NEW BOSTON LANDFILL
BOWIE COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 576C

PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX F2
GROUNDWATER SAMPLING AND ANALYSIS PLAN

TYPE I

Prepared for

Waste Management of Texas, Inc.

July 2013

JOHN MICHAEL SNYDER
GEOLOGY
595

7-8-2013

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

STATE OF TEXAS
JOHN MICHAEL SNYDER
GEOLOGY
595
LICENSED
PROFESSIONAL GEOSCIENTIST
7-8-2013

CONTENTS

LIST OF TABLES AND FIGURES

TABLES

FIGURES

LIST OF ACRONYMS

ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
COC	Constituents of Concern
DQR	Data Quality Reviews
FR	Federal Regulations
GCMS	gas chromatography/mass spectrometry
GWPS	groundwater protection standard
GWSAP	Groundwater Sampling and Analysis Plan
IH	Interstate Highway
LQM	Laboratory Quality Manual
MCL	maximum containment level
MDL	method detection limits
MS	matrix spike
MSD	matrix spike duplicate
MSW	Municipal Solid Waste
MSWLF	Municipal Solid Waste Landfill Unit
ND	non-detects
PQL	Practical Quantitation Limits
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RSD	relative standard deviation
SH	State Highway
SSI	statistically significant increase
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds
WMTX	Waste Management of Texas, Inc.

1 INTRODUCTION

This Groundwater Sampling and Analysis Plan (GWSAP) presents the details of the groundwater monitoring program for the Type I West Disposal Area and North Disposal Area of the New Boston Landfill Municipal Solid Waste (MSW) landfill currently operated by Waste Management of Texas, Inc. (WMTX) under the Texas Commission on Environmental Quality (TCEQ) Permit No. MSW 576B. The facility is located near the intersection of Interstate Highway 30 (IH-30) and State Highway 82 (SH-82) in New Boston, Bowie County, Texas.

The program incorporates permanent monitoring elements to provide environmental protection during and after landfill development. When approved, this GWSAP will replace the current facility GWSAP approved by the TCEQ in a letter dated March 17, 2009.

This GWSAP describes the background and detection monitoring frequencies, monitoring parameters, a sampling and analysis plan, and an appropriate site-specific statistical methodology. All elements of this program are in compliance with 40 Code of Federal Regulations (CFR) Part 258 (Subtitle D) and Title 30 of the Texas Administrative Code (TAC) Chapter 330. This GWSAP will serve as a guidance document for personnel performing site monitoring during the active life of the facility and during closure and post-closure periods.

The groundwater monitoring system at the facility is described in Attachment F – Groundwater Characterization Report. Figures in Appendix F1 include the locations of existing and proposed monitoring wells and monitoring well construction details for the existing and proposed wells. A separate GWSAP is provided for the groundwater monitoring program related to the Type IV South Disposal Area at the facility in Attachment F, Appendix F3.

2 GROUNDWATER MONITORING

Proper sampling procedures are the most important and fundamental aspect in an effective monitoring program. All environmental quality sampling at the site will be accomplished by personnel trained in proper sampling protocol.

This section summarizes specific tasks involved in sampling of the groundwater monitoring system and presents the proposed groundwater monitoring parameters and sampling schedule for the New Boston Landfill. The discussion includes the WMTX technical approach to selecting effective monitoring parameters, which is based on the State of Texas Solid Waste Management regulations (30 TAC §330). Selection of effective monitoring parameters will also be based on an ongoing comparison of chemistry data obtained for collected groundwater samples.

2.1 Well Inspection

Prior to performing any purging or sampling each monitoring well will be inspected to assess its integrity. The condition of each well will be evaluated for any physical damage that may have been caused by the operation of site equipment or other vehicular traffic. The security of each well will be assessed in order to confirm that no outside source constituents have been introduced to the well. All inspection information, as well as the date and time, general weather conditions, and sampling personnel identification, will be documented on the Field Information form. If it has been determined that the integrity of the well has, or may have been, compromised the necessary information will be documented and the executive director notified. No additional actions will be taken without the approval of the TCEQ.

2.2 Sample Collection

Each monitoring well in the groundwater monitoring system may have a dedicated sampling device (i.e., a Well Wizard™ bladder pump or equivalent or a Teflon or stainless-steel bailer). If a non-dedicated sampling device is used it will be properly decontaminated prior to its use. Sampling flow rates for the dedicated sampling device will not exceed the EPA recommended rate of 0.1 liter per minute for organic constituents. If purge rates exceed the sampling flow rate, the lines must be cleared at a flow rate of 0.1 liter per minute prior to sampling. For inorganic constituents, a higher flow rate may be used.

In the event that a non-dedicated sampling device (i.e., bailer) is required, the bailer will be lowered gently into, and through, the water column in order to minimize turbulence that may affect sample results. In all situations, volatile samples will be collected first, followed by metals and finally, other inorganics.

2.2.1 Water Level Measurements

Prior to groundwater purging and sampling, water level measurements will be taken at each well location utilizing a portable water level indicator, fiberglass tape, or other suitable measuring device. Water level measurements will be collected over a period of time short enough to avoid temporal variations in water levels. Water levels will be measured from a clearly marked location at the top of the riser pipe or dedicated sampling device cap. Water levels will be recorded to the nearest hundredth of a foot. Water level measuring devices will be properly decontaminated between each well.

2.2.2 Purging / Bailing

Prior to sampling at each location, water will be evacuated in accordance with this section, or until the well has been pumped or bailed dry, or field parameters (pH, specific conductance, and temperature) have stabilized. All purge data collected will be submitted to WMTX with the sample results.

Field parameter measuring equipment will be properly calibrated daily during each sampling event. All information collected during purging and sampling will be recorded on the Field Information form. Purge water will be managed appropriately for disposal.

The goal of low-flow purging and sampling is to better ensure the collection of representative groundwater samples from the uppermost aquifer. The methods used should minimize both exposure to the atmosphere (which may affect dissolved oxygen, temperature, pH, and/or result in the volatilization of organic compounds) and the variability in sampling procedures. Data must be submitted which clearly demonstrates that low-flow purging is appropriate for the monitoring wells using this methodology. WMTX requests that the following procedures, which are generally in accordance with guidance contained in the April 1996 EPA Ground Water Issue Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (EPA/540/S-95/504), be implemented at the New Boston Landfill:

i. Low-flow purging is to be limited to monitoring wells that, with sustained pumping, exhibit nominal drawdown. Water levels are measured and recorded before pumping. Purging is initiated and the flow adjusted to a rate that results in minimal (< 0.1 m) well drawdown, excluding the effects of pump cycling. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site specific conditions and personal experience. Water levels and flow rates are recorded every three to five minutes during purging and upon completion of sampling. The optimum pumping rate for each well should be determined from this information and recorded for future reference.

ii. The pump intake is properly located near the middle of the screened interval to avoid mixing formation water with sediments in the well bottom or the overlying stagnant water within the well casing. All pump apparatus, including tubing, should be permanently installed. If non-dedicated equipment is to be used, it must be decontaminated appropriately and installed at least 24 hours before sample collection to minimize disturbance of the water column and suspended solids in the well.

iii. Purge rates for low-flow sampling are typically 0.1 - 0.5 L/min. A higher purge rate may be acceptable, but this is based on the site hydrology and must be determined at each well location. If purge rates greater than 0.25 L/min are used, pump lines are to be cleared using a flow rate less than 0.25 L/min prior to sample collection for analysis of volatile organic compounds (VOCs).

iv. The minimum purge volume should be the equivalent of at least twice the combined volumes of the fluid filled portion of the sample pump and tubing.

v. An in-line flow-through-cell is to be used for field-parameter measurements of temperature, specific conductance, and pH. Turbidity measured in nephelometric turbidity units (NTUs), using a turbidimeter, is to be included as a stabilization parameter. Dissolved oxygen (DO) or redox potential (Eh) may be proposed as alternatives, if demonstrated to be effective parameters for determining stabilization. The well is to be purged until water quality parameters (temperature, specific conductance, turbidity, pH, or alternates) have stabilized for three consecutive measurements taken at three to five minute intervals. Stabilization is ±3% for temperature and conductivity, ±10% for turbidity and DO, and ± 0.2 units for pH.

vi. The pumping rate for sampling should be the same or less than the purging rate, and sufficiently low to minimize sample aeration. When collecting samples for VOC analysis, pumps should be operated at rates less than 0.25 L/min and the discharge from the pump should produce a thin, continuous stream of water when filling the sample vial. If cyclic-discharge pumps are used, vials should be completely filled from a single discharge cycle.

vii. Documentation of all purge data, including volumes (both of water purged and water sampled), elapsed times, pump-flow rates, water levels, and geochemical parameter measurements must be submitted with sampling results.

