=	95.62%	D	
102	68	12/90	Puente Hills	Gas Turbine (#1)	Toluene	92.13	1751	43.00	0.0021	30012	1.09809	0.00092	=	99.92%	D	
102	68	8/91	Puente Hills	Gas Turbine (#1)	Toluene	92.13	1195	42.00	0.0020	28684	0.73198	0.00084	=	99.89%	D	
102	68	10/92	Puente Hills	Gas Turbine (#1)	Toluene	92.13	1522	33.00	0.0029	29625	0.73250	0.00125	=	99.83%	D	
														98.81%		
				Gas Turbine (#2)	Toluene	92.13	1398	4.20	0.0027	20415	0.08563	0.00080	=	99.06%	D	
102	68	11/91	Puente Hills	Gas Turbine (#2)	Vinyl Chloride	62.5	1301	1.00	0.0005	22937	0.01287	0.00011	=	99.12%	D	
				Gas Turbine (#1)	Xylenes	106.16	1852	17.60	0.0169	30559	0.54777	0.00868	=	98.42%	D	
102	68	10/92	Puente Hills	Gas Turbine (#1)	Xylenes	106.16	1522	29.00	0.0005	29625	0.74174	0.00025	=	99.97%	D	Eff is >99.97
														99.19%		
				Gas Turbine (#2)	Xylenes	106.16	1398	29.00	0.0013	20415	0.68131	0.00045	=	99.93%	D	
														99.56%		
				Gas Turbine (#1)	halo	Average								99.17%		
				Gas Turbine (#1)	nonhalo	Average								98.76%		
				Gas Turbine (#2)	halo	Average								99.34%		
				Gas Turbine (#2)	nonhalo	Average								98.78%		
				Overall	halo	Average								99.26%		
				Overall	nonhalo	Average								98.77%		
				Overall	NMOC	Average								94.39%		
						Stdev								4.07%		
						95% Conf								5.64%		
	NOTES:	NOTE: For the LACSD Ref. 102 data, only CE data for which detectable concs. at the inlet are presented (for non-detects at the exhaust 0.5 x the detect limits are assumed). Multiple data points were used for compounds where a wide range of CE's were observed (I.e., >1.0%).														

