Johnstown Landfill

FULTON COUNTY, NEW YORK

Site Management Plan

NYSDEC Site Number: 518002

Prepared for:
New York State Department of Environmental Conservation
Division of Environmental Remediation
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1.0 INTRODUCTION AND DESCRIPTION OF REMEDIAL PROGRAM

1.1 INTRODUCTION

This document is required as an element of the remedial program at the Johnstown City Landfill Site (hereinafter referred to as the “Site”) under the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program administered by New York State Department of Environmental Conservation (NYSDEC). The Site was remediated in accordance with the interim Order on Consent between Johnstown and the U.S. Environmental Protection Agency dated October 4, 1988 and the Record of Decision (ROD), Site # 518002, which was executed on March 31, 1993.

1.1.1 General

In October 1988 the City of Johnstown entered into an interim Consent Order with the NYSDEC to remediate a 68-acre property located in Johnstown, Fulton County, New York. This interim Order required the Remedial Party, the City of Johnstown, to investigate and remediate contaminated media at the Site. A figure showing the Site location and boundaries of this 68-acre Site is provided in Figure 1-1. The boundaries of the Site are more fully described in the metes and bounds Site description that is part of the Environmental Easement.

After completion of the remedial work described in the Johnstown City Landfill Remedial Action Report and the Record of Decision, all known soil contamination was consolidated into the on-Site landfill and represents the “remaining contamination” in the subsurface at this Site, which is hereafter referred to as ‘remaining contamination.” This Site Management Plan (SMP) was prepared to manage remaining contamination at the

Site until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. All reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State.

This SMP was prepared by Arcadis of New York, Inc. (Arcadis), on behalf of the City of Johnstown, in accordance with the requirements in NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010, and the guidelines provided by NYSDEC. This SMP addresses the means for implementing the Institutional Controls (ICs) and Engineering Controls (ECs) that are required by the Environmental Easement for the Site.

1.1.2 Purpose

The Site contains contamination within a closed, capped landfill. Engineering Controls have been incorporated into the Site remedy to control exposure to remaining contamination during the use of the Site to ensure protection of public health and the environment. The City of Johnstown has acquired an Environmental Easement from the NYSDEC, which requires compliance with this SMP and all ECs and ICs placed on the Site. The ICs place restrictions on Site use, and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. This SMP specifies the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for remaining contamination at the Site. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor’s successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

This SMP provides a detailed description of all procedures required to manage remaining contamination at the Site after completion of the Remedial Action, including: (1) implementation and management of all Engineering and Institutional Controls; (2) media monitoring; and (3) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports

To address these needs, this SMP includes two plans: (1) an Engineering and Institutional Control Plan for implementation and management of EC/ICs; and (2) a Monitoring Plan for implementation of Site Monitoring

This plan also includes a description of annual Environmental Monitoring Reports and the Periodic Review Reports for the periodic submittal of data, information, recommendations, and certifications to NYSDEC.

It is important to note that:

This SMP details the Site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the SMP is a violation of the environmental easement, which is grounds for revocation of the Certificate of Completion (COC);

Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375 for the site, and thereby subject to applicable penalties.

1.1.3 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. In accordance with the Environmental Easement for the site, the NYSDEC will provide a notice of any approved changes to the SMP, and append these notices to the SMP that is retained in its files.

1.2 SITE BACKGROUND

The Johnstown Landfill is located in the Town of Johnstown, Fulton County, New York. The City used half of the 68-acre landfill Site as a sanitary landfill from 1947 until 1989. Wastes from local tanneries and textile mills were accepted at the Site until 1977. Wastewater treatment plant sludge was also disposed at the landfill from 1973 until 1979.

The tannery wastes contained elevated levels of chromium and the wastewater sludge contained chromium, iron, and lead.

The Johnstown landfill was placed on the National Priorities List of Superfund sites by the EPA (I.D. No. NYD980506927) and the New York State Registry of Inactive Hazardous Waste Disposal Sites by the NYSDEC (I.D. No. 518002). Based on the results of the RI/FS, a ROD was issued on March 31, 1993, selecting the remedy for the Site which included:

1. Excavation of LaGrange Gravel Pit sediments and placement of the excavated materials on the existing landfill (the pit now serves as a storm water detention basin for the northeaster swale and the entire eastern portion of the landfill);

2. Re-grading and compacting the landfill mound to provide a stable foundation for placement of the various layers of the cap and to promote rapid runoff of stormwater;

3. Construction of a multilayer closure cap (impermeable membrane, 12 inches of sand, and 12 inches of topsoil) over the landfill mound and excavated sediments per the New York State 6 NYCRR Part 360 regulations to reduce leachate generation and thereby improve the groundwater quality in the upper (overburden) and lower (bedrock) aquifers, and the surface water quality in Mathew Creek through natural attenuation of contaminants;

4. Expansion of the Johnstown City water supply system to provide potable water to all private water supplies potentially impacted by the landfill. This expansion required the extension of the City’s water lines and construction of a booster pump station;

5. Erection of approximately 6,800 feet of conventional chain-link fence surrounding the entire landfill mound and placement of warning signs; and

6. Implementation of a public awareness program to ensure that the nearby residents were familiar with all aspects of the response action.

The landfill closure was completed in December 1996 and the remedial activities were completed at the Site in July 1997.

1.2.1 Site Location and Description

The Site is located in the Town of Johnstown, County of Fulton, New York and is identified as Block 148 and Lot 1-59 on the Johnstown Tax Map. The Site is located approximately 1.5 miles northwest of the City of Johnstown and 1.75 miles west of the City of Gloversville. The Site is an approximately 68-acre area bounded by low density residential areas along West Fulton Street Extension to the north, and mixed wooded and agricultural lands to the east, south, and west (Figure 1-1). The boundaries of the Site are more fully described in Appendix A, Metes and Bounds.

1.2.2 Site History

The Johnstown landfill was used as an open refuse disposal facility from 1947 to 1960 before being converted to a sanitary landfill. The landfill accepted industrial wastes from local tanneries and textile plants until April 1979, and sludge from the Gloversville-Johnstown Joint Sewage Treatment Plant from 1973 to April 1979. Much of the tannery wastes were disposed of as chromium-treated hide trimmings and other materials. Sewage sludge was disposed of at a rate of approximately 20,000 cubic yards per year. The sludge contained chromium, iron, and lead. There are no records available which detail the amount of industrial wastes accepted by the landfill. Landfill operations ceased in June 1989.

1.2.3 Geologic Conditions

The Site is generally underlain by the Canajoharie Shale, a mid-Ordovician age, calcareous shale with occasional pyrite lobes. The bedrock was found to be mildly fractured in the upper 20 feet of the unit. Depth to bedrock ranges across the Site from about 30 feet to 120 feet.

Two water bearing units exist beneath the Johnstown City landfill. The upper (overburden) unit flows through till, sand, and gravel and flows generally towards the south and south east from the landfill following surface drainage patterns (Figure 1-2). The groundwater flow pattern in the deep (bedrock) unit is from west to east across the Site.

Wetland areas associated with Mathew Creek were identified using aerial photography, the NYSDEC wetland map on the Johnstown area, and the U.S. Soil Conservation Service draft soils map of the area. The wetland types include palustrine forest, scrub-shrub, emergent, and open water.

1.3 SUMMARY OF REMEDIAL INVESTIGATION FINDINGS

A Remedial Investigation (RI) was performed between June 1989 and March 1992 to characterize the nature and extent of contamination at the Site. The results of the RI are described in detail in the report titled “Remedial Investigation/Feasibility Study” (Thermo Consulting Engineers 1993).

Appendix B contains tables summarizing the data collected during the RI. A summary of Site conditions when the RI was performed is presented below.

The RI determined that the Site soils located directly beneath the landfill were contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and pesticides. The downgradient monitoring wells were found to contain VOCs, SVOCs, metals, and low concentrations of pesticides; several VOCs were detected within the bedrock groundwater aquifer at both upgradient and downgradient monitoring wells at concentrations generally much greater than those found in the landfill wells). Surface water and sediment samples were collected during the RI from Mathew Creek. VOCs, SVOCs, and metals were found in surface water samples, with concentrations generally higher at the headwater springs than the other downstream locations. Seven of the eight surface water samples collected in Mathew creek contained concentrations of bis (2-ethylhexyl) phthalate that exceeded the NYSDEC surface water standard. Sediments in Mathew Creek were found to contain ammonia-nitrogen, VOCs, SVOCs, pesticides, and metals, with concentrations of arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and nickel exceeding the NYSDEC Sediment Criteria Guidance Values in one or more samples. Sediments within the LaGrange Gravel Pit were also found to contain inorganic compounds, VOCs, SVOCs, and pesticides.

Ambient air in the vicinity of the landfill was sampled for VOCs and particulate chromium. Using both the guidance values for occupational exposure (1989 ACGIH Short Term TWA-TLV) and New York State guidance criteria (Ambient Guideline Concentration, Annual Average, 1989 ACGIH TWA-TLV) all of the airborne VOCs and chromium detected during the RI were within the accepted guideline values.

The RI also included a human health risk assessment, which concluded that under the current land-use conditions, the cumulative cancer risk for all receptors evaluated (i.e., adults, youths, children) was 6×10^{-6}, which was within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6}. The overwhelming contribution to the risk was attributable to residents ingesting contaminated groundwater. However, under future land-use conditions, which assumed that the contaminated groundwater beneath the landfill would migrate to a residential receptor, a cancer risk of 2×10^{-4} was found for the adult receptor. This risk, which slightly exceeds the acceptable cancer range, was also attributed to the ingestion of groundwater.