If groundwater flow is slow, minor drawdown may occur during micro-purging. However, using dedicated pumps greatly reduces potential sampling variability. Micro-purging is anticipated to provide results with less variability and, therefore, is the more preferred method than bailing or non-dedicated pumps.

2.2.3 Equipment Decontamination

All equipment used for purging and the collection of groundwater samples will be decontaminated prior to use at each well location unless the equipment is dedicated to a specific well. An appropriate decontamination procedure will be sufficient to avoid (and prevent) the introduction of any contaminant into a well and to not allow any contaminant to be transported between wells that will create false sample results or otherwise harm the environment.

2.3 Sample Preservation and Filtering

Samples collected for background, detection, or assessment monitoring (i.e., the constituents listed in Table F2-1) shall not be filtered prior to laboratory analysis. If field filtered samples are to be collected it is recommended that an in-line flow system be used. When using an in-line flow system a minimum of three pump cycles of water must be allowed to pass through the filter before obtaining a sample. All field filtering equipment must be properly decontaminated prior to use at each well. All samples requiring filtration must be filtered through a 0.45 micron membrane pressure filter. The material used must be noted on the Field Chain of Custody Record and Field Information form.

The appropriate sample container and preservative for each analyte will be provided by the laboratory. Pre-labeled containers may be supplied by the laboratory or the sampling personnel for each sampling event.

2.4 Sample Shipment

After collection and sample preservation, the sample bottles will be wiped clean, checked for proper labeling and placed into an insulated, plastic-shelled cooler or other suitable shipping container with frozen ice packs or ice. The samples will be maintained at about 4 degrees C. The temperature of the samples will be recorded when the shipping container arrives at the analytical laboratory to assure that the appropriate sample temperature was maintained during shipment. All samples included in the cooler will be packed in such a manner to minimize the potential for container breakage. VOA vials and TOX bottles (if any) will never be placed directly on the ice packs. A Field Information form and Chain of Custody form will be sealed in a water resistant bag and placed with the appropriate sample bottle set. The coolers will then be properly sealed with a tamper proof custody seal and sent to the designated analytical laboratory. All shipments will be scheduled for next day delivery. The bill of lading or receipt for the shipping container will be attached to the Chain of Custody form upon arrival at the analytical laboratory.

2.4.1 Chain of Custody

Appropriate chain of custody procedures for samples will be implemented to ensure sample integrity, and to provide technically and legally defensible groundwater quality data. At the time each sample is collected, Chain of Custody and Field Information forms will be completed and placed in the shipping container. The Field Information form will include general sampling event information including location, time, weather conditions, sampler identification, well integrity, any numerical field data values and well purging procedures. The cooler will then be sealed with a tamper proof custody seal provided with the shipping container. Upon arrival of the shipping container at the laboratory, the cooler will be opened and the chain of custody forms will be signed and time/dated by the person taking custody of the samples. If the cooler is shipped, this person will affix the bill of lading or receipt to the Chain of Custody form.

2.5 Constituents of Concern

WMTX's approach to selecting effective monitoring parameters is to first evaluate those constituents that are reasonably expected to be present in landfill leachate. These parameters are defined hereinafter as Constituents of Concern (COC). The specific approach to selecting sample analytes is discussed in detail in Section 2.6.1, Approach to Selecting Sample Analytes.

COCs are defined as waste constituents, reaction or degradation products, and hazardous constituents that are reasonably expected to be in, or derived from, waste contained in a waste management unit. Chemical parameters referenced in 40 CFR Part 258, Appendix I, plus specific leachate indicator parameters as defined later in this section comprise the COC list. The routine sample analyte list is a subset of the COC list based on published and site-specific groundwater and leachate characterization.

2.6 Groundwater Sample Analytes

This section describes the approach to selecting effective routine detection monitoring parameters, and presents the parameter list for the New Boston Landfill facility. An integral part of this process and one of the keys to the overall detection monitoring program is the accurate determination of background (i.e., natural groundwater unaffected by the MSWLF) groundwater parameter concentrations.

2.6.1 Approach to Selecting Sample Analytes

Specific laboratory analyses to be performed under the detection monitoring program will be selected based on the State of Texas regulatory requirements and on constituent physical and chemical properties (e.g., persistence, detectability, mobility) that make them generally good indicators of contaminant migration. VOCs (as a class) are detected more frequently than any other class of organic compounds in solid waste landfill leachate. However, other detection monitoring constituents listed in 40 CFR Part 258, Appendix I are not often found in landfill leachate. Additional research by Dr. Robert Gibbons, professor at the University of Illinois, Chicago, and others indicate that, in addition to VOCs, certain leachate indicators (e.g., total dissolved solids, chloride, and alkalinity) and metals (e.g., calcium, magnesium, and potassium) not found in the aforementioned regulation have greater detection frequencies in leachate than other constituents in their compound class. An examination of the WMTX landfill leachate database (for various landfill facilities) supports these conclusions. Selection of parameters to be analyzed as part of the detection monitoring program will be based on several performance factors, including persistence, detectability, mobility, and contrast to natural groundwater concentrations of each parameter.

As leachate data is accumulated as a result of annual or other leachate sampling events, the detection monitoring parameter list will continue to be re-evaluated and updated, if appropriate. If additional parameters are added or removed from the routine detection monitoring list, background concentrations will be determined and they will be added to the program upon TCEQ approval. Conversely, if parameters proposed for routine detection monitoring are not found in the site leachate during repeated sampling events, these parameters may be deleted from the monitoring program following the TCEQ approval.

2.6.2 Background Sampling Objectives

The purpose of obtaining adequate background groundwater data is to approximate the true range of ambient concentrations of targeted compounds in the groundwater system being monitored. In other words, background groundwater data should eliminate, to the extent possible, all potential causes of statistically significant increases in groundwater chemistry not attributable to the monitored facility. True background data is obtained by monitoring a sufficient number of wells upgradient of the facility (for inter-well comparisons), or wells downgradient of the facility not previously impacted by the waste management unit (for intra-well comparisons).

Three major components must be met to successfully achieve the goals of obtaining adequate background samples:

1) Collecting the minimum number of samples that satisfy the requirements of the statistical methods that are used (i.e., that result in adequate statistical power);

2) Incorporating seasonality or temporal variability into the background data set; and

3) Incorporating the spatial component of variability into the background data set (i.e., the variability that comes with obtaining samples from different locations within the same groundwater zone).