Appendix F: FLARES
Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	Date mo/yr	Landfill ID	Device ID	Compound	> <	Average D.E. (%)	Flare Average (%)	Site Average (%)	Comments
	NMOC								
102	3/92	A	Flare (#1)		=	99.40	99.40	99.28	
102	2/91	A	Flare (#3)		>	99.97	99.97		
102	10/91	A	Flare (#4)		=	97.27	98.60		
102	5/96	A	Flare (#4)		>	99.92			
102	12/94	A	Flare (#5)		>	99.80	99.85		
102	9/90	A	Flare (#5)		>	99.90			
102	11/93	A	Flare (#6)		=	97.37	98.58		
102	9/90	A	Flare (#6)		=	99.78			
102	8/92	B	Flare (#1)		=	99.48	99.65	99.09	
102	9/94	B	Flare (#1)		=	99.66			
102	5/96	B	Flare (#1)		=	99.80			
102	7/90	B	Flare (#2)		=	99.67	99.26		
102	7/93	B	Flare (#2)		=	98.30			
102	5/96	B	Flare (#2)		>	99.80			
102	8/92	B	Flare (#3)		=	98.73	99.18		
102	6/95	B	Flare (#3)		>	99.63			
102	8/92	B	Flare (#4)		=	99.23	99.44		
102	6/95	B	Flare (#4)		>	99.64			
102	7/90	B	Flare (#5)		=	99.56	99.01		
102	7/93	B	Flare (#5)		=	97.80			
102	6/95	B	Flare (#5)		=	99.67			
102	8/92	B	Flare (#6)		=	99.41	99.54		
102	6/95	B	Flare (#6)		>	99.66			
102	7/93	B	Flare (#7)		=	97.30	98.50		
102	5/96	B	Flare (#7)		>	99.70			
102	11/91	B	Flare (#9)		=	98.29	98.57		
102	9/94	B	Flare (#9)		>	98.84			
102	11/91	B	Flare (#10)		>	98.98	99.23		
102	11/94	B	Flare (#10)		=	99.47			
102	9/94	B	Flare (#11)		=	99.40	99.40		
102	11/91	B	Flare (#12)		=	98.20	98.27		
102	7/93	B	Flare (#12)		=	96.90			
102	5/96	B	Flare (#12)		>	99.70			
102	1/94	C	Flare (#1)		=	98.90	98.90	99.33	
102	10/91	C	Flare (#2)		=	99.15	99.38		
102	2/92	C	Flare (#2)		=	99.20			
102	5/95	C	Flare (#2)		>	99.80			
102	2/92	C	Flare (#3)		=	99.60	99.70		
102	5/95	C	Flare (#3)		>	99.80			
102	8/90	C	Flare (#5)		>	99.79	99.39		
102	1/94	C	Flare (#5)		=	98.99			
102	10/91	C	Flare (#6)		=	99.21	99.26		
102	3/93	C	Flare (#6)		=	99.06			
102	4/96	C	Flare (#6)		=	99.50			
102	3/93	D	Flare (#1)		=	99.20	99.45	99.31	
102	3/95	D	Flare (#1)		>	99.70			
102	3/93	D	Flare (#2)		=	97.10	97.10		
102	2/91	D	Flare (#3)		=	99.42	99.54		
102	2/92	D	Flare (#3)		=	99.50			
102	3/95	D	Flare (#3)		>	99.70			
102	3/90	D	Flare (#4)		>	99.99	99.66		
102	2/92	D	Flare (#4)		=	99.50			
102	3/95	D	Flare (#4)		=	99.50			
102	3/90	D	Flare (#5)		=	99.20	99.15		
102	3/93	D	Flare (#5)		=	99.10			
102	3/90	D	Flare (#6)		>	99.70	99.43		
102	2/94	D	Flare (#6)		=	98.80			
102	3/96	D	Flare (#6)		=	99.78			
102	2/91	D	Flare (#7)		>	99.93	99.74		
102	7/95	D	Flare (#7)		=	99.54			
102	3/96	D	Flare (#8)		=	99.84	99.84		
102	3/96	D	Flare (#9)		=	99.84	99.84		

BID Ref.	Date mo/yr	Landfill ID	Device ID	Compound	> <	Average D.E. (%)	Flare Average (%)	Site Average (%)	Comments
102	10/90	E	Flare (#2)		>	99.66	97.44	98.50	
102	2/93	E	Flare (#2)		=	98.56			
102	8/95	E	Flare (#2)		=	94.10			
102	10/90	E	Flare (#3)		>	99.75	99.33		
102	5/94	E	Flare (#3)		=	98.90			
102	10/90	E	Flare (#4)		>	99.69	96.69		
102	2/93	E	Flare (#4)		=	96.57			
102	8/95	E	Flare (#4)		=	93.80			
102	5/91	E	Flare (#5)		=	99.01	98.71		
102	5/94	E	Flare (#5)		=	98.40			
102	12/91	E	Flare (#6)		=	99.21	99.10		
102	2/93	E	Flare (#6)		=	98.50			
102	3/95	E	Flare (#6)		=	99.59			
102	5/91	E	Flare (#7)		=	99.36	98.53		
102	5/94	E	Flare (#7)		=	97.70			
102	2/93	E	Flare (#8)		=	97.18	98.34		
102	3/95	E	Flare (#8)		>	99.50			
102	6/90	E	Flare (#9)		>	99.60	98.80		
102	5/94	E	Flare (#9)		=	98.00			
102	6/90	E	Flare (#10)		>	99.66	99.37		
102	12/93	E	Flare (#10)		=	98.90			
102	3/95	E	Flare (#10)		=	99.56			
102	6/90	E	Flare (#11)		>	99.71	99.46		
102	5/92	E	Flare (#11)		=	99.21			
102	2/96	E	Flare (#11)		=	99.46			
102	6/90	E	Flare (#12)		>	99.65	99.50		
102	12/93	E	Flare (#12)		=	99.20			
102	3/95	E	Flare (#12)		>	99.65			
102	7/90	E	Flare (#13)		>	99.78	99.43		
102	5/92	E	Flare (#13)		=	98.88			
102	2/96	E	Flare (#13)		>	99.64			
102	7/90	E	Flare (#14)		=	97.33	98.39		
102	12/93	E	Flare (#14)		=	99.44			
102	7/90	E	Flare (#15)		=	98.24	98.93		
102	2/96	E	Flare (#15)		>	99.62			
102	7/90	E	Flare (#16)		=	97.91	98.47		
102	12/93	E	Flare (#16)		=	99.02			
102	5/91	E	Flare (#17)		=	97.80	98.25		
102	5/92	E	Flare (#17)		=	98.70			
102	12/91	E	Flare (#18)		=	99.27	97.13		
102	11/92	E	Flare (#18)		=	99.32			
102	8/95	E	Flare (#18)		=	92.80			
102	5/91	E	Flare (#19)		=	99.21	99.00		
102	5/92	E	Flare (#19)		=	98.79			
102	12/91	E	Flare (#20)		=	98.98	99.15		
102	11/92	E	Flare (#20)		>	99.32			
102	12/91	E	Flare (#22)		=	99.08	98.54		
102	11/92	E	Flare (#22)		=	97.99			
102	10/90	E	Flare (#24)		>	99.68	95.94		
102	10/92	E	Flare (#24)		=	98.15			
102	8/95	E	Flare (#24)		=	90.00			