Site-Related Ecological Risk Assessment

A four-step process was utilized for assessing site-related ecological risks for sediment, surface water, vegetation, wildlife, fish, and macroinvertebrates along Mathew Creek and a nearby reference stream, Halls Brook. The RI investigation concluded that the vegetation did not appear to be adversely affected in Mathew Creek, but the sediments contained concentrations of several metals that exceeded the criteria established by

NYSDEC. These elevated concentrations were potentially placing the Mathew Creek benthic macroinvertebrates (worms, beetles, and midges) at risk. It was concluded that free swimming aquatic organisms in Mathew Creek could also be adversely affected by the high ammonia and metal concentrations detected in the surface water.

1.4 SUMMARY OF REMEDIAL ACTIONS

The Site was remediated in accordance with the EPA-approved Record of Decision (ROD) dated March 1993. The following is a summary of the Remedial Actions performed at the Site:

1. Excavation of the LaGrange Gravel Pit sediments and placement of the excavated materials on the existing landfill (the pit now serves as a storm water detention basin for the northeaster swale and the entire eastern portion of the landfill);

2. Re-grading and compacting the landfill mound to provide a stable foundation for placement of the various layers of the cap and to promote rapid runoff of stormwater;

3. Construction of a multilayer closure cap (impermeable membrane, 12 inches of sand, and 12 inches of topsoil) over the landfill mound and excavated sediments per the New York State 6 NYCRR Part 360 regulations to reduce leachate generation and thereby improve the groundwater quality in the upper (overburden) and lower (bedrock) aquifers, and the surface water quality in Mathew Creek through natural attenuation of contaminants;

4. Expansion of the Johnstown City water supply system to provide potable water to all private water supplies potentially impacted by the landfill. This expansion required the extension of the City’s water lines and construction of a booster pump station;

5. Erection of approximately 6,800 feet of conventional chain-link fence surrounding the entire landfill mound and placement of warning signs; and

6. Implementation of a public awareness program to ensure that the nearby residents were familiar with all aspects of the response action.

Remedial activities were completed at the Site in July 1997.

1.4.2 Site-Related Treatment Systems

No long-term treatment systems were installed as part of the Site remedy.

1.4.3 Remaining Contamination

The Third Five-Year Review Report completed by the EPA (December 2010), as well as the annual reports for 2011 and 2014 (Arcadis), summarize the remaining contamination in the Site groundwater and surface water and sediment of Mathew Creek. The analytical data is presented in Appendix D, Tables 1 through 4. In the Third Five-Year Review Report the EPA concluded that there are no risks presented at the Site by either groundwater or soils, and none are expected as long as the Site use does not change and the engineering and access controls are properly monitored and maintained.

Table 3 in Appendix D presents the Site groundwater sampling data. In general, several metals continue to exceed the NYSDEC Class GA Groundwater Standards at several monitoring well locations, including upgradient and downgradient monitoring wells from both water bearing units. During the July 2014 sampling event the following metals were detected above the NYSDEC Class GA Groundwater Standards in at least one groundwater sample: antimony, iron, lead, manganese, and sodium. There also continue to be isolated detections of VOCs and isolated exceedances of the conventional parameters at various groundwater monitoring locations from both water bearing units. In July 2014 ammonia nitrogen, color, and total phenols were the only conventional parameters present at concentrations greater than the respective NYSDEC Class GA Groundwater Standard. The organic, inorganic, and conventional parameter results from the 2014 sampling events were generally consistent with analytical results from the previous post-closure groundwater sampling events and groundwater remediation in the vicinity of the landfill is not warranted.

Historically, iron and manganese were detected in all surface water samples, including the background sample, at concentrations exceeding their respective NYSDEC surface water standards. Tables 4 and 4a present the surface water sampling data. Several metals continue to exceed the NYSDEC Class A Surface Water Standards at several surface water locations. In July 2014, aluminum, iron, and manganese were the only three inorganic parameters that were measured at concentrations exceeding NYSDEC Class A Surface Water Standards. There continue to be isolated detections of VOCs and isolated exceedances of the conventional parameters in various surface water locations as shown in Table 4. The organic, inorganic, and conventional parameter data were generally consistent with the data from the previous post-closure surface water sampling events. Based on the 2014 surface water results, the EPA concluded that the levels of iron and manganese are not an ecological concern, as these concentrations are relatively consistent with the background concentrations or are localized, signifying there are no widespread impacts from the landfill leachate.

Following the analysis of the sediment data collected in 2006, the EPA requested in their Third Five Year Review Report that a further sediment evaluation be completed to ensure that the landfill contaminants were not impacting the wetland areas associated with Mathew Creek. Sediment sampling was conducted during the November 2011, December 2011, and July 2014 sampling events and the results are summarized below and presented in Tables 5, 5a, and 6. Three sediment samples (SED-1 through SED-3) were collected (co-located with the surface water samples) during the November 2011 and December 2011 sampling events (Figure 1-4) and analyzed for TAL metals and total organic carbon (TOC). At the location of SED-1, cadmium, iron, manganese, and mercury exceeded the NYSDEC Lowest Effect Level in November 2011. Cadmium, iron, and manganese exceeded the NYSDEC Severe Effect Level, and zinc concentrations exceeded the Lowest Effect Level in December 2011. At the location of SED-3, silver concentrations exceeded the NYSDEC Severe Effect Level in December 2011. In July

2014 sediment sampling was conducted in Mathew Creek at locations SED-4 through SED–9 (Figure 1-4) and analyzed for TAL metals and TOC. The only parameters that exceeded NYSDEC Class A Screening Concentrations were arsenic and nickel.

As discussed above in Section 1.4, a multilayer cap was constructed over the closed landfill mound (and excavated sediments from the Lagrange Gravel pit) per the New York State 6 NYCRR Part 360 regulations to reduce leachate generation and thereby improve the groundwater quality in the upper (overburden) and lower (bedrock) aquifers, and surface water quality in Mathew Creek through natural attenuation of contaminants. Per the EPAs request, additional surface water and sediment data was collected to evaluate the need for another ecological assessment. Based on the July 2014 sediment and surface water sampling data the landfill has not significantly affected the surface water or sediment of Mathew Creek. As a result, and as approved by the EPA, further ecological risk assessment is not warranted.

Groundwater, surface water, and sediment analytical data for the past 18 years (1996-2014) are presented in Appendix D.

2.0 ENGINEERING AND INSTITUTIONAL CONTROL PLAN

2.1 INTRODUCTION

2.1.1 General

Since remaining contaminated soil and groundwater exists within the landfill, Engineering Controls and Institutional Controls (EC/ICs) are required to protect human health and the environment. This Engineering and Institutional Control Plan describes the procedures for the implementation and management of all EC/ICs at the site. The EC/IC Plan is one component of the SMP and is subject to revision by NYSDEC.

2.1.2 Purpose

This plan provides:

- A description of all EC/ICs on the site;
- The basic implementation and intended role of each EC/IC;
- A description of the key components of the ICs set forth in the Environmental Easement;
- A description of the features to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of EC/ICs, such as the implementation of the Excavation Work Plan for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the Site; and

- Any other provisions necessary to identify or establish methods for implementing the EC/ICs required by the Site remedy, as determined by the NYSDEC.

2.2 ENGINEERING CONTROLS

2.2.1 Engineering Control Systems

2.2.1.1 Landfill Cap

Exposure to remaining contamination in soil/fill at the Site is prevented by a landfill cap placed over the Site. The landfill cap is comprised of five separate layers including a geotextile layer, a gas collection layer, a geomembrane layer, a barrier protection layer, and a topsoil layer. Quality assurance and quality control testing was performed on the materials used and further detailed in the Remedial Action Report (Malcolm Pirnie 1997).

- The geotextile layer consists of separation fabric placed directly on the intermediate cover and below the gas vent layer. The purpose of this layer is to prevent the migration of soil particles from the intermediate cover into the gas vent layer. The geotextile layer consists of a needle-punched, non-woven polypropylene fabric.

- The gas collection layer consists of 12 inches of sand placed above the geotextile and below the geomembrane. This layer collects gases that may emanate from the waste. The gas collected in this layer is vented to the atmosphere through 37 PVC gas vents.

- The geomembrane layer consists of one sheet of linear low density polyethylene (nominal thickness of 60 mil). The geomembrane was placed above the gas collection layer and below the barrier protection layer.

- The barrier protection layer consists of a 12-inch layer of sandy soil placed above the geomembrane and below the topsoil. The primary function of the barrier protection layer is to prevent damage to the underlying geomembrane.

- The topsoil layer consists of 6 inches of fertile, loamy soil suitable for establishing and maintaining vegetation on the cap. The primary function of the topsoil layer is to stabilize the surface of the cap and prevent erosion of the cap materials.

The Excavation Work Plan that appears in Appendix E outlines the procedures required to be implemented in the event the landfill cap is breached, penetrated or temporarily removed, and any underlying remaining contamination is disturbed. Procedures for the inspection and maintenance of the landfill cap are provided in the Monitoring Plan included in Section 4 of this SMP.

2.2.1. Site Drainage

Two large drainage swales were constructed, one in the northeastern corner and one in the southwestern corner of the landfill, to convey runoff from the cap and surrounding areas to two stormwater detention basins. The swale in the northeastern corner of the landfill receives runoff from a large contributing area along West Fulton Street Extension, as well as a portion of the cap, and ultimately discharges in the former LaGrange Pit. The swale in the southwestern corner of the landfill receives runoff from a large portion of the landfill cap, as well as a large portion of the private property that borders the landfill to the north. The southwestern swale ultimately discharges to the borrow pit stormwater detention basin. Each swale is constructed with both synthetic and concrete channel liners.

The remainder of the capped landfill drains by sheet flow to the south and east sides of the landfill. On the south, approximately half of the run-off flows to the storm water detention basin in the borrow pit and the other half flows toward the southeast. On the east, the majority of the run-off flows to the former LaGrange Pit.

As stated above in Section 1.4, the LaGrange Gravel Pit sediments were excavated and relocated in the existing landfill. Approximately 8,000 cubic yards of clean backfill were placed in the LaGrange Pit. This area now serves as a stormwater detention basin for the northeastern swale and the entire eastern portion of the landfill.