The parameters that will be analyzed to establish the background groundwater database are presented in Table F2-1. These parameters are designed to provide an accurate characterization of the uppermost hydrogeologic unit and to establish the initial baseline concentrations for implementation of site-specific statistical evaluation.

2.6.3 Detection Monitoring Parameters

The initial detection monitoring parameter list for the facility will be the constituents listed in Table F2-1. No statistics are ever applied to the field measurements. However, once adequate leachate data are collected and evaluated pursuant to Section 2.6.1, Approach to Selecting Sample Analytes, the list of detection monitoring parameters may be amended, if appropriate. Leachate data will be collected pursuant to Section 3, Data Evaluation. Detection monitoring parameters will be added or deleted from the Table F2-1 list (with the TCEQ's approval), based on comparison of constituent levels in groundwater to levels reported for site leachate samples. To ensure that the contrast between leachate and groundwater chemical concentrations is sufficient to effectively identify a release from the waste management unit, constituent levels in leachate samples must be at least five times those of groundwater. Parameters may also be added or deleted from the Table F2-1 list (with TCEQ approval), based on concentration contrast with surrounding groundwater chemistry, mobility, persistence, and detectability.

2.6.4 Water Quality Parameters

The water quality parameters listed in Table F2-2 may be sampled and analyzed at the discretion of the facility operator as additional indicators of water quality. However, the analytical results for these parameters will not be subject to statistical evaluation.

Table F2-1 Groundwater Monitoring Parameters, New Boston Landfill[1]

	Common Name[2]	CAS RN[3]
Trace Metal Constituents (Analytical Method)		
(1)	Antimony (6020)[4]	Total
(2)	Arsenic (6010)[4]	Total
(3)	Barium (6010)[4]	Total
(4)	Beryllium (6010B)[4]	Total
(5)	Cadmium (6010)[4]	Total
(6)	Chromium (6010)[4]	Total
(7)	Cobalt	Total
(8)	Copper	Total
(9)	Lead (6010)[4]	Total
(10)	Nickel	Total
(11)	Selenium (6020)[4]	Total
(12)	Silver (6010B)[4]	Total
(13)	Thallium (6020)[4]	Total
(14)	Vanadium (6010B)[4]	Total
(15)	Zinc (6010B)[4]	Total
Organic Constituents: (8260)[4]		
(16)	Acetone	67-64-1
(17)	Acrylonitrile	107-13-1
(18)	Benzene	71-43-2
(19)	Bromochloromethane	74-97-5
(20)	Bromodichloromethane	75-27-4
(21)	Bromoform; Tribromomethane	75-25-2
(22)	Carbon disulfide	75-15-0
(23)	Carbon tetrachloride	56-23-5
(24)	Chlorobenzene	108-90-7
(25)	Chloroethane; Ethyl chloride	75-00-3
(26)	Chloroform; Trichloromethane	67-66-3
(27)	Dibromochloromethane; Chlorodibromomethane	124-48-1
(28)	1,2-Dibromo-3-chloropropane; DBCP	96-12-8
(29)	1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4
(30)	o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
(31)	p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
(32)	trans-1,4-Dichloro-2-butene	110-57-6
(33)	1,1-Dichloroethane; Ethylidene chloride	75-34-3
(34)	1,2-Dichloroethane; Ethylene dichloride	107-06-2
(35)	1,1-Dichloroethylene;1,1-Dichloroethene; Vinylidene chloride	75-35-4
(36)	cis-1,2-Dichloroethylene; cis-1,2- Dichloroethene	156-59-2
(37)	trans-1,2-Dichloroethylene;trans-1, 2- Dichloroethene	156-60-5
(38)	1,2-Dichloropropane; Propylene dichloride	78-87-5
(39)	cis-1,3-Dichloropropene	10061-01-5
(40)	trans-1,3-Dichloropropene	10061-02-6
(41)	Ethylbenzene	100-41-4
(42)	2-Hexanone; Methyl butyl ketone	591-78-6
(43)	Methyl bromide; Bromomethane	74-83-9
(44)	Methyl chloride; Chloromethane	74-87-3
(45)	Methylene bromide; Dibromomethane	74-95-3

	Common Name[2]	CAS RN[3]
(46)	Methylene chloride; Dichloromethane	75-09-2
(47)	Methyl ethyl ketone; MEK; 2-Butanone	78-93-3
(48)	Methyl iodide; Iodomethane	74-88-4
(49)	4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1
(50)	Styrene	100-42-5
(51)	1,1,1,2-Tetrachloroethane	630-20-6
(52)	1,1,2,2-Tetrachloroethane	79-34-5
(53)	Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4
(54)	Toluene	108-88-3
(55)	1,1,1-Trichloroethane; Methylchloroform	71-55-6
(56)	1,1,2-Trichlolroethane	79-00-5
(57)	Trichloroethylene; Trichloroethene	79-01-6
(58)	Trichlorofluoromethane; CFC-11	75-69-4
(59)	1,2,3-Trichloropropane	96-18-4
(60)	Vinyl acetate	108-05-4
(61)	Vinyl chloride	75-01-4
(62)	Xylenes	1330-20-7

Notes:

1 This list contains 47 volatile organics for which possible analytical procedures provided in EPA Report SW-846 "*Test Methods for Evaluating Solid Waste*," third edition, November 1986 (as revised), includes Method 8260; and 10 inorganics for which SW-846 provides either Method 6010 or a method from the 7000 series of methods and five other inorganic parameters for which the testing method is indicated.

2 Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

3 Chemical Abstracts Service registry number. Where "Total" is entered, all species in the groundwater that contain this element are included.

4 Analytical methods listed above may be substituted as necessary provided that the alternate methods provide adequate analytical data to fulfill monitoring requirements and meet regulatory performance standards.

Table F2-2 Water Quality Parameters[1] List, New Boston Landfill

Common Name[2]		CAS RN[3]
Inorganic Constituents (Analytical Method)[4]:		
(1)	Ammonia (6010B)	
(2)	Alkalinity (6010B)	
(3)	Chloride (6010B)	
(4)	Magnesium (6010B)	(Dissolved)
(5)	Sodium (6010B)	(Dissolved)
(6)	Iron (6010B)	(Dissolved)
(7)	Calcium (6010B)	(Dissolved)
(8)	Total Dissolved Solids (6010B)	
(9)	Sulfate (6010B)	

Notes:

1 The analytical results for water quality parameters are not subject to statistical analysis.

2 Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

3 Chemical Abstracts Service registry number. Where "Total" is entered, all species in the groundwater that contain this element are included.

4 Analytical methods listed above may be substituted as necessary provided that the alternate methods provide adequate analytical data to fulfill monitoring requirements and meet regulatory performance standards.

2.7 Groundwater Sampling Schedule

The approved groundwater monitoring system is designed pursuant to State of Texas regulations and 40 CFR 258 (Subtitle D) in order to ensure the earliest possible detection of a release from the facility. The following groundwater monitoring schedule is proposed for the New Boston Landfill.

2.7.1 Background Sampling Frequency

The schedule for background monitoring at the site is dictated by the statistical methodology proposed and by performance criteria for the statistical methodology detailed in 40 CFR 258 (Subtitle D - see Section 3, Data Evaluation). The New Boston Landfill is implementing an intra-well monitoring program.

An intra-well monitoring program does not require background monitoring at upgradient wells because water chemistry of a well is compared to itself over time. However, upgradient well(s) are useful for detecting any potential offsite influences on the monitoring network. Intra-well monitoring is generally preferable to inter-well monitoring because it eliminates the spatial component of natural groundwater chemistry variability. This spatial component comprises a significant portion of the total variability that must be accounted for by the statistical methodology. Each well requires a minimum of eight samples to increase the sensitivity of the statistical method(s) being used, and to account for seasonality or other causes of temporal variability. For new and replacement monitor wells, representative background groundwater quality, not affected by leakage from a MSWLF unit, will be collected on an approximately quarterly basis within the first two years following well installation.