Appendix F: FLARES
Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	Date mo/yr	Landfill ID	Device ID	Compound	> <	Average D.E. (%)	Flare Average (%)	Site Average (%)	Comments
104	12/94	F	Flare		=	99.00	99.00	99.00	
105	10/93	G	Flare		>	99.98	99.98	99.98	
106	4/96	H	Flare		=	99.80	99.80	99.80	EF rating downgraded primarily due to NOx
107	10/96	I	Flare		>	99.13	99.13	99.13	
108	11/93	J	Flare		>	98.46	98.46	98.46	
109	3/94	K	Flare		>	99.70	99.70	99.70	
55	8/90	N	Flare		>	84.50			
59	8/90	O	Flare		>	97.70			
60	5/90	P	Flare		=	99.60			
62	4/92	Q	Flare		>	92.05			
							Average	99.23	
							Stdev	0.48	
							95% Conf	0.29	
	Individual Species								
102	12/94	A	Flare (#5)	Benzene	>	99.98			Lacking Backup Data.
				Toluene	>	99.98			
				Xylenes	>	99.98			Lacking Backup Data.
				Average					
				Perchloroethylene	>	99.00			Lacking Backup Data.
				Methylene Chloride		N/A			not detected at inlet.
				Dichlorobenzene	>	99.39			Lacking Backup Data.
				Average					
102	7/93	B	Flare (#2)	Benzene	>	99.90			Lacking Backup Data.
				Toluene	>	99.98			Lacking Backup Data.
				Xylenes	>	99.94			Lacking Backup Data.
				Average					
				Perchloroethylene	=	99.96			
				Methylene Chloride	>	99.98			Lacking Backup Data.
				Dichlorobenzene	>	99.04			Lacking Backup Data.
				Average					
102	2/92	C	Flare (#3)	Benzene	>	99.90			Lacking Backup Data.
				Toluene	>	99.90			
				Xylenes	>	99.90			Lacking Backup Data.
				Average					
				Perchloroethylene	>	99.90			Lacking Backup Data.
				Methylene Chloride	>	99.90			Lacking Backup Data.
				Dichlorobenzene		N/A			Inlet and outlet concentrations were not detected.
				Average					
102	2/92	D	Flare (#4)	Benzene	>	99.51			Lacking Backup Data.
				Toluene	>	99.98			Lacking Backup Data.
				Xylenes	>	99.98			Lacking Backup Data.
				Average					
				Perchloroethylene	=	99.92			
				Methylene Chloride	>	99.99			Lacking Backup Data.
				Dichlorobenzene	>	99.22			Lacking Backup Data.
				Average					