2.2.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when effectiveness monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.6 of NYSDEC DER-10.

2.2.2.1 Landfill Cap

The landfill cap is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in perpetuity.

2.2.2.2 Monitored Natural Attenuation

Groundwater sampling has been occurring at the Site since 1996. Monitoring well locations are presented on Figure 1-3. Groundwater monitoring activities will continue, as determined by the NYSDEC, until residual groundwater concentrations are found to be consistently below NYSDEC standards or have become asymptotic at an acceptable level over an extended period. Monitoring will continue until permission to discontinue is granted in writing by the NYSDEC. If groundwater contaminant levels become asymptotic at a level that is not acceptable to the NYSDEC, additional source removal, treatment and/or control measures will be evaluated.

2.3 INSTITUTIONAL CONTROLS

A series of Institutional Controls is required by the ROD to: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination;

and, (3) the imposition of property deed restrictions to prevent the installation of drinking water wells at the Site and to restrict activities which could affect the integrity of the cap. Adherence to these Institutional Controls on the Site is required by the Environmental Easement and will be implemented under this Site Management Plan. These Institutional Controls are:

- Compliance with the Environmental Easement and this SMP by the Grantor and the Grantor's successors and assigns;
- All Engineering Controls must be maintained as specified in this SMP;
- All Engineering Controls on the Controlled Property must be inspected at a frequency and in a manner defined in the SMP;
- Groundwater, surface water, and other environmental or public health monitoring must be performed as defined in this SMP; and
- Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in this SMP.

Institutional Controls identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement.

The Site has a series of Institutional Controls in the form of Site restrictions. Adherence to these Institutional Controls is required by the Environmental Easement. Site restrictions that apply to the Controlled Property are:

- The property may only be used for commercial or industrial use provided that the long-term Engineering and Institutional Controls included in this SMP are employed;

- The property may not be used for a higher level of use, such as unrestricted or restricted residential use, without additional remediation and amendment of the Environmental Easement, as approved by the NYSDEC;

- All future activities on the property that will disturb remaining contamination must be conducted in accordance with this SMP;

- The use of the groundwater underlying the property is prohibited without treatment rendering it safe for intended use;

- The potential for vapor intrusion must be evaluated for any buildings developed on the footprint of the closed landfill, and any potential impacts that are identified must be monitored or mitigated; and

- Vegetable gardens and farming on the property are prohibited.

The Site owner or remedial party will submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or an alternate period of time that NYSDEC may allow and will be made by an expert that the NYSDEC finds acceptable. The ICs currently established for the Site in the 1995 remedial design include the NYSDEC-approved Operation and Maintenance Manual, which contains the procedures for inspecting and evaluating the landfill cap, monitoring of groundwater quality in the immediate vicinity of the landfill, and long-term monitoring of downgradient groundwater wells. Repairs are to be made to the cap and drainage systems, as necessary, to control the effects of settling, subsidence, erosion, or other events that might interfere with the performance of the remedy.

The Operation and Maintenance Manual requires that the Site be inspected on a quarterly basis, as follows:

- The landfill cap for signs of erosion, excessive settlement, surface water ponding, seedling growth, and stressed vegetation;
- The Site for any vectors and report damage;
- The groundwater monitoring wells for ease of locating, operation of locks, damage/vandalism, and the condition of the surface seals;
- The Site access gates and fence for operational locks, vandalism, and damage;
- The access roads for ruts, and drivability; and
- The Site for debris, litter and/or waste.

The Site inspection also includes air quality readings using a 4 Gas Monitor.

2.3.1 Excavation Work Plan

The Site has been remediated as described in Section 1.4 and re-development of the site for any future higher use is not planned at this time or anticipated in the future. Any future intrusive work that will penetrate the landfill cap, or encounter or disturb the remaining contamination, including any modifications or repairs to the existing cover system, will be performed in compliance with the Excavation Work Plan (EWP) that is attached as Appendix E to this SMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) prepared for the specific work at the Site. The current HASP for the Site is attached as Appendix F to this SMP and is in current compliance with DER-10, 29 CFR 1910, 29 CFR 1926, and all other applicable Federal, State and local regulations. Based on future changes to State and federal health and safety requirements, and specific methods employed by future contractors, the HASP and CAMP will be updated and re-submitted with the notification provided in Section A-1 of the EWP. Any intrusive construction work will be performed in compliance with the EWP, HASP and CAMP, and will be included in the periodic inspection and certification reports submitted under the Site Management Reporting Plan (See Section 5).

The Site owner and associated parties preparing the remedial documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all intrusive work, the structural integrity of excavations, proper disposal of excavation de-water, control of runoff from open excavations into remaining contamination, and for structures that may be affected by excavations (such as building foundations and bridge footings). The Site owner will ensure that Site development activities will not interfere with, or otherwise impair or compromise, the engineering controls described in this SMP.

2.3.2 Soil Vapor Intrusion Evaluation

Prior to the construction of any enclosed structures located over areas that contain remaining contamination an SVI evaluation will be performed to determine whether any mitigation measures are necessary to eliminate potential exposure to vapors in the proposed structure. Alternatively, an SVI mitigation system may be installed as an element of the building foundation without first conducting an investigation. This mitigation system will include a vapor barrier and passive sub-slab depressurization system that is capable of being converted to an active system.

Prior to conducting an SVI investigation or installing a mitigation system, a work plan will be developed and submitted to the NYSDEC and NYSDOH for approval. This work plan will be developed in accordance with the most recent NYSDOH “Guidance for Evaluating Vapor Intrusion in the State of New York”. Measures to be employed to mitigate potential vapor intrusion will be evaluated, selected, designed, installed, and maintained based on the SVI evaluation, the NYSDOH guidance, and construction details of the proposed structure.

Preliminary (unvalidated) SVI sampling data will be forwarded to the NYSDEC and NYSDOH for initial review and interpretation. Upon validation, the final data will be transmitted to the agencies, along with a recommendation for follow-up action, such as mitigation. Validated SVI data will be transmitted to the property owner within 30 days of validation. SVI sampling results, evaluations, and follow-up actions will also be summarized in the next Periodic Review Report.

2.4 INSPECTIONS AND NOTIFICATIONS

2.4.1 Inspections

Inspections of all remedial components installed at the Site will be conducted at the frequency specified in the SMP Monitoring Plan schedule. The inspections will determine and document the following:

- Whether Engineering Controls continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Environmental Easement;
- Achievement of remedial performance criteria;
- Sampling and analysis of appropriate media during monitoring events;
- If Site records are complete and up to date; and
- Changes, or needed changes, to the remedial or monitoring system.

Inspections will be conducted in accordance with the procedures set forth in the Monitoring Plan of this SMP (Section 3). The reporting requirements are outlined in the Periodic Review Reporting section of this plan (Section 5).

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the Site by a qualified environmental professional as determined by NYSDEC.

2.4.2 Notifications

Notifications will be submitted by the property owner to the NYSDEC as needed for the following reasons:

- 60-day advance notice of any proposed changes in Site use that are required under the terms of the6NYCRR Part 375, and/or Environmental Conservation Law.

- 7-day advance notice of any proposed ground-intrusive activities pursuant to the Excavation Work Plan.

- Notice within 48-hours of any damage or defect to the foundation, structures or engineering control that reduces or has the potential to reduce the effectiveness of an Engineering Control and likewise any action to be taken to mitigate the damage or defect.

- Verbal notice by noon of the following day of any emergency, such as a fire, flood, or earthquake that reduces or has the potential to reduce the effectiveness of Engineering Controls in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action shall be submitted to the NYSDEC within 45 days and shall describe and document actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the Site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser has been provided with a copy of the ROD, and all approved work plans and reports, including this SMP.

- Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing.

2.5 CONTINGENCY PLAN

Emergencies may include injury to personnel, fire or explosion, environmental release, or serious weather conditions.

2.5.1 Emergency Telephone Numbers

In the event of any environmentally related situation or unplanned occurrence requiring assistance, the Owner or Owner's representative(s) should contact the appropriate party from the contact list below. For emergencies, appropriate emergency response personnel should be contacted. These emergency contact lists must be maintained in an easily accessible location at the site.

Table 2-1 Emergency Contact Numbers

Medical, Fire, and Police:	911
One Call Center:	(800) 272-4480 (3 day notice required for utility markout)
Poison Control Center:	(800) 222-1222
Pollution Toxic Chemical Oil Spills:	(800) 424-8802