2.7.2 Detection Monitoring Frequency

In accordance with 30 TAC §330.407(a), detection monitoring will be conducted semi-annually at detection monitor well locations at the facility. The monitoring parameters for the site are listed in Section 2.6, Groundwater Sample Analytes (Table F2-1). Each sampling event will include the collection and analysis of one sample at each of the monitor wells included in the detection program. The monitoring requirement continues throughout the active life of the landfill and the post-closure care period.

3 DATA EVALUATION

The following subsections describe the criteria by which data will be evaluated at the New Boston Landfill. These criteria represent a conservative approach to groundwater analysis and incorporate state-of-the-art statistical and other evaluation methodologies.

3.1 Groundwater

This section outlines the evaluation methodology that will be used for detection of a release from the facility using reporting limits (practical quantitation limits that meet state specified limits of precision and accuracy as defined below) as the concentration limits for VOCs, and the Shewart cumulative sum (Shewart-CUSUM) for inorganic parameters.

During background sample collection, it will be necessary to examine the data for outliers, anomalies, and trends that might be an indication of a release. The inclusion of such values in the historical database used for statistical evaluation could cause mis-interpretation of the data set.

Evidence of a release from the facility will be evaluated during background development for those wells that have at least four measurements for a given constituent using time versus concentration graphs. Parameter concentrations that appear anomalous (i.e., that are five times or greater than the previous results) will be verified during the next sampling collection event or after a reasonable period of time to ensure sample independence (e.g., three months). Any detected systematic trends or verified outliers in the background database will be evaluated and reported to the TCEQ in a timely manner.

The practical quantitation limit (PQL) is defined as the lowest concentration reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions and is considered equivalent to the limit of quantitation (LOQ) described in the most recent National Environmental Laboratory Accreditation Conference (NELAC) Standard (www.nemc.us/epa12/2003standards.html). The PQL is method, instrument, and analyte specific and may be updated as more data becomes available. To help ensure these practices will be observed the following information is provided:

- The PQL will be below the groundwater protection standard established for each analyte in accordance with 30 TAC §330.409(h) unless approved otherwise by the executive director.

- Precision and accuracy targets shown in the table below represent TCEQ guidance as of the date of this document. Should TCEQ guidance change, the targets will be adjusted accordingly. The PQL will be determined as the concentration that corresponds to the following precision and accuracy criteria:

Constituent/Chemical of Concern	Precision (% RSD)	Accuracy (% Recovery)
Metals	10	70-130
Volatiles	20	50-150
Semi-Volatiles	30	50-150

- The precision and accuracy of the PQL initially will be determined from the PQLs reported over the course of a minimum of eight groundwater monitoring events. The results obtained from these events will be used to demonstrate that the PQLs meet the specified precision and accuracy limits. The PQL may be updated as more data becomes available.

- The PQL will be supported by analysis of a PQL check sample, consisting of a laboratory reagent grade sample matrix spiked with constituents/chemicals of concern at concentrations equal to or less than the PQL. At a minimum, a PQL check sample will be performed quarterly during the calendar year to demonstrate that the PQL continues to meet the specified limits for precision and accuracy.

- Analytical results for data below the limit of detection ("non-detect" results) must be reported as less than the established PQL that meets the specified precision and accuracy requirements.

- If a PQL cannot be established according to the specified precision and accuracy limits, the owner or operator will ensure that the laboratory provides sufficient documentation to justify the alternate precision and accuracy limits. This information will be reported to the executive director by the owner or operator and will be evaluated on a case-by-case basis.

3.1.1 Historical Data Analysis

To remove the possibility of historical outliers and trends creating false statistical limits, the data for each well and each constituent will be tested for the existence of outliers. Outliers will be removed from consideration during the establishment of all statistical limits. The statistical outlier and trend detection procedure will be performed for those wells that have had at least five measurements for a given constituent. Once the background database is established, the outlier procedure described by Dr. Gibbons (1994) will be applied and appropriate statistical limits set in accordance with Section 3.1.2, Statistical Methodology.

3.1.2 Statistical Methodology

The statistical approach presented in this GWSAP is not generic, but was developed through the interaction of a qualified statistician (Dr. Gibbons) and the WMTX Director of Groundwater Protection. The use of intra-well statistical comparisons for evaluation of groundwater chemistry data is supported by the USEPA and is in widespread use.

3.1.2.1 Volatile Organic Compounds

It is generally accepted that when a landfill facility actually produces a release to groundwater, multiple constituents contained in the leachate are associated with the source fluids and are subsequently detected by the groundwater monitoring program. A single constituent at very low concentration typically is not the signature that is produced from an actual release.

VOCs represent very effective indicators of a release from a solid waste unit. Because these compounds are rarely detected in background groundwater samples, establishing monitor well-specific limits for VOCs is generally not an option. Therefore, detection decision rules based on laboratory-specific PQLs will be used. Although this simple comparison to a fixed limit is not statistically based, the PQLs used by the lab represent a concentration limit consistent with EPA guidance that considers specified precision and accuracy during routine operating conditions and potential matrix interferences.

3.1.2.2 Inorganic Parameters

The statistical analysis methodology for inorganic parameters, listed in 40 CFR Part 258, Appendix I, will be based on a combined Shewart-CUSUM control chart that is capable of detecting both sudden and gradual changes in groundwater chemistry. Combined Shewart-CUSUM control charts will be constructed for each well and parameter monitored to provide a statistical/visual tool for detecting trends and abrupt changes in inorganic groundwater chemistry.

The combined Shewart-CUSUM procedure assumes that the data are independent and normally distributed. The most important assumption is independence (Gibbons, 1994). The assumption of normality is somewhat less of a concern because the data can usually be adequately transformed for most applications. Non-detects (NDs) can be replaced by one-half of the MDL without serious consequence, although this procedure should only be applied to constituents that are detected in at least 25 percent of all samples.

The combined Shewart-CUSUM procedure requires a minimum of eight historical independent samples (i.e., background data) to provide a reliable estimate of the mean and standard deviation of each constituent in each well. Once background data are obtained from each detection monitor well, subsequent sample results are statistically compared to the estimated control limit both in terms of their absolute magnitude and cumulative sum.

3.1.3 Statistical Analysis

The statistical analysis program used for inorganic parameters (i.e., DUMPStat®, Downgradient Upgradient Monitoring Program Statistics) will be based on combined Shewart-CUSUM control charts at all compliance point wells and background wells. Future intra-well measurements that are within control will, upon approval from the TCEQ, be integrated into the background data set (not more often than once every two years) and statistical limits will be updated. Before the background data set is updated, the analytical results will be evaluated to ensure the data are representative of background groundwater constituent concentrations unaffected by waste management activities or other sources of contamination and a report of this evaluation will be prepared and submitted to the executive director before the next subsequent groundwater monitoring event following the updated (or initial) background period.

For those constituents that are detected less than 25 percent of the time during background monitoring, each constituent will be evaluated for statistically significant increases (SSIs) after eight background events using nonparametric tests, with a "pass 1 of 2" verification resampling scheme.

3.1.4 Detection Verification Procedure

Once groundwater analysis results have been collected the results must be verified in accordance with the objectives of 40 CFR 258.53. Verification resampling is an integral part of the statistical methodology described by USEPA's Addendum to Interim Final Guidance Document - Statistical Analysis of Groundwater Monitoring Data at Resource Conservation and Recovery Act (RCRA) Facilities (July 1992). Without verification resampling, much larger statistical limits would be required to achieve site-wide false positive rates of five percent or less.