Appendix F: FLARES

Background Data for Control Efficiencies from 1998 AP-42 Update

BID Ref.	Date mo/yr	Landfill ID	Device ID	Compound	> <	Average D.E. (%)	Flare Average (%)	Site Average (%)	Comments
	5/90	E	Flare (#9)	Benzene	=	99.57			
				Toluene	=	99.86			
				Xylenes	>	99.88			Lacking Backup Data.
				Average					
				Perchloroethylene	=	99.89			
				Methylene Chloride	>	99.96			Lacking Backup Data.
				Dichlorobenzene	>	99.23			Lacking Backup Data.
				Average					
	3&4/1992	L	Flare	Benzene	=	38.20			
				Toluene		n/a			
				Xylenes		n/a			
				Average		not calculated			not used in emission factor development.
				Perchloroethylene	>	94.40			
				Methylene Chloride	=	91.80			
				Dichlorobenzene		n/a			
				Average	>	93.10			
	3&4/1992	M	Flare	Benzene	=	85.90			
				Toluene		n/a			
				Xylenes		n/a			
				Average	=	85.90			
				Perchloroethylene	>	98.40			
				Methylene Chloride	>	90.50			
				Dichlorobenzene		n/a			
				Average	>	94.45			
	8/90	N	Flare	Benzene	>	98.72			
				Toluene	=	99.94			
				Xylenes	>	99.89			
				Average	=	99.52			
				Perchloroethylene	>	98.17			
				Methylene Chloride		n/a			test results not used (-73% DE)
				Dichlorobenzene		n/a			
				Average	>	98.17			
	8/90	O	Flare	Benzene	>	83.40			
				Toluene	=	99.80			
				Xylenes	>	99.40			
				Average	>	94.20			
				Perchloroethylene	>	98.90			
				Methylene Chloride		n/a			test results not used (-54% DE)
				Dichlorobenzene		n/a			
				Average	>	98.90			

Appendix F: ENGINES
Background Data for Control Efficiencies from 1998 AP-42 Update

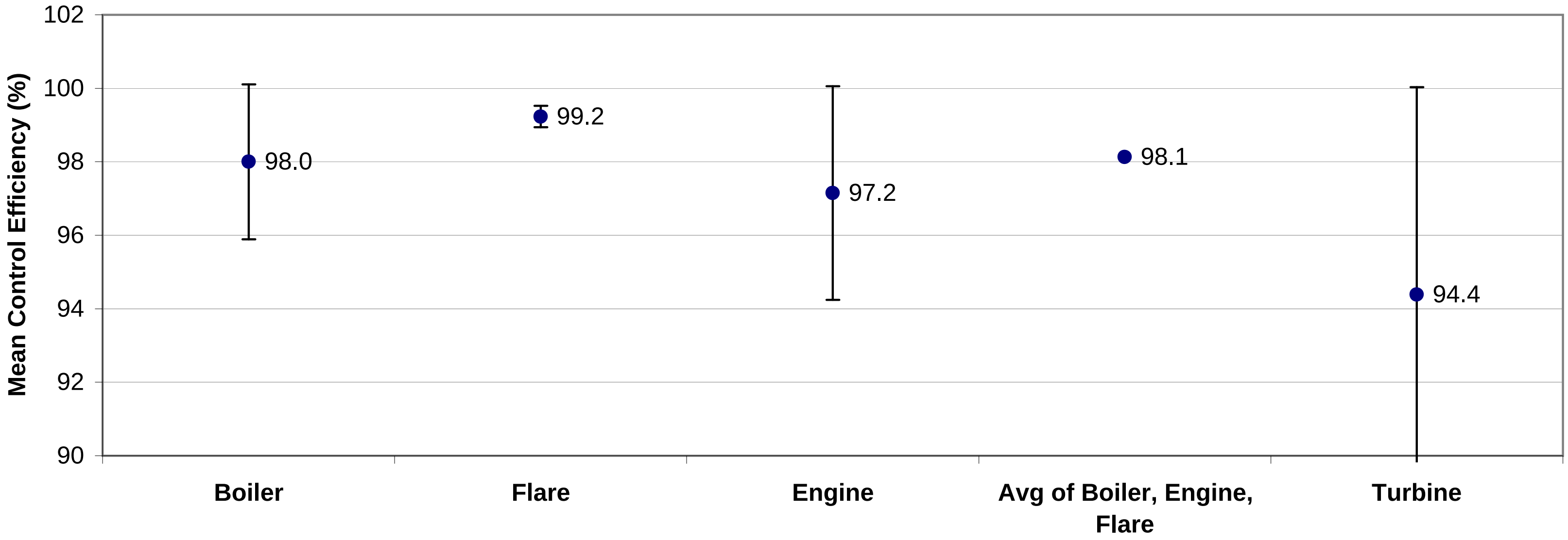
BID Ref.	Date mo/yr	Device ID	Compound	> <	Average CE (%)	EF Rating	Comments
98	12/90	IC Engine	Methane	=	97.80	B	
			Ethane	=	98.33	B	
			Propane	=	90.46	B	
			Butane	=	94.53	B	
			Pentane	>	98.34	B	
			NMOC	=	97.13	B	
99	4/91	IC Engine	NMOC	=	94.59	C	
100	2/88	IC Engine	NMOC	=	99.74	D	
			Trichloroethylene	=	98.93	D	
			Perchloroethylene	=	99.41	D	
			Methane	=	94.06	D	
101	3/88	IC Engine					
			Benzene	=	25.00	D	data point excluded
			Toluene	=	96.67	D	
			Xylene	=	99.22	D	
			Trichloroethylene	=	94.00	D	
			1,1,1-Trichloroethylene	=	90.00	D	
			Perchloroethylene	=	95.00	D	
			Methane	=	62.12	D	
			Avg. NMOC		97.15		
			Stdev		2.58		
			95% Conf		2.91		
			Avg. All (non-methane) Species		89.99		
			Avg. Halo Species		95.47		
			Avg. Non-Halo Species		86.08		