NYSDEC Spills Hotline	(800) 457-7362

Table 2-2: Contact Numbers

City of Engineer	(518) 736 – 4014

* Note: Contact numbers subject to change and should be updated as necessary

2.5.2 Map and Directions to Nearest Health Facility

Site Location: W. Fulton Street Ext. Gloversville, NY

Nearest Hospital Name: St. Mary's Hospital

Hospital Location: 99 East State Street, Gloversville NY

Hospital Telephone: (518) – 725-8621

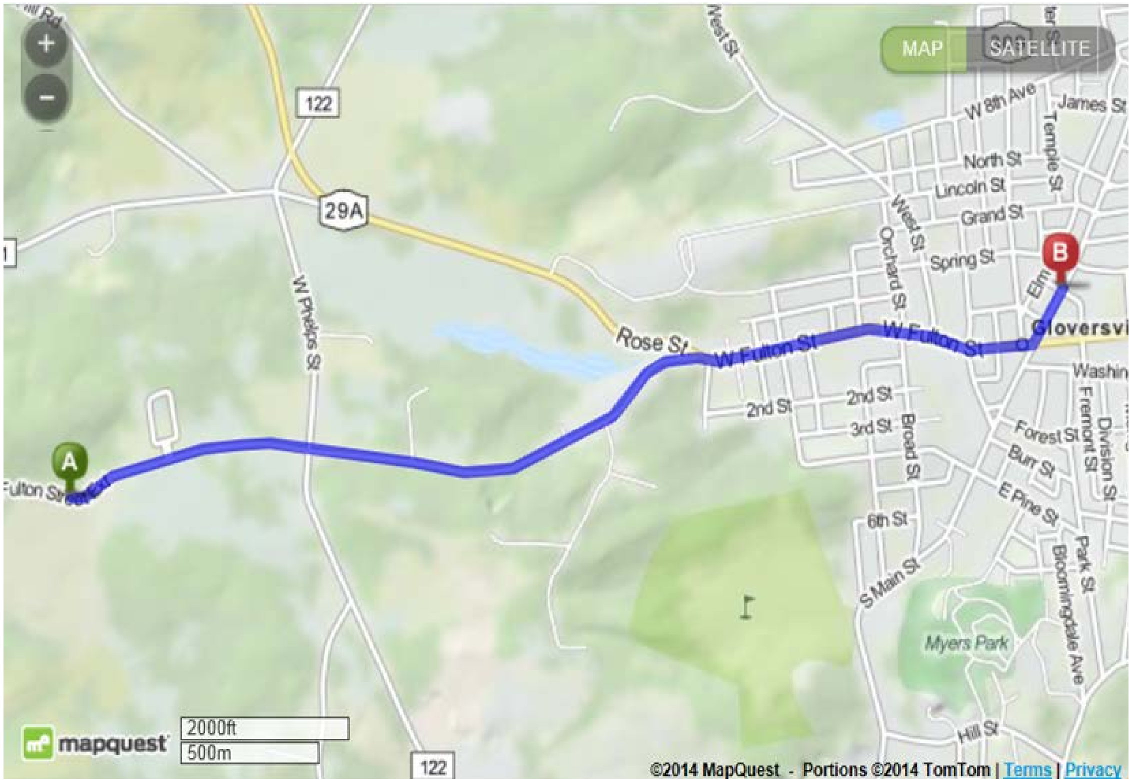
Directions to the Hospital:

1. Head east on W Fulton St towards County Rd 122
2. Turn left onto N. Main St
3. St. Mary's Hospital

Total Distance: 2.6 miles

Total Estimated Time: 7 minutes

Map Showing Route from the Site to the Hospital:



2.5.3 Response Procedures

As appropriate, the fire department and other emergency response group will be notified immediately by telephone of the emergency. The emergency telephone number list is found at the beginning of this Contingency Plan (Table 2-1). The list will also be posted prominently at the City Engineer's office. No material are collected or transported from the Site. The Site is inactive and unoccupied. In case of emergency, any on Site personnel will meet at the location designated in the HASP.

3.0 SITE MONITORING PLAN

3.1 INTRODUCTION

3.1.1 General

The Monitoring Plan describes the measures for evaluating the performance and effectiveness of the remedy to reduce or mitigate contamination at the Site, the landfill cap, and all affected Site media identified below. This Monitoring Plan may only be revised with the approval of NYSDEC.

3.1.2 Purpose and Schedule

This Monitoring Plan describes the methods to be used for:

- Sampling and analysis of all appropriate media (e.g., groundwater, surface water, and sediment);
- Assessing compliance with applicable NYSDEC standards, criteria and guidance, particularly ambient groundwater and surface water standards, and Technical Guidance for Screening Contaminated Sediments;
- Assessing achievement of the remedial performance criteria;
- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment; and
- Preparing the necessary reports for the various monitoring activities.

To adequately address these issues, this Monitoring Plan provides information on:

- Sampling locations, protocol, and frequency;
- Information on all designed monitoring systems (e.g., well logs);
- Analytical sampling program requirements;
- Reporting requirements;
- Quality Assurance/Quality Control (QA/QC) requirements;
- Inspection and maintenance requirements for monitoring wells;
- Monitoring well decommissioning procedures; and
- Annual inspection and periodic certification.

Monitoring of the performance of the remedy and overall reduction in contamination on-Site and off-site will be conducted for the first 30 years. The frequency thereafter will be determined by NYSDEC. Trends in contaminant levels in surface water, sediment, and groundwater in the affected areas will be evaluated to determine if the remedy continues to be effective in achieving remedial goals. Monitoring programs are summarized in Table 3-1 and outlined in detail in Sections 3.2 and 3.3 below.

Table 3-1: Monitoring/Inspection Schedule

Monitoring Program	Frequency*	Matrix	Analysis
Monitoring Well Network	Annual	Groundwater	NYCRR Part 360 Baseline (1 round)
Surface Water (SW-1 – SW-3)	Semiannual	Surface water	NYCRR Part 360 Baseline + hardness (1 round) NYCRR Part 360 Routine + hardness (1 round)
Sediment (SED-1 –SED-9)	Annual	Sediment	TAL metals and TOC
Landfill Inspection	Quarterly	Includes Air Monitoring at gas vents	NA

* The frequency of events will be conducted as specified until otherwise approved by NYSDEC and NYSDOH

3.2 COVER SYSTEM MONITORING

The landfill cap was constructed as an engineering control to protect human health and limit wildlife exposure to the former waste materials remaining within the landfill. The landfill will be inspected quarterly to verify that the cap and associated surface water drainage and conveyance features are functioning as intended.

3.3 MEDIA monitoring Program

3.3.1 Groundwater Monitoring

Groundwater monitoring will be performed on an annual basis to assess the performance of the remedy.

The network of monitoring wells has been installed to monitor both up-gradient and down-gradient groundwater conditions at the Site. The locations of the monitoring wells (MW-2S, 2M, and 2D; MW-3S, 3M, and 3D; MW-6S and 6M; and MW-7S and 7D; MW-9S and 9D; and MW-15S and 15D) are shown on Figure 1-3. Wells were installed either in the overburden or bedrock water bearing unit as noted on Table 3-2 below.

Table 3-2: Monitoring Well Screened Interval Location, Johnstown Landfill

Hydrogeologic Unit	**Well ID**
Overburden Water Bearing Unit	
	2S
	3S
	6S
	7S
	9S
	15S
	2M
	3M
	6M
	9D
	15D
Bedrock Water Bearing Unit	
	2D
	3D
	7D

Each of the 14 monitoring wells will be sampled annually and analyzed for baseline parameters. The sampling frequency may be modified with the approval of the NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by NYSDEC. Category B laboratory deliverables will be required.

The sampling frequency may be modified with the approval NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by NYSDEC.

Deliverables for the groundwater monitoring program are specified below.

3.3.1.1 Sampling Protocol

All monitoring well sampling activities will be recorded in a field book and a groundwater sampling log presented in Appendix G. Other observations (e.g., well integrity, etc.) will be noted on the well sampling log. The well sampling log will serve as the inspection form for the groundwater monitoring well network.

Groundwater samples will be collected following EPA-approved low-flow groundwater sampling procedures using a dedicated low-flow bladder pump. Prior to collecting groundwater samples, pH, conductivity, turbidity, dissolved oxygen (DO), temperature, and oxidation-reduction potential (REDOX) will be measured using a water quality meter and recorded on groundwater sampling purge logs.

Groundwater samples collected during the groundwater monitoring program are analyzed for 6 NYCRR 360 baseline parameters. A round of water levels will be measured prior to sampling.

3.3.1.2 Monitoring Well Repairs, Replacement and Decommissioning

If biofouling or silt accumulation occurs in the On-site and/or Off-site monitoring wells, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced (as per the Monitoring Plan), if an event renders the wells unusable.

Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance.

The NYSDEC will be notified prior to any repair or decommissioning of monitoring wells for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent periodic report. Well decommissioning without replacement will be done only with the prior approval of NYSDEC. Well abandonment will be performed in accordance with NYSDEC's "Groundwater Monitoring Well Decommissioning Procedures." Monitoring wells that are decommissioned because they have been rendered unusable will be reinstalled in the nearest available location, unless otherwise approved by the NYSDEC.

3.3.1. 3 Surface Water Sampling

Surface water sampling activities will be recorded in a field book and the surface water sampling log presented in Appendix G. Other observations (e.g., stream conditions, surrounding vegetation, etc.) will be noted on the sampling log.

Surface water monitoring will be conducted in Mathew Creek at locations SW-1 through SW-3 on a semiannual schedule. The sampling locations are shown on Figure 1- 4.

Surface water samples will be analyzed for 6 NYCRR Part 360 baseline parameters plus hardness during the first semiannual event of the year, and 6 NYCRR Part 360 routine parameters plus hardness during the second semiannual event for each given year. Samples will be collected by slowly submerging sample containers in the surface water body. In the event that the containers cannot be completely submerged, water will be collected in clean glass beakers and poured into the sample bottles. Prior to collecting surface water samples, pH, conductivity, turbidity, dissolved oxygen (DO), temperature and oxidation-reduction potential (REDOX) will be measured using a water quality meter and recorded on surface water sampling logs.

Category B laboratory deliverables will be required for the baseline event and Category A deliverables will be required for the routine event.

3.3.1.4 Sediment Sampling

Sediment sampling will be performed on an annual basis to assess whether landfill contaminants are affecting sediment associated with the Mathew Creek.

Sediment locations SED-1 through SED-9 will be sampled during one event simultaneously with one of the surface water sampling events. All sediment sampling activities will be recorded in a field book and the sediment sampling log presented in Appendix G. Other observations (e.g., stream conditions, surrounding vegetation, etc.) will be noted on the sampling log.

The sediment sampling locations include SED-1 through SED-9 and are shown on Figure 1-4. The sediment samples will be collected from 0 to 0.5 feet below the sediment surface and analyzed for TAL metals and TOC. Samples will either be collected with a stainless steel trowel or a disposable spoon, placed in a clean ziplock bag, photographed, and then filled into laboratory provided sample jars. Samples will be collected from the most downstream sampling location (SED-9) to the most upstream sampling location (SED-1). Category B laboratory deliverables will be provided.