The following procedure will be performed for each compound determined to be initially above its statistical limit. Only compounds that initially exceed their statistical limit will be sampled for verification purposes.

In accordance with 30 TAC §330.407(b)(2), resampling will be completed and the results submitted to the executive director within 60 days of the determination of an initial exceedance.

3.1.4.1 Volatile Organic Compounds

If one or more VOC is detected above its statistical limit (i.e., PQL), up to two independent verification resamples will be conducted before the next semi-annual event. WM will employ a “pass 1 of 2” verification scheme where a statistical exceedance will be reported and assessment monitoring initiated if any single VOC is measured above the PQL in both verification resamples.

3.1.4.2 Inorganic Constituents

If one or more of the heavy metals listed in Table F2-1 are detected above their statistical limit (i.e., Shewart-CUSUM control chart computation value), up to two verification resamples will be collected to confirm the exceedance above the statistical limit before the next semi-annual event. WM will employ a “pass 1 of 2” verification scheme where a statistical exceedance will be reported and assessment monitoring initiated if verification of an elevated parameter is confirmed by both of the verification resamples.

Inorganic indicator parameters (not heavy metals) listed in Table F2-2 will not be subject to statistical analysis.

3.1.5 Assessment Monitoring

Assessment monitoring will be conducted if, during detection monitoring, a statistically significant increase (SSI) over background is detected and verified for the constituents identified in Section 2.6.3, Detection Monitoring Parameters in accordance with TCEQ regulations. Upon commencement of assessment monitoring, a groundwater sample will be collected from the well (or wells) for which the verified SSI was reported and at the wells immediately adjacent on each side of the well(s) exhibiting the SSI, unless an alternative subset of wells allowed by 30 TAC §330.409(b) is approved by the TCEQ. This sampling (assessment monitoring) will occur within a period of 90 days from the date of notice to the TCEQ of the SSI identified during detection monitoring. Samples collected for assessment monitoring will be analyzed for the assessment constituents listed in Appendix II to 40 CFR 258 and for the detection monitoring constituents identified in Table F2-1. For assessment monitoring an abbreviated list of assessment constituents may be approved by the executive director in accordance with 30 TAC §330.409(b).

If the concentrations of all assessment constituents are at or below the established statistical limit for two consecutive assessment monitoring events, normal detection monitoring can be resumed in subsequent events, if approved by the executive director.

4 LABORATORY ANALYSIS PLAN

This section describes the procedures for completing successful laboratory analyses of the samples that are collected from the site.

4.1 Program Quality Assurance/Quality Control Procedures

Trip blanks, equipment blanks, and field blanks provide QA/QC measures for the monitoring program.

4.1.1 Trip Blanks

Trip blanks are an integral part of the field sampling QA/QC program if VOCs are collected. They are used to detect contamination that may be introduced in the field (either atmospheric or from sampling equipment), in transit (to or from the sampling site), or in the bottle preparation, sample log-in, or sample storage stages at the laboratory. Laboratory method blanks are used during the analytical process to detect any laboratory introduced contamination that may occur during analysis.

Trip blanks are samples of organic-free water (e.g., deionized) prepared at the laboratory. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. Trip blank sample bottles must not be opened at any time during this process. Upon return to the laboratory, trip blanks will be analyzed for VOCs using the same procedures and methods that are used for the collected field samples.

Trip blank results will be reported in the laboratory results as separate samples, using the designations TB-(well number) as their sample point designation.

4.2 Field Blanks

Field blanks are an integral part of the field sampling QA/QC program. The purpose of the field blank is to detect any contamination which might be introduced into the groundwater samples through the air.

Field blanks must be prepared in the field (at the sampling site) using laboratory-supplied bottles and deionized or laboratory reagent-quality water. Each field blank is prepared by pouring the deionized water into the sample bottles at the location of one of the wells in the sampling program. The well at which the field blank is prepared must be identified on the Field Information form, along with any observations that may help explain anomalous results (e.g., prevailing wind direction, up-wind potential sources of contamination, etc.). Once a field blank is collected, it is handled and shipped in the same manner as the rest of the samples.

For dedicated or disposable equipment requiring no filtration, or in-line filtration, the deionized or laboratory reagent-quality water is exposed to the air, transferred to the field blank bottles, and the proper preservative added as required. If the required filtration is not done in-line, the deionized or laboratory reagent-quality water is exposed to the air, poured into pre-filtration bottles, filtered (as required), and placed in the field blank bottles, and the proper preservative is added as required.

Field blank results will be reported in the laboratory results as separate samples, using the designations FB-(well number) as their sample point designation.

4.2.1 Equipment Blanks

Prior to introducing non-dedicated purging and/or sampling equipment into the monitor well, an equipment blank will be collected. Equipment blanks are prepared by pouring deionized or laboratory reagent-quality water into or through the sampling device (e.g., the bailer) and collecting the water in a sample bottle. If the analytes for the equipment blank would normally be filtered, this water should be placed into a pre-filtration bottle and subsequently filtered. Whether or not it is filtered, this water is placed into the equipment blank bottles, and the proper preservative added (as required). Disposable (single use) sampling devices are considered dedicated and no equipment blank need be collected.

Equipment blank results will be reported in the laboratory results as separate samples, using the designations EB-(well number) as their sample point designation.

4.3 Quality Assurance/Quality Control

New Boston Landfill has historically utilized a NELAC (National Environmental Laboratory Accreditation Council) certified laboratory for analysis of groundwater samples and will continue to use a NELAC certified laboratory for future groundwater analyses. Laboratory data analyses with a laboratory case narrative, or with a Laboratory Review Checklist, will be performed and submitted for each sampling event. NELAC standards require that laboratories have an established quality system that includes a comprehensive laboratory quality manual (LQM) and an authorized quality assurance officer. A copy of the LQM will be maintained in the New Boston Landfill site operating records (SOR) for use in data evaluation.

The laboratory calibrates equipment and instrumentation according to the laboratory's LQM and referenced methodologies. Quality control including matrix spikes, matrix spike duplicates or sample duplicates, laboratory control samples, method blanks, and surrogates are analyzed along with field groundwater samples and field QC samples also in accord with the LQM and method requirements. The laboratory evaluates and reports this information in a report with laboratory case narrative (LCN), with qualifiers and narrative detail where appropriate such that New Boston Landfill may ensure that all sample collection, preparation and analyses, and data management activities have been conducted. The laboratory report (including the LCN) will report the number of samples, sampling parameters, and sample matrix, the name of the laboratory (including subcontract labs) involved in the analysis, an explanation of each failed precision and accuracy measurement determined to be outside the laboratory and/or method control limits and whether such a quality control excursion represents a positive or negative bias and the limitations these excursions have on data quality. Additionally, exceedance of sample holding times and identification of matrix interferences shall be identified in the LCN. Any dilutions implemented due to sample matrix interference will be done to the smallest dilution possible to bring the sample into control for analysis.

In addition to the exceptions listed above, the LCN report for all problems and anomalies observed will be included in the laboratory report for each sampling event. The LCN will report, at a minimum, the following information:

1. The exact number of samples, testing parameters, and sample matrix.
2. The name of the laboratory involved in the analysis. If more than one laboratory is used, all laboratories shall be identified in the case narrative.
3. The test objective regarding samples.
4. Explanation of each failed precision and accuracy measurement determined to be outside of the laboratory and/or method control limits.
5. Explanation if the effect of the failed precision and accuracy measurements on the results induces a positive or negative bias.
6. Identification and explanation of problems associated with the sample results, along with the limitations these problems have on data usability.
7. A statement on the estimated uncertainty of analytical results of the samples when appropriate and/or when requested.
8. A statement of compliance and/or noncompliance with the requirements and specifications. Exceedance of holding times and identification of matrix interferences must be identified. Dilutions shall be identified and if dilutions are necessary, they must be done to the smallest dilution possible to effectively minimize matrix interferences and bring the sample into control for analysis.
9. Identification of any and all applicable quality assurance and quality control samples that will require special attention by the reviewer.
10. A statement on the quality control of the analytical method of the permit and the analytical recoveries information shall be provided when appropriate and/or when requested.