APPENDIX F: DATA STATS
Background Data for Control Efficiencies from 1998 AP-42 Update

1998 AP-42 Update Data for Equipment NMOC Control Efficiency

	Number of Data Points	Min (%)	Max (%)	Mean (%)	Standard Deviation (%)	95% Confidence Limit (%)
Boiler	3	95.9	99.5	98.0	1.9	2.1
Flare	11	98.5	100.0	99.2	0.5	0.3
Engine	3	94.6	99.7	97.2	2.6	2.9
Avg of Boiler, Engine, Flare				**98.1**		
Turbine	2	91.5	97.3	94.4	4.1	5.6

NMOC Control Efficiency - 95% Confidence Intervals in the Mean



Note: Error bars represent the 95% confidence interval in the mean.
Note: 95% confidence limit (mean) for turbines is 134.8%.

APPENDIX F: BOILER
Background Data for Control Efficiencies from 2008 AP-42 Update

Number of Data Points	**5**
Mean CE (%)	**98.6**
Minimum (%)	**95.9**
Maximum (%)	**99.6**
Standard Deviation (%)	**1.6**
95% Conf. Limit (%)	**1.4**

New Data from Current Update:

Test Report ID	Control	Compound	Total Inlet Flow (scfm)	Control Efficiency
TR-167	Boiler	NMOC (as CH4)		99.40%
TR-220	Boiler	NMOC (as CH4)		99.64%

APPENDIX F: FLARE
Background Data for Control Efficiencies from 2008 AP-42 Update

Number of Data Points	**25**
Mean CE (%)	**97.7**
Minimum (%)	**85.8**
Maximum (%)	**100.0**
Standard Deviation (%)	**3.4**
95% Conf. Limit (%)	**1.3**

New Data from current update:

Test Report ID	Control	Compound	Molecular Weight	Total Inlet Flow (scfm)	Inlet Concentration (ppm)	Inlet Flow Rate (lb/hr)	Total Outlet Flow (scfm)	Outlet Concentration (ppm)	Outlet Flow Rate (lb/hr)	Control Efficiency
TR-145	Flare	NMOC (as CH4)	86	1570	2533.0	54	21522	19.5	6	89.4
TR-145	Flare	VOC				14.86			1.0	93.3
TR-146	Flare	NMOC (as CH4)	86	1978	5533.3	149	30380	13.4	5.5	96.3
TR-146	Flare	VOC		1978	5607	27.75	30380	13.4	1.01	96.4
TR-147	Flare	NMOC (as CH4)	86	885	1786.3	22	9770.4	23.0	3.1	85.8
TR-148	Flare	NMOC (as C6H8)	86	2467	261	9	24560	0.54	0.2	97.9
TR-148	Flare	VOC		2467		8.65	24560		0.18	97.9
TR-153	Flare	NMOC (as C)	12	2090	4357	17.4	30630	<1.2	<0.072	99.6
TR-156	Flare	NMOC (as C)	12	780	3253	4.9	12750	1.18	0.059	98.8
TR-157	Flare	NMOC (as C)	12	2460	3423	15.78	29920	<1.0	<0.06	99.6
TR-160	Flare	NMOC			2529	64.7		<2.19	<0.056	99.9
TR-165	Flare	NMOC (as CH4)		1388	4190	14.7	17233	7.98	0.33	97.8
TR-167	Flare	NMOC (as CH4)		5940	3990	60	43204	3.2	0.35	99.4
TR-168	Flare	NMOC (as C6H8)				27.2			0.28	99.0

APPENDIX F: ENGINE
Background Data for Control Efficiencies from 2008 AP-42 Update

Number of Data Points	**3**
Mean CE (%)	**97.2**
Minimum (%)	**94.6**
Maximum (%)	**99.7**
Standard Deviation (%)	**2.6**
95% Conf. Limit (%)	**2.9**

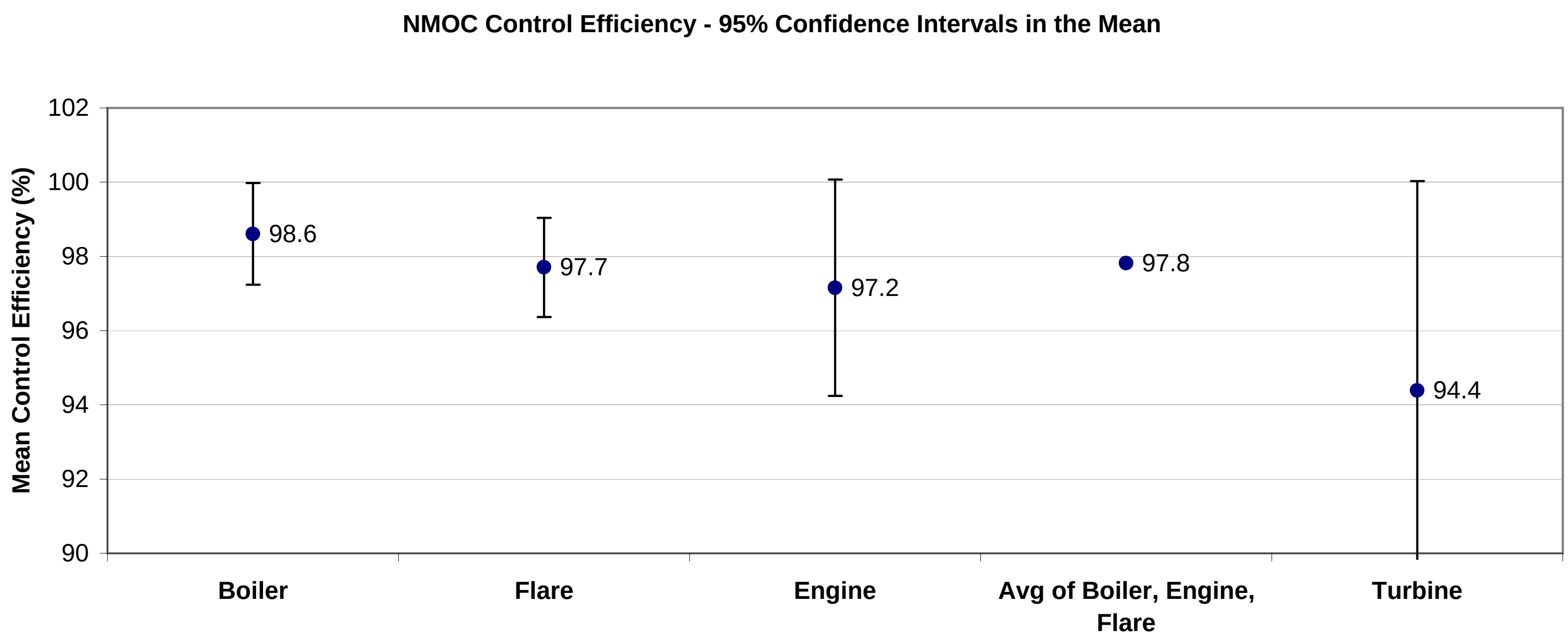
Only used old data points, since new data point below is a negative efficiency.