3.4 SITE-WIDE INSPECTION

Site-wide inspections will be performed on a regular schedule at a minimum of once a year. Site-wide inspections will also be performed after all severe weather conditions that may affect Engineering Controls or monitoring devices. During these inspections, an inspection form will be completed (Appendix G). The form will compile sufficient information to assess the following:

- Compliance with all ICs, including Site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General Site conditions at the time of the inspection;
- The Site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection;
- The landfill cap for signs of erosion, excessive settlement, surface water ponding, seedling growth, and stressed vegetation;

- The Site for any vectors and report damage;
- The groundwater monitoring wells for ease of locating, operation of locks, damage/vandalism, and the condition of the surface seals;
- The Site access gates and fence for operational locks, vandalism, and damage;
- The access roads for ruts, standing water, and drivability; and
- The Site for debris, litter and/or waste.

The Site inspection also includes monitoring air quality readings using a 4 Gas Monitor.

3.5 MONITORING QUALITY ASSURANCE/QUALITY CONTROL

All sampling and analyses will be performed in accordance with the requirements of the Quality Assurance Project Plan (QAPP) prepared for the Site (Appendix H). Main Components of the QAPP include:

- QA/QC Objectives for Data Measurement;
- Sampling Program:
  - Sample containers will be properly washed, decontaminated, and appropriate preservative will be added (if applicable) prior to their use by the analytical laboratory. Containers with preservative will be tagged as such.
  - Sample holding times will be in accordance with the NYSDEC ASP requirements.
  - Field QC samples (e.g., trip blanks, coded field duplicates, and matrix spike/matrix spike duplicates) will be collected as necessary.

- Sample Tracking and Custody;
- Calibration Procedures:
    - All field analytical equipment will be calibrated immediately prior to each day's use. Calibration procedures will conform to manufacturer's standard instructions.
    - The laboratory will follow all calibration procedures and schedules as specified in USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods.
- Analytical Procedures;
- Preparation of a Data Usability Summary Report (DUSR), which will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method;
- Internal QC and Checks;
- QA Performance and System Audits;
- Preventative Maintenance Procedures and Schedules; and
- Corrective Action Measures.

3.6 MONITORING REPORTING REQUIREMENTS

Forms and any other information generated during regular monitoring events and inspections will be kept on file at Arcadis' office in Clifton Park, NY. All forms, and other relevant reporting formats used during the monitoring/inspection events, will be (1) subject to approval by NYSDEC and (2) submitted at the time of the annual Environmental Monitoring Report, as specified in the Reporting Plan of this SMP.

All monitoring results will be reported to NYSDEC on a periodic basis in the annual Environmental Monitoring Report with required certification statements included in the Periodic Review Report which will be prepared and submitted every fifth year.

Data will be reported in hard copy or digital format as determined by NYSDEC. A summary of the monitoring program deliverables are summarized in Table 3-3 below.

Table 3-3: Schedule of Monitoring/Inspection Reports

Task	**Reporting Frequency***
Quarterly landfill Inspections	Annually
Periodic Review Report	Every Fifth Year
Environmental Monitoring Report	Annually

* The frequency of events will be conducted as specified until otherwise approved by NYSDEC

4.0 OPERATION AND MAINTENANCE PLAN

4.1 INTRODUCTION

The Site remedy does not rely on any mechanical systems, such as sub-slab depressurization systems or air sparge/soil vapor extraction systems to protect public health and the environment. Therefore, the operation and maintenance of such components is not included in this SMP.

5. INSPECTIONS, REPORTING AND CERTIFICATIONS

5.1 SITE INSPECTIONS

5.1.1 Inspection Frequency

All inspections will be conducted at the frequency specified in the schedules provided in Section 3 Monitoring Plan. Site-wide inspection will be conducted quarterly whenever a severe condition has taken place, such as after a severe flooding event that may affect the ECs.

5.1.2 Inspection Forms, Sampling Data, and Maintenance Reports

All inspections and monitoring events will be recorded on the appropriate forms which are contained in Appendix G. These forms are subject to NYSDEC revision.

All applicable inspection forms and other records, including all media sampling data and system maintenance reports, generated for the Site during the reporting period will be provided in electronic format in the Annual Environmental Monitoring Report.

5.1.3 Evaluation of Records and Reporting

The results of the inspection and Site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

- EC/ICs are in place, are performing properly, and remain effective;
- The Monitoring Plan is being implemented;
- Operation and maintenance activities are being conducted properly; and, based on the above items,

- The Site remedy continues to be protective of public health and the environment and is performing as designed in the ROD.

5.2 CERTIFICATION OF ENGINEERING AND INSTITUTIONAL CONTROLS

Every fifth year, a qualified environmental professional will prepare the following certifications:

For each institutional or engineering control identified for the Site, I certify that all of the following statements are true:

- The inspection of the Site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;

- The institutional control and/or engineering control employed at this Site is unchanged from the date the control was put in place, or last approved by the Department;

- Nothing has occurred that would impair the ability of the control to protect the public health and environment;

- Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;

- Access to the Site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;

- If a financial assurance mechanism is required under the oversight document for the Site, the mechanism remains valid and sufficient for the intended purpose under the document;

- Use of the Site is compliant with the environmental easement;

- The engineering control systems are performing as designed and are effective;

- To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the Site remedial program;

- The information presented in this report is accurate and complete; and

- I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [INSERT NAME], of [INSERT BUSINESS ADDRESS], am certifying as [OWNER OR OWNER'S DESIGNATED SITE REPRESENTATIVE] for the Site.

The assumptions made in the qualitative exposure assessment remain valid.

In addition, since this Site does not represent a significant threat to public health or the environment, the following notes will also be included in the certifications: No new information has come to my attention, including groundwater monitoring data from wells located at the Site boundary, if any, to indicate that the assumptions made in the qualitative exposure assessment of off-Site contamination are no longer valid;

The signed certifications will be included in the Periodic Review Report described below.

5.3 PERIODIC REVIEW REPORT

A Periodic Review Report will be submitted to the Department every fifth year, beginning fifteen months after the approval of this SMP is issued. In the event that the Site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the Site described in Appendix A (Metes and Bounds). The report will be prepared in accordance with NYSDEC DER-10 and submitted within 30 days of the end of each certification period.

The Periodic Review report will include:

- Identification, assessment and certification of all ECs/ICs required by the remedy for the Site; and
- A Site evaluation, which includes the following:
  - The compliance of the remedy with the requirements of the Site-specific RAWP, ROD or Decision Document;
  - Any new conclusions or observations regarding Site contamination based on inspections or data generated by the Monitoring Plan for the media being monitored;
  - Recommendations regarding any necessary changes to the remedy and/or Monitoring Plan; and
  - The overall performance and effectiveness of the remedy.

The Periodic Review Report will be submitted, in hard-copy format, to the NYSDEC Central Office and Regional Office in which the Site is located, and in electronic format to NYSDEC Central Office, Regional Office and the NYSDOH Bureau of Environmental Exposure Investigation.

5.4 ANNUAL ENVIRONMENTAL MONITORING REPORT

Media sampling results will be incorporated into the annual Environmental Monitoring Report. This report will include:

- Results of the required quarterly Site inspections and severe condition inspections, if applicable;
- Inspection forms and other records generated for the Site during the reporting period in electronic format;

- Data summary tables and graphical representations of contaminants of concern by media (groundwater, surface water, sediment), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends; and

- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period (electronically in a NYSDEC-approved format).

The annual Environmental Monitoring Report will be submitted, in hard-copy format, to the NYSDEC Central Office and Regional Office in which the Site is located, and in electronic format to NYSDEC Central Office, Regional Office and the NYSDOH Bureau of Environmental Exposure Investigation.

5.5 CORRECTIVE MEASURES PLAN

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a corrective measures plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the corrective measures plan until it is approved by the NYSDEC.

5.6 REFERENCES

Arcadis of New York, Inc. City of Johnstown Landfill, Revised Sediment and Surface Water Evaluation of Mathew Creek. September 2014.

Arcadis of New York, Inc., 2011, City of Johnstown, 2011 Environmental Monitoring Annual Report, July 2012.

Malcolm Pirnie, 1997, Remedial Action Report, City of Johnstown Landfill Closure Construction Certification Report, Town of Johnstown, Fulton County, New York.

Thermo Consulting Engineers, Remedial Investigation/Feasibility Study, Johnstown Landfill, 1993.

United States Environmental Protection Agency, Third Five Year Review Report Johnstown City Landfill Superfund Site, Fulton County, Town of Johnstown, New York, December 2010.

United States Environmental Protection Agency, Superfund Record of Decision: Johnstown City Landfill, New York, March 1993.