The analytical laboratory report for each sampling event will document the results and methods for each sample and analyte along with the quantification limit. The report will also include a copy of the chain-of-custody and an understandable correlation between the chain-of-custody and the sample results reported to the TCEQ. The analytical laboratory report will be submitted either electronically or in hard copy upon TCEQ request.

The New Boston Landfill shall ensure that a data reviewer considers the project data quality objectives as appropriate to determine if the results meet the project needs with respect to completeness, representativeness, and accuracy. Prior to submittal of the data to the Commission all analytical data will be examined to ensure that the data quality objectives are considered and met and that the results representing the samples are accurate and complete. The data will be reviewed, including the laboratory quality control results, the relative percent difference (RPD) of the monitor well results and its duplicate analysis (DUP) as a measure of accuracy. The data review will include a statement assessing data usability by a certified groundwater scientist with respect to the project data quality objectives (primarily a statistical evaluation of the groundwater analytical data) and, when necessary, provide comment to further explain or supplement the quality control data on the laboratory report. If the facility determines that the analytical data may be utilized, any and all problems and corrective action that the laboratory identified during the analysis will be included in the report submitted to the TCEQ.

A record of laboratory sample receipt, storage, and analysis procedures will be kept for each sample received. A summary of this record will be part of the laboratory analysis report. A copy of the NELAC Certified LQM is maintained as part of the facility's Site Operating Record (SOR). If at any time the site changes analytical laboratories, the new laboratory's LQM will be submitted by the laboratory and the site SOR updated.

Although the QA/QC procedures for use at this facility apply predominantly to groundwater analytical data, it is possible that soil sample analytical results may be reported in the future. If the data is from soils and/or sediment samples, it will be reported on a dry weight basis with the percent solids and the percent moisture reported so that any back calculations of the wet analysis may be performed.

4.4 Analytical Methodologies

Table F2-3 (and Table F2-1) show the analytical methodologies to be used by the laboratory for all of the parameters required in the monitoring program. All methods are USEPA approved and are fully described in the laboratory method and standard operating procedure documents.

Table F2-3 – Analytical Methods

Parameter	Method Description	Reference Method*
Alkalinity	Total, Methyl Orange	(A) 310.1
Chloride	Calorimetric	(A) 325.2 or 9252
Metals	ICP/ICP-MS	(A) 200 Series or 6010
Ammonia-N	Colorimetric, Automated Phenate	(A) 353.2 or 350.1
Sulfate	Turbidometric	(B) 9038 or 375.4
TDS	Gravimetric	(A) 160.1
TOC	Combustion or Oxidation	(A) 415.1
VOCs	Purge & Trap GC/MS	(B) 8260 or equivalent
Semi-VOCs	GC/MS with Solid-phase Extraction	(B) 8270 or equivalent

Note: *Analytical methods listed above may be substituted as necessary provided that the alternate methods provide adequate analytical data to fulfill monitoring requirements and meet regulatory performance standards.*

References:
(A) *Methods for Chemical Analysis of Water and Wastes*, USEPA 600/4-79-020, EMSL, Cincinnati, OH (as revised).
(B) *Test Methods for Evaluating Solid Waste*, Physical/Chemical Methods, SW-846, 3rd Edition, (as revised).

5 DATA QUALITY REVIEW, REPORTING, AND RECORDKEEPING

Prior to the submittal of a monitoring report to the TCEQ, several data evaluation, reporting, and recordkeeping tasks will be implemented. The following sections describe the evaluation, reporting, and recordkeeping procedures that are followed upon receipt of the analytical report.

5.1 Reporting Requirements

Within 60 days of each groundwater sampling event, a determination will be made whether an apparent or verified exceedance of a statistically calculated background limit has occurred. "Apparent exceedance," "apparent SSI," and "initial exceedance" all refer to the same matter and are identical in their meaning, correspond to the SSI referred to in the first sentence of 30 TAC §330.407(b), and are based on the statistical evaluation of an initial sample during a detection monitoring event that has not yet been confirmed by verification sampling. A statistically significant increase (SSI) over background of any tested constituent is not recorded until the initial exceedance has been verified in accordance with the verification resampling portion of the statistical methodology described in Section 3.1.3. If an apparent SSI is observed, the executive director and any local pollution agency with jurisdiction that has requested notification will be notified in writing within 14 days of the apparent SSI determination. If an apparent SSI of any tested constituent at any monitoring well including upgradient wells has occurred, the following actions will be initiated, as appropriate for each separate apparent SSI incident, in accordance with 30 TAC §330.407(b).

1. The facility shall immediately place a notice in the site operating record describing the release and establish an assessment monitoring program meeting the requirements of §330.409 within 90 days of the date of notice to the TCEQ, except as provided in (2) and (3) below.

2. The facility shall submit results of resampling as appropriate for the statistical method within 60 days of determining the apparent SSI. The resample data may be used to statistically confirm or disprove the apparent SSI.

3. If there is reasonable cause to think that another source or an error(s) in sampling, analysis, statistical evaluation, or natural variation in groundwater quality caused the SSI, then the facility may submit a report documenting the error or alternate source in accordance with §330.407(b)(3), as follows:

a. Notify, in writing, the executive director and any local pollution agency with jurisdiction that has requested to be notified within 14 days of determining the SSI.

b. Submit the demonstration, prepared and certified by a qualified groundwater scientist, within 90 days of the SSI determination.

c. Do not filter the sample for constituents addressed by the demonstration prior to laboratory analysis.

d. Continue detection monitoring.

If the owner/operator does not make a demonstration satisfactory to the executive director within 90 days after the date of notice, as evidenced by a letter of denial from the TCEQ, the owner/operator shall initiate an assessment monitoring program within 90 days of the date of the notice. If the owner/operator receives a response from the executive director that a demonstration is not satisfactory after the deadline for initiating assessment monitoring, then assessment monitoring will be initiated at the next regularly scheduled semiannual monitoring event following receipt of the response.

5.1.1 Annual Report

Annually, within 90 days after the facility's last groundwater monitoring event in a calendar year, a report will be submitted that includes the following information gathered since the previous annual report:

1. A statement regarding SSI(s) in any well and the status of same.
2. The results of all groundwater monitoring, testing, and analytical work obtained or prepared under the requirements of the permit in hard copy format on form TCEQ-0312 – Groundwater Sampling Report, and any other format requested by the executive director (e.g., electronic files). A summary of background groundwater quality values, groundwater monitoring analyses, and statistical calculations, as well as graphs and drawings, will also be included.
3. The facility will submit the laboratory case narrative and either the checklist or a copy of the laboratory QA/QC report and laboratory analytical data.
4. All laboratory analytical data will be submitted in either electronic or hard copy format as requested by TCEQ.
5. The facility will explain any problems or observed anomalies associated with the analysis or deficiencies in the LCN by attaching additional information to the checklist or LCN.
6. Any information required in the laboratory case narrative that cannot be completed by the laboratory will be completed by the permittee.

7. Groundwater flow rate and direction in the uppermost aquifer, using the previous year's data collected, including documentation used to determine the flow rate and direction.