Test Report ID	Control	Compound	Total Inlet Flow (scfm)	Inlet Concentration (ppm)	Inlet Flow Rate (lb/hr)	Total Outlet Flow (scfm)	Outlet Concentration (ppm)	Outlet Flow Rate (lb/hr)	Control Efficiency
TR-266	Engine	NMOC (as hexane)	254.4	150.7	**0.51**	1344.7	38.1	**0.69**	-34%

APPENDIX F: COMBINED DATA
Background Data for Control Efficiencies from 1998 and 2008 AP-42 Update

Combined 1998 and 2008 AP-42 Data for Equipment NMOC Control Efficiency

	Number of Data Points	Min (%)	Max (%)	Mean (%)	Standard Deviation (%)	95% Confidence Limit (%)
Boiler	5	95.9	99.6	98.6	1.6	1.4
Flare	25	85.8	100.0	97.7	3.4	1.3
Engine	3	94.6	99.7	97.2	2.6	2.9
Avg of Boiler, Engine, Flare				**97.8**		
Turbine	2	91.5	97.3	94.4	4.1	5.6



Note: Error bars represent the 95% confidence interval in the mean.
Note: 95% confidence limit (mean) for turbines is 134.8%.
The mean CE % for boilers, engines, and flares all lie within the 95% confidence limits of each other.

Appendix G
Example LFG Combustion By-Product Emission Calculations

The following example calculations walk through the steps necessary to calculate emission rates in kg/million cubic meters CH_4 from the data given in emission tests (differences may occur from listed emission factors due to rounding).

Example 1: TR-266 – NOx for an engine.
Given: 2.42 lb NOx/hr in exhaust, LFG feed rate of 254.4 dry standard cubic feet/minute (dscfm), LFG methane content = 31.1%.

$$2.42\frac{lbNOx}{hr} \times \frac{kg}{2.2046lb} = 1.10\, {}^{kgNOx}\!/\!_{hr}$$

$$\frac{254.4dscfLFG}{\min} \times \frac{60\min}{hr} \times .311\frac{CH_4}{LFG} \times \frac{dscm}{35.315dscf} = 134.4\, dscmCH_4/hr$$

Next, convert from cubic feet and multiply out for a million cubic meters of methane:

$$1.10\frac{kgNOx}{hr} \div \frac{134.4dscmCH_4}{hr} \times 1.0E6 = 8{,}170\, {}^{kgNOx}\!/\!_{milliondscmCH_4}$$

Example 2: Calculate the above emission factor in alternate units such as lb/ megawatt-hr (lb/MWh) and grams per brake horsepower-hour (g/bhph):

First, express the emission factor in English units (lb/million dscf CH_4):
510 lb NOx/million dscf CH_4.

Next, the heat content of CH_4 and an engine heat rate are needed to calculate lb/MWh. For these calculations, a heat rate of 11,100 Btu/kWh is assumed, and the heat content of CH_4 is 1,012 Btu/scf.

$$\frac{510lbNOx}{1.0E6dscfCH_4} \div 1{,}012\, {}^{Btu}\!/\!_{dscf} \times 11{,}100\, {}^{Btu}\!/\!_{kWh} \times 1{,}000\, {}^{kWh}\!/\!_{MWh} = 5.6\, {}^{lbNOx}\!/\!_{MWh}$$

To calculate a g/bhph factor, you must account for a shaft-to-electricity efficiency. This analysis assumed 95%.

$$\left(5.6\, {}^{lbNOx}\!/\!_{MWh} \times 453.6\, {}^{g}\!/\!_{lb}\right) \div \left(1.0E6\, {}^{W}\!/\!_{MW} \times 1.341E-3\, {}^{bhp}\!/\!_{W}\right) \div 0.95 = 2.0\, {}^{gNOx}\!/\!_{bhph}$$