Figures

CITY OF JOHNSTOWN
JOHNSTOWN LANDFILL

SITE MANAGEMENT PLAN

SITE AND SITE BOUNDARIES

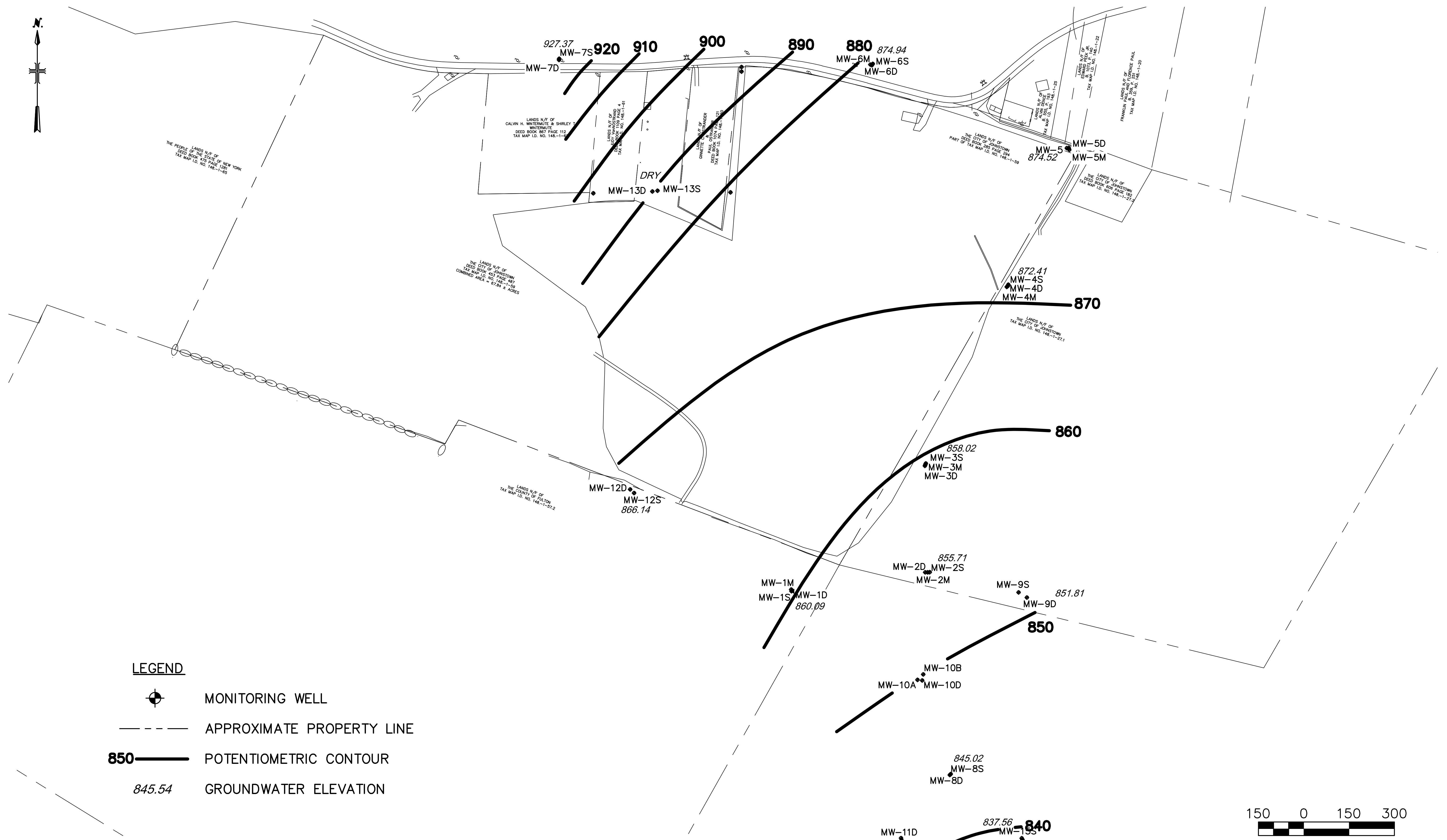
ARCADIS

FIGURE

1-1

Path: G:\GISMOD\2384020\SMP.mxd Date Saved: 9/22/2014 4:14:49 PM

USER: HAUSMANN FILENAME: G:\ACAD\PROJ\2384020\FIGURES\FIGURE 1-2.DWG SAVE DATE: 10/15/2014 6:16 AM PLOT DATE: 10/15/2014 6:16 AM



MAP SOURCE: SURVEY PERFORMED BY NORTHEAST LAND SURVEY
& LAND DEVELOPMENT CONSULTANTS, P.C.

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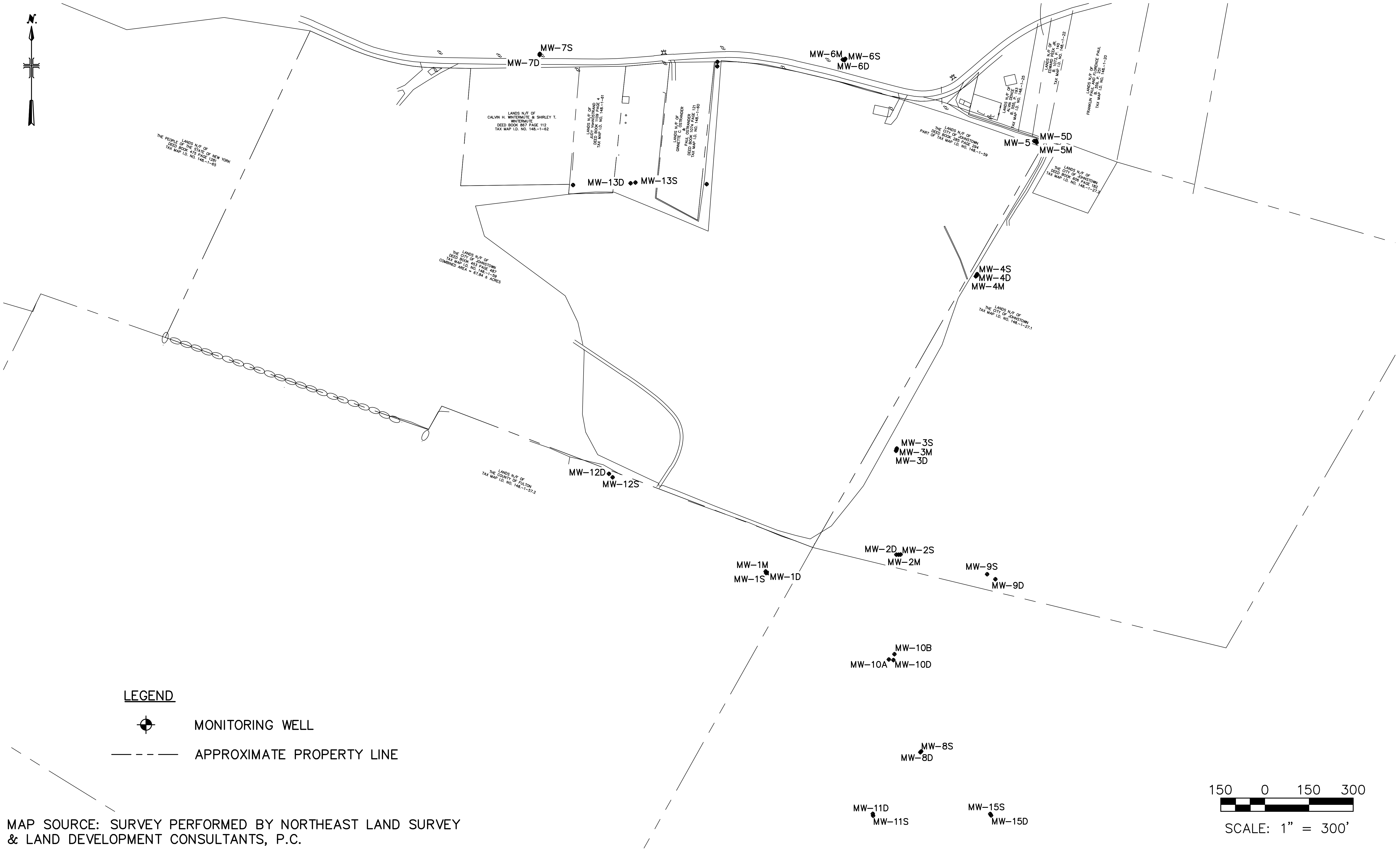
Infrastructure · Water · Environment · Buildings

CITY OF JOHNSTOWN
FULTON COUNTY, NEW YORK
CITY OF JOHNSTOWN LANDFILL

SHALLOW POTENTIOMETRIC MAP
(DECEMBER 27, 2011)
SCALE: 1"=300'

SEPTEMBER 2014

FIGURE 1-2



LEGEND

⌖ MONITORING WELL

— - - — APPROXIMATE PROPERTY LINE

MAP SOURCE: SURVEY PERFORMED BY NORTHEAST LAND SURVEY
& LAND DEVELOPMENT CONSULTANTS, P.C.

USER: HAUSMANN FILENAME: G:\ACAD\PROJ\2384020\FIGURES\FIGURE 1-3.DWG SAVE DATE: 10/15/2014 6:15 AM PLOT DATE: 10/15/2014 6:16 AM