8. Contour map(s) of piezometric water levels in the uppermost aquifer based on concurrent measurements at all monitoring wells, including supporting data.

9. Any recommendations for changes to the groundwater monitoring program.

10. Any other items requested by the executive director.

5.2 Data Recordkeeping Requirements

All analytical data are maintained by the laboratory indefinitely. The laboratory ensures that, at each stage of a process where a permanent data record is required, security measures are in place to guarantee the integrity of the data. Standard operating procedures are in place for computer security, computer data storage, and back-up.

6 REFERENCES

Aitchison, J. 1955, On the distribution of a positive random variable having a discrete probability mass at the origin: Journal of American Statistical Association, v. 50, pp. 901-908.

ASTM, Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers: Designation: D 5092-90.

Barcelona, M.J., Wehrmann, H.A., and Varljen, M.D., 1994, Reproducible well-purging procedures and VOC stabilization criteria for ground water sampling: Groundwater, v. 32, No. 1, pp. 12-22.

EMCON, September 1996, Permit Amendment for Vertical Expansion, New Boston Landfill, Bowie County, Texas.

Freeze, R.A., Cherry, J.A., 1979, Groundwater: Prentice-Hall, Englewood Cliffs, New Jersey.

Gibbons, R.D., 1987a, Statistical prediction intervals for the evaluation of ground-water quality: Ground Water, v.25, pp.455-465.

Gibbons, R.D., 1987b, Statistical models for the analysis of volatile organic compounds in waste disposal facilities: Ground Water, v.25, pp.572-580.

Gibbons, R.D., 1990, A general statistical procedure for ground-water detection monitoring at waste disposal facilities: Ground Water, v.28, pp.235-243.

Gibbons, R.D., 1991, Some additional nonparametric prediction limits for ground-water monitoring at waste disposal facilities: Ground Water, v.29, 729-736.

Gibbons, R.D., 1992, An overview of statistical methods for ground-water detection monitoring at waste disposal facilities: Ground-Water Contamination at Hazardous Waste Sites: Chemical Analysis, Marcel Dekker, Inc., New York.

Gibbons, R.D., 1994, Statistical methods for groundwater monitoring: John Wiley & Sons, Inc., Publishers, 286 p.

Gibbons, R.D., and Baker, J., 1991, The properties of various statistical prediction limits: Journal of Environmental Science and Health, A26-4, pp. 535-553.

Gibbons, R.D., Jarke, F.H., Stoub, K.B., 1991, Detection limits: for linear calibration curves with increasing variance and multiple future detection decisions: Waste Testing and Quality Assurance, v. 3, ASTM STP 1075. American Society for Testing and Materials, Philadelphia.

Gibbons, R.D., Grams, N.E., Jarke, F.H., and Stoub, K.B., 1992, Practical Quantitation Limits: Chemometrics and Intelligent Laboratory Systems, v.12, pp. 225-235).

Gibbons, R.D. and Discerning Systems, 1994, DUMPStat: An artificially intelligent computer program for statistical analysis of groundwater monitoring data under Subtitle C and Subtitle D Regulations: Robert D. Gibbons LTD, Chicago, Illinois (unpublished).

Giddings, T., 1983, Bore-Volume purging to improve monitoring well performance: an often-mandated myth: Proceedings of the NWWA Third National Symposium on Aquifer Restoration and Groundwater Monitoring, Columbus, Ohio. pp. 253-256.

Heidlauf, D.T. and Bartlett, T.R., 1993, Effects of monitoring well purge and sample techniques on the concentration of metal analytes in unfiltered groundwater samples: Proceedings of the NGWA Outdoor Action Conference, Las Vegas, NV, May 1993, pp. 437-450.

Kearl, P.M., Korte, N.E., and Cronk, T.A., Suggested modifications to groundwater sampling procedures based on observations from the colloidal borescope: Groundwater Monitoring Review, v.12, No. 2, pp.155-161.

Powell, R.M. and Puls, R.W., 1993, Passive sampling of groundwater monitoring wells without purging: multilevel well chemistry and tracer disappearance: Journal of Contaminant Hydrology, No.12, pp.51-77.

Puls, R.W., Clark, D.A., Bledsoe, B., Powell, R.M., and Paul, C.J., 1992, Metals in groundwater: Sampling Artifacts and Reproducibility, Hazardous Waste and Hazardous Materials, v. 9, No.2, pp. 149-162.

RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD), NWWA/USEPA, September 1986.

Robin, M.L. and Gillham, R.W., 1987, Field evaluation of well purging procedures: Groundwater Monitoring Review, v.7, No. 4, pp.85-93.

Scott, V.H., and Scalmanini J.C., 1989, Water wells and pumps: their design, construction, operation and maintenance: Division of Agriculture Science, University of California, Bull.

Shanklin, D.W., Sidle, and Ferguson, M., 1993, Waste minimization and groundwater sampling efficiency: a new technique for purging groundwater monitoring wells at the Fernald Environmental Management Project: U.S. Department of Energy, Cincinnati, OH.

Shapiro, S.S. and Wilk, M.B., 1965: An analysis of variance test for normality (complete samples). Biometrika, 52, pp. 591-911.

Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance: USEPA/530-SW-89-026, April 1989.

Texas Administrative Code, Title 30, Environmental Quality, Part 1, Texas Natural Resource Conservation Commission, Chapter 330, Municipal Solid Waste.

U.S. EPA, 1977, Procedures manual for groundwater monitoring at solid waste disposal facilities: USEPA SW-611, Office of Solid Waste.

U.S. EPA, 1988, Statistical methods for evaluating ground-water monitoring from hazardous waste facilities; final rule: Federal Register, 53, 196, 39720-39731.

U.S. EPA, 1989, Interim final guidance document - Statistical analysis of ground-water monitoring data at RCRA facilities.

U.S. EPA, Federal Register, 1991, Code of Federal Regulations (CFR) Parts 257 and 258: Solid Waste Disposal Facility Criteria; Final Rule.

U.S. EPA, 1992, Addendum to interim final guidance document - Statistical analysis of ground-water monitoring data at RCRA facilities.

U.S. EPA Contract Laboratory Program (CLP) Statement of Work for Inorganic Analysis: Document No. ILM01.0.

Wilk, M.B. and Shapiro, S.S., 1968, The joint assessment of normality of several independent samples: Technometrics, v.10, No. 4, pp. 825-839.

FIGURES

LABORATORY DATA COVER PAGE AND LABORATORY REVIEW CHECKLIST

(For Informational Purposes Only.
Actual form may vary.)

Municipal Solid Waste Laboratory Review Checklist

This data package consists of:

☐ This signature page, and the laboratory review checklist consisting of Table 1, Reportable Data (which includes the reportable data identified on this page), Table 2, Supporting Data, and Table 3, Exception Reports.