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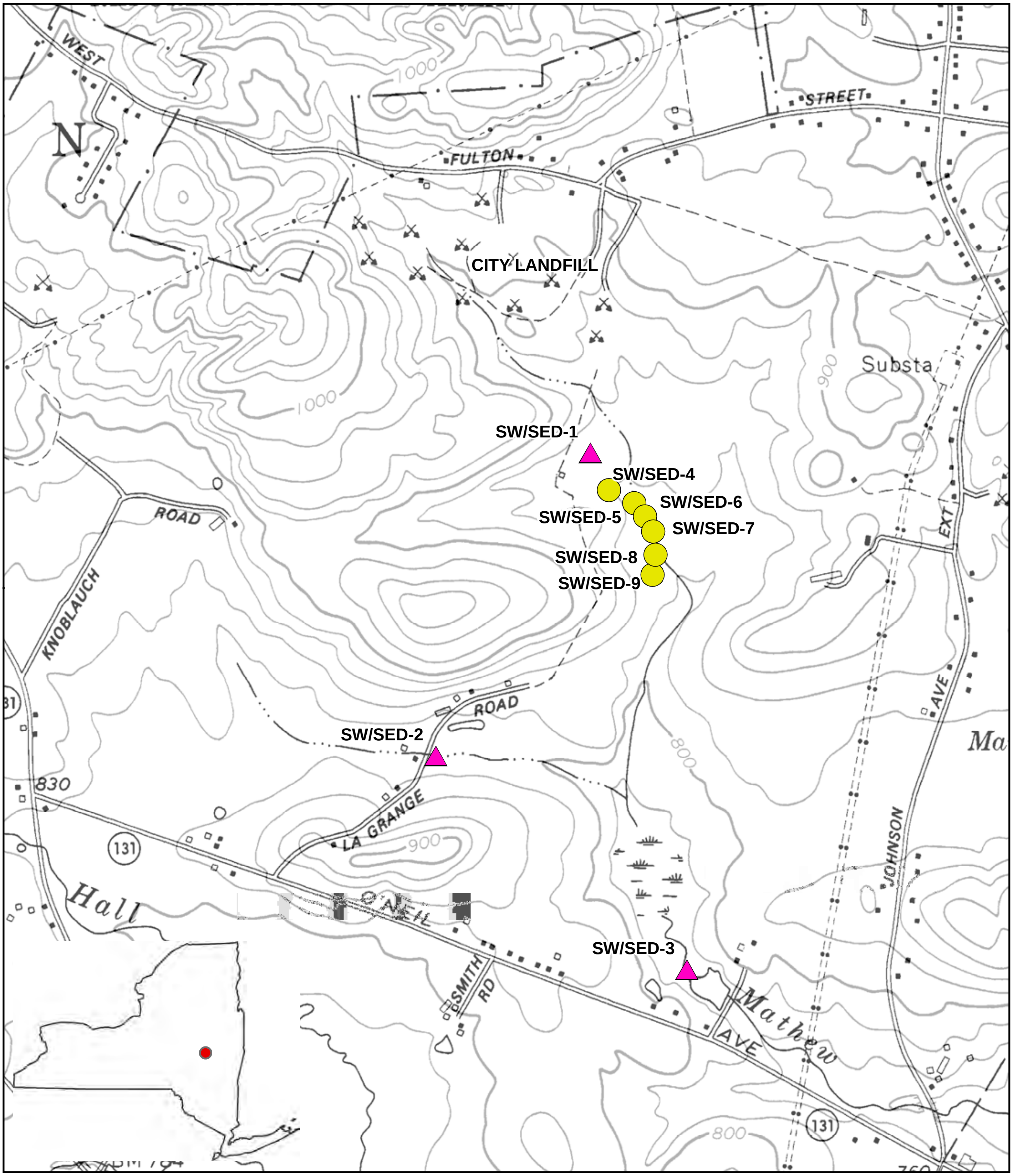
CITY OF JOHNSTOWN
FULTON COUNTY, NEW YORK
CITY OF JOHNSTOWN LANDFILL

GROUNDWATER MONITORING WELL LOCATIONS

SCALE: 1"=300'

SEPTEMBER 2014

FIGURE 1-3



LEGEND:

● 2014 Sampling Location

▲ Baseline/Routine SW Sampling Location

N

0 500 1,000 2,000 3,000 4,000

SCALE IN FEET

CITY OF JOHNSTOWN
JOHNSTOWN LANDFILL

SITE MANAGEMENT PLAN

SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS

ARCADIS

FIGURE

1-4

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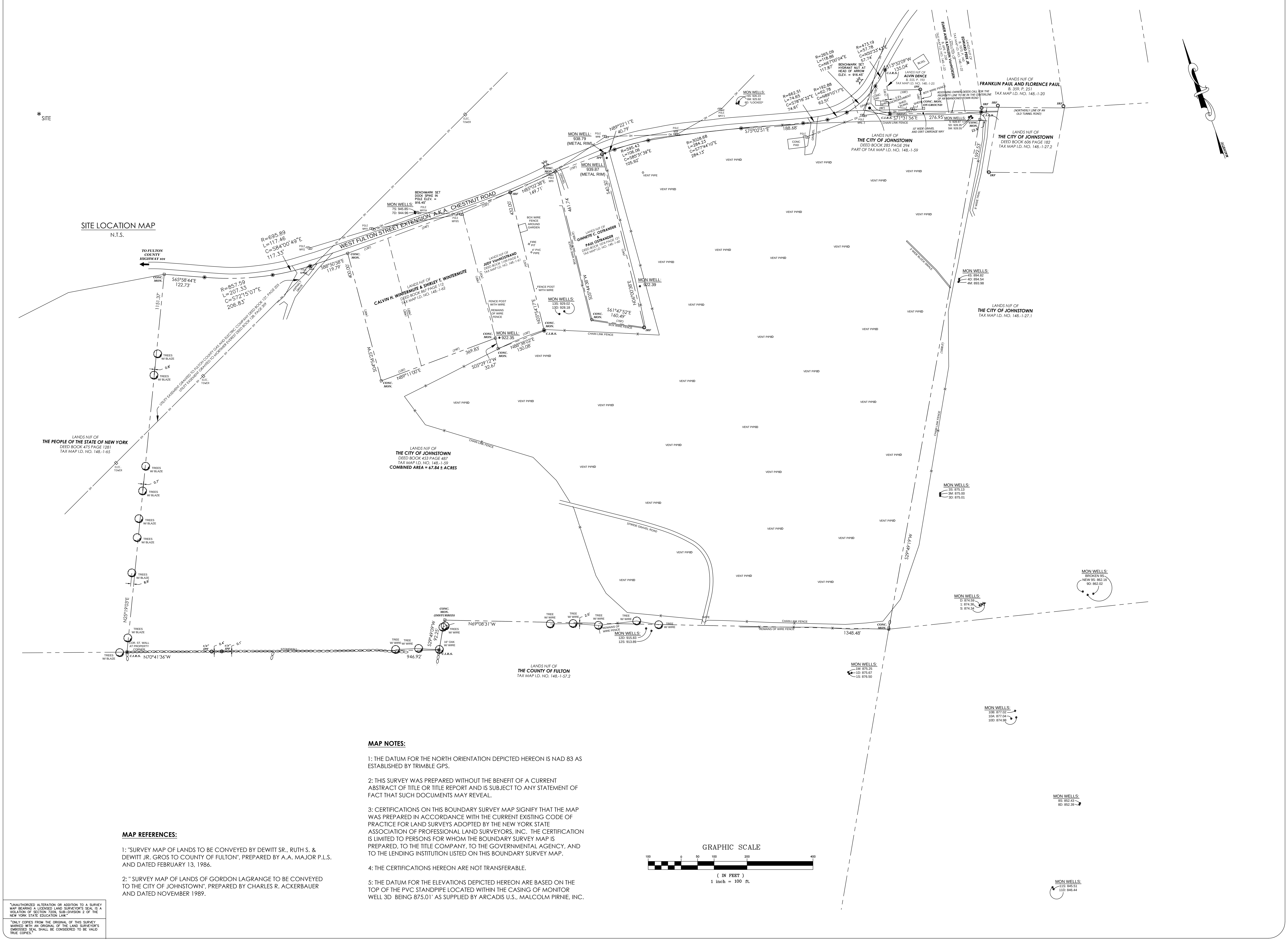
Appendices

APPENDIX A - METES AND BOUNDS

SITE LOCATION MAP

N.T.S.

*SITE



MAP NOTES:

1: THE DATUM FOR THE NORTH ORIENTATION DEPICTED HEREON IS NAD 83 AS ESTABLISHED BY TRIMBLE GPS.

2: THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A CURRENT ABSTRACT OF TITLE OR TITLE REPORT AND IS SUBJECT TO ANY STATEMENT OF FACT THAT SUCH DOCUMENTS MAY REVEAL.

3: CERTIFICATIONS ON THIS BOUNDARY SURVEY MAP SIGNIFY THAT THE MAP WAS PREPARED IN ACCORDANCE WITH THE CURRENT EXISTING CODE OF PRACTICE FOR LAND SURVEYS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS, INC. THE CERTIFICATION IS LIMITED TO PERSONS FOR WHOM THE BOUNDARY SURVEY MAP IS PREPARED, TO THE TITLE COMPANY, TO THE GOVERNMENTAL AGENCY, AND TO THE LENDING INSTITUTION LISTED ON THIS BOUNDARY SURVEY MAP.

4: THE CERTIFICATIONS HEREON ARE NOT TRANSFERABLE.

5: THE DATUM FOR THE ELEVATIONS DEPICTED HEREON ARE BASED ON THE TOP OF THE PVC STANDPIPE LOCATED WITHIN THE CASING OF MONITOR WELL 3D BEING 875.01' AS SUPPLIED BY ARCADIS U.S., MALCOLM PIRNIE, INC.

MAP REFERENCES:

1: "SURVEY MAP OF LANDS TO BE CONVEYED BY DEWITT SR., RUTH S. & DEWITT JR. GROS TO COUNTY OF FULTON", PREPARED BY A.A. MAJOR P.L.S. AND DATED FEBRUARY 13, 1986.

2: " SURVEY MAP OF LANDS OF GORDON LAGRANGE TO BE CONVEYED TO THE CITY OF JOHNSTOWN", PREPARED BY CHARLES R. ACKERBAUER AND DATED NOVEMBER 1989.

"UNAUTHORIZED ALTERATION OR ADDITION TO A SURVEY MAP BEARING A LICENSED LAND SURVEYOR'S SEAL IS A VIOLATION OF SECTION 7209, SUB-DIVISION 2 OF THE NEW YORK STATE EDUCATION LAW."

"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES."

SHEET 1 OF 1

SURVEY OF LANDS OF
THE CITY OF JOHNSTOWN
BOOK 453 OF DEEDS AT PAGE 487, BOOK 285 OF DEEDS AT PAGE 294
TAX MAP ID. NO. 148.00-1-59

DATE:	RECORD OF WORK:	DRN:	CHECK:	APPR:

TOWN OF: JOHNSTOWN
COUNTY OF: FULTON, N.Y.
DATE: JANUARY 10, 2012
SCALE: 1" = 100'
PROJ. NO.: 11-071
DWG. NO.: 12-004
DRAWN BY: AK/D.K.S.

"UNAUTHORIZED ALTERATION OR ADDITION TO A SURVEY MAP BEARING A LICENSED LAND SURVEYOR'S SEAL IS A VIOLATION OF SECTION 7209, SUB-DIVISION 2 OF THE NEW YORK STATE EDUCATION LAW."

"ONLY COPIES OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S EMBOSSED SEAL OR AN ORIGINAL RED INK SEAL SHALL BE CONSIDERED TO BE TRUE AND VALID COPIES."