☐ R1 Field chain-of-custody documentation

☐ R2 Sample identification cross-reference

☐ R3 Test reports (analytical data sheets) for each environmental sample that includes:
  - (a) Items specified in NELAC Chapter 5 for reporting results, e.g., Section 5.5.10 in 2003 NELAC Standard
  - (b) Dilution factors
  - (c) Preparation methods
  - (d) Cleanup methods
  - (e) If required for the project, tentatively identified compounds (TICs)

☐ R4 Surrogate recovery data including:
  - (a) Calculated recovery (%R)
  - (b) The laboratory's surrogate QC limits

☐ R5 Test reports/summary forms for blank samples

☐ R6 Test reports/summary forms for laboratory control samples (LCSs) including:
  - (a) LCS spiking amounts
  - (b) Calculated %R for each analyte
  - (c) The laboratory's LCS QC limits

☐ R7 Test reports for project matrix spike/matrix spike duplicates (MS/MSDs) including:
  - (a) Samples associated with the MS/MSD clearly identified
  - (b) MS/MSD spiking amounts
  - (c) Concentration of each MS/MSD analyte measured in the parent and spiked samples
  - (d) Calculated %Rs and relative percent differences (RPDs)
  - (e) The laboratory's MS/MSD QC limits

☐ R8 Laboratory analytical duplicate (if applicable) recovery and precision:
  - (a) The amount of analyte measured in the duplicate
  - (b) The calculated RPD
  - (c) The laboratory's QC limits for analytical duplicates

☐ R9 List of method quantitation limits (MQLs) for each analyte for each method and matrix

☐ R10 Other problems or anomalies

☐ The Exception Report for every item for which the result is "No" or "NR" (Not Reviewed)

Release Statement: I am responsible for the release of this laboratory data package. This data package as been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data.

Check, if applicable: [ ] This laboratory is an in-house laboratory controlled by the person responding to rule. The official signing the cover page of the rule-required report in which these data are used is responsible for releasing this data package and is by signature affirming the above release statement is true.

Name (printed)	Signature	Official Title	Date

Table 1. Reportable Data.

Laboratory Name: ______________________________

Project Name: ______________________________

Reviewer Name: ______________________________

LRC Date: ______________________________

Laboratory Job Number: ______________________________

Prep Batch Number(s): ______________________________

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
R1	O, I	**Chain-of-custody (COC)**		
		Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?		
		Were all departures from standard conditions described in an exception report?		
R2	O, I	**Sample and quality control (QC) identification**		
		Are all field sample ID numbers cross-referenced to the laboratory ID numbers?		
		Are all laboratory ID numbers cross-referenced to the corresponding QC data?		
R3	O, I	**Test reports**		
		Were all samples prepared and analyzed within holding times?		
		Other than those results < MQL, were all other raw values bracketed by calibration standards?		
		Were calculations checked by a peer or supervisor?		
		Were all analyte identifications checked by a peer or supervisor?		
		Were sample quantitation limits reported for all analytes not detected?		
		Were all results for soil and sediment samples reported on a dry weight basis?		
		Was % moisture (or solids) reported for all soil and sediment samples?		
		If required for the project, TICs reported?		
R4	O	**Surrogate recovery data**		
		Were surrogates added prior to extraction?		
		Were surrogate percent recoveries in all samples within the laboratory QC limits?		
R5	O, I	**Test reports/summary forms for blank samples**		
		Were appropriate type(s) of blanks analyzed?		
		Were blanks analyzed at the appropriate frequency?		

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
		Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures?		
		Were blank concentrations < MQL?		
R6	O, I	**Laboratory control samples (LCS):**		
		Were all COCs included in the LCS?		
		Was each LCS taken through the entire analytical procedure, including prep and cleanup steps?		
		Were LCSs analyzed at the required frequency?		
		Were LCS (and LCSD, if applicable) %Rs within the laboratory QC limits?		
		Does the detectability data document the laboratory's capability to detect the COCs at the MDL used to calculate the SQLs?		
		Was the LCSD RPD within QC limits?		
R7	O, I	**Matrix spike (MS) and matrix spike duplicate (MSD) data**		
		Were the project/method specified analytes included in the MS and MSD?		
		Were MS/MSD analyzed at the appropriate frequency?		
		Were MS (and MSD, if applicable) %Rs within the laboratory QC limits?		
		Were MS/MSD RPDs within laboratory QC limits?		
R8	O, I	**Analytical duplicate data**		
		Were appropriate analytical duplicates analyzed for each matrix?		
		Were analytical duplicates analyzed at the appropriate frequency?		
		Were RPDs or relative standard deviations within the laboratory QC limits?		
R9	O, I	**Method quantitation limits (MQLs):**		
		Are the MQLs for each method analyte included in the laboratory data package?		
		Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?		
		Are unadjusted MQLs included in the laboratory data package?		
R10	O, I	**Other problems/anomalies**		
		Are all known problems/anomalies/special conditions noted in this LRC and ER?		
		Were all necessary corrective actions performed for the reported data?		
		Was applicable and available technology used to lower the SQL minimize the matrix interference affects on the sample results?		

Table 2. Supporting Data.

Laboratory Name: ____________________

Project Name: ____________________

Reviewer Name: ____________________

LRC Date: ____________________

Laboratory Job Number: ____________________

Prep Batch Number(s): ____________________

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
S1	O, I	**Initial calibration (ICAL)**		
		Were response factors and/or relative response factors for each analyte within QC limits?		
		Were percent RSDs or correlation coefficient criteria met?		
		Was the number of standards recommended in the method used for all analytes?		
		Were all points generated between the lowest and highest standard used to calculate the curve?		
		Are ICAL data available for all instruments used?		
		Has the initial calibration curve been verified using an appropriate second source standard?		
S2	O, I	**Initial and continuing calibration verification (ICCV and CCV) and continuing calibration blank (CCB):**		
		Was the CCV analyzed at the method-required frequency?		
		Were percent differences for each analyte within the method-required QC limits?		
		Was the ICAL curve verified for each analyte?		
		Was the absolute value of the analyte concentration in the inorganic CCB < MDL?		
S3	O	**Mass spectral tuning:**		
		Was the appropriate compound for the method used for tuning?		
		Were ion abundance data within the method-required QC limits?		
S4	O	**Internal standards (IS):**		
		Were IS area counts and retention times within the method-required QC limits?		
S5	O, I	**Raw data (NELAC section 1 appendix A glossary, and section 5.)**		
		Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?		
		Were data associated with manual integrations flagged on the raw data?		

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
S6	O	**Dual column confirmation**		
		Did dual column confirmation results meet the method-required QC?		
S7	O	**Tentatively identified compounds (TICs):**		
		If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?		
S8	I	**Interference Check Sample (ICS) results:**		
		Were percent recoveries within method QC limits?		
S9	I	**Serial dilutions, post digestion spikes, and method of standard additions**		
		Were percent differences, recoveries, and the linearity within the QC limits specified in the method?		
S10	O, I	**Method detection limit (MDL) studies**		
		Was a MDL study performed for each reported analyte?		
		Is the MDL either adjusted or supported by the analysis of DCSs?		
S11	O, I	**Proficiency test reports:**		
		Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?		
S12	O, I	**Standards documentation**		
		Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources?		
S13	O, I	**Compound/analyte identification procedures**		
		Are the procedures for compound/analyte identification documented?		
S14	O, I	**Demonstration of analyst competency (DOC)**		
		Was DOC conducted consistent with NELAC Chapter 5C?		
		Is documentation of the analyst's competency up-to-date and on file?		
S15	O, I	**Verification/validation documentation for methods (NELAC Chap 5n 5)**		
		Are all the methods used to generate the data documented, verified, and validated, where applicable?		
S16	O, I	**Laboratory standard operating procedures (SOPs):**		
		Are laboratory SOPs current and on file for each method performed?		

Table 3. Exception Reports.

Laboratory Name: ____________________

Project Name: ____________________

Reviewer Name: ____________________

LRC Date: ____________________

Laboratory Job Number: ____________________

Prep Batch Number(s): ____________________

Exception Report No.	Description

---

[1] Items identified by the letter "R" must be available as a hard copy or as a .pdf file. Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.

[2] O - organic analyses; I - inorganic analyses (including general chemistry constituents, when applicable).

[3] NA - Not applicable; NR - Not reviewed.

[4] Exception Report identification number; an Exception Report should be completed for an item if the result is "No" or "NR."