LEGEND

(DC)	DEED CALL
W/W	WITH WIRE
C.I.R.S	CAPPED IRON ROD SET
I.P.F.	IRON PIPE FOUND
C.I.R.F.	CAPPED IRON ROD FOUND
I.R.F.	IRON ROD FOUND
116.00-2-39	TAX MAP SECTION-BLOCK-LOT
B.769 P.986	DEED BOOK & PAGE
N/F	NOW OR FORMERLY
(176.5)	DEED INFORMATION
—— OH ——	OVERHEAD UTILITY LINES

NORTHEAST LAND SURVEY &
LAND DEVELOPMENT CONSULTANTS, P.C.
P.O. BOX 2140, MALTA, N.Y. 12020, PARADE GROUND VILLAGE
PH: (518) 899-7339 FAX: (518) 899-7340
EMAIL: NORTHEAST@NELANDSURVEY.COM

NORTHEAST
LAND SURVEY &
LAND DEVELOPMENT
CONSULTANTS, P.C.

APPENDIX B – RI DATA SUMMARY TABLES

Tables

Table 1A: Nature and Source of Contaminants Profile
Metals and Miscellaneous Inorganics
Groundwater and Surface Water
Johnstown Landfill, Johnstown, New York

	GROUND WATER UPGRADIENT WELLS				GROUND WATER LANDFILL WELLS				GROUND WATER DOWNGRADIENT WELLS				GROUND WATER RESIDENTIAL WELLS				SURFACE WATER MATHEW CREEK				SURFACE WATER LaGRANGE PIT		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	RESIDENT	FREQ	LOW	HIGH	STAT#	FREQ	LOW	HIGH
METALS (µg/L)																							
Aluminum	27/27	67	43,200	5S	3/3	13,300	55,800	16	51/51	83.8	104,000	11S	34/52	16.0	1,410	Gunnison	11/12	34.9	363	#2R	2/2	192	357
Antimony	2/27	15.8	26.3	14D	0/3				0/51				8/52	13.6	21.4	Palmateer	1/12		13.9	#1	1/2		17
Arsenic	22/27	1.1	16.0	5S	3/3	11.9	35.7	16	44/51	0.8	49.5	3S	11/52	0.30	1.6	LaGrange	0/12				1/2		1.6
Barium	26/27	18.4	425	13D	3/3	17.7	1,080	16	51/51	41.6	594	15S	41/52	2.1	555	Gunnison	12/12	27	72.6	#1	2/2	22.9	32.4
Beryllium	7/27	0.23	3.3	13D	3/3	2.4	6.0	16	51/51	0.37	9.2	11S	4/52	0.21	0.45	Hulbert	0/12				0/2		
Cadmium	16/27	1.3	53.0	7D	3/3	2.5	77.6	16	22/51	1.1	11.4	3D	0/52				0/12				0/2		
Calcium	27/27	42,700	796,000	13D	3/3	327,000	1,430,000	16	51/51	35,300	1,610,000	3S	51/52	87.8	121,000	Pine Tree	12/12	49,900	111,000	#1	2/2	64,900	88,200
Chromium(T)	25/27	3.5	187	13D	3/3	145	2,330	16	46/51	2.6	229	15S	1/52		3.4	Blanket	4/12	3.7	7.2	#4	2/2	34	40.6
Cobalt	13/27	2.4	69	5S	3/3	20.6	61.2	18	29/51	2.2	121	1S	0/52				1/12		3.7	#1	0/2		
Copper	19/27	3.5	269	13D	3/3	104	259	16	39/51	6.8	288	3S	22/52	3.1	30.5	Gunnison	0/12				0/2		
Iron	27/27	651	124,000	5S	3/3	45,800	130,000	16	51/51	58.0	202,000	3S	43/52	53.0	6,840	Gunnison	12/12	63.7	4,940	#4	2/2	1,410	6,330
Lead	26/27	1.0	65.3	5S	3/3	34.0	487	16	45/51	1.0	454	2S	18/52	0.4	5.6	Pine Tree	1/12		5.9	#4	1/2		2.2
Magnesium	27/27	5,210	86,600	5S	3/3	36,800	82,900	16	51/51	4,960	80,400	2S	51/52	33.9	26,100	LaGrange	12/12	6,480	15,000	#2	2/2	8,070	11,100
Manganese	27/27	24	4,630	5S	3/3	1,350	2,570	18	51/51	7.9	57,300	1S	46/52	0.72	7,990	Gunnison	12/12	29.3	557	#1	2/2	93.9	944
Mercury	2/27	0.20	0.40	5S	3/3	0.21	10.6	16	9/51	0.25	0.49	1S	0/52				0/12				0/2		
Nickel	18/27	6.9	247	13D	3/3	91.7	445	16	46/51	7.6	332	3S	5/52	5.9	13.6	Pine Tree	3/12	9.2	12	#4	1/2		12.6
Potassium	27/27	701	13,100	5S	3/3	7,100	206,000	16	50/51	1,070	19,500	3S	43/52	518	13,500	Blanket	12/12	2,980	5,420	#1	2/2	9,790	23,000
Selenium	0/27				0/3				0/51				10/52	0.5	1.4	Forrester	2/12	1.2	1.4	#2R	0/2		
Silver	0/27				0/3				0/51				1/52		2.5	Wintermute	0/12				0/2		
Sodium	27/27	1,890	89,800	6D	3/3	13,300	423,000	16	51/51	1,790	166,000	1S	52/52	2,200	258,000	Hannon	12/12	14,700	70,900	#2	2/2	33,000	97,300
Thallium	0/27				1/3		1.9	16	2/51	1.0	2.7	1S	6/52	0.7	1.6	Schreppel	0/12				0/2		
Vanadium	21/27	3.7	163	13D	2/3	49.9	131	18	35/51	4	270	15S	2/52	6.6	7.2	Wheeler	0/12				2/2	5.9	8
Zinc	27/27	10.8	798	13D	3/3	215	2,730	16	50/51	3.6	479	1S,3S	39/52	4.2	750	Pine Tree	3/12	3.5	20.4	#4	2/2	16.8	283
Cyanide	0/27				1/3		73	16	1/51		10.2	1D	2/52	16.0	29.2	Wager	2/12	34.8	41.0	#3	0/2		
Hexchrome	2/27	30	30	5S,M	0/3				3/51	20	40	1S	0/52				0/12				0/2		
INORG. (mg/L)																							
Sulfate	20/27	7.41	103	5M	3/3	11.5	13.2	19	36/51	11.9	51.8	3D	45/52	10.3	57.9	Wager	10/12	11.1	58.9	#1	2/2	18.9	29.2
Chloride	25/27	6.30	112	6D	3/3	25.3	699	16	46/51	3.17	215	3S	34/52	3.1	154	Pine Tree	12/12	22.2	88.8	#2	2/2	40.3	136
COD	14/27	11.2	668	13D	3/3	19.3	852	18	29/51	10.3	672	10B	5/52	12.7	36.7	Hulbert	6/12	10.4	41	#3	2/2	25.2	219
TDS	27/27	101	634	5S	3/3	286	2,100	16	51/51	134	1,330	3S	52/52	82.0	1,160	Wheeler	12/12	202	463	#1	2/2	322	738
Bicarbonate	27/27	84.4	522	5S	3/3	411	2,890	16	51/51	74.4	760	3S	52/52	67.5	590	Pine Tree	12/12	140	409	#1	2/2	245	315
Carbonate	0/11				0/3				0/23				12/35	0.02	2.4	LaGrange	0/4				0/1		
TOC	11/11	1.4	105	7D	3/3	16.1	178	16	22/23	0.64	68.7	15D					4/4	4.70	11.2	#3	1/1		8.15
Hardness	11/11	81.0	550	5S	3/3	251	700	16	23/23	108	448	4S	17/17	74	328	Pine Tree	4/4	198	279	#1	1/1		197
Ammonia-N	10/11	0.05	15.9	5M	3/3	33.8	472	16	23/23	0.08	64.5	15S,9D	8/8	0.010	5.5	Pine Tree	4/4	2.72	33.5	#1	1/1		11.2

Notes:

FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,RESIDENCE,STAT# = Sample location where highest concentration of analyte was detected

UPGRADIENT WELLS: CLUSTER MWs 5,6,7,13,14
DOWNGRADIENT WELLS: CLUSTER MWs 1,2,3,4,8,9,10,11,12,15
LANDFILL WELLS: MWs 16,18,19

Table 1B: Nature and Source of Contaminants Profile
Metals and Miscellaneous Inorganics
Soil Boring and Sediment Samples
Johnstown Landfill, Johnstown, New York

	SOIL SAMPLES UPGRADIENT BORINGS				SOIL SAMPLES LANDFILL BORINGS				SOIL SAMPLES DOWNGRADIENT BORINGS				SEDIMENT-ROUNDS 1 & 2 MATHEW CREEK				SEDIMENT-ROUND 3 MATHEW CREEK				SEDIMENT-ROUNDS 2 & 3 LaGRANGE PIT		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	STATION	FREQ	LOW	HIGH	STATION	FREQ	LOW	HIGH
METALS (mg/Kg)																							
Aluminum	2/2	3,860	5,710	14D	3/3	4,000	6,480	16	4/4	3,050	11,200	11D	16/16	1,940	16,100	#1,0-6"	16/16	1,590	20,200	BD#2,6-12"	6/6	2,600	3,660
Antimony	0/2				1/3		4.2	17	0/4				0/16				0/16				0/6		
Arsenic	2/2	0.7	1.4	14D	3/3	0.43	1.1	16	4/4	0.5	1.0	12D	16/16	0.58	12.2	#1,6-12"	16/16	0.76	91.0	2R,0-6"	6/6	0.30	2.2
Barium	2/2	14.4	21.3	14D	3/3	16.0	23.9	16	4/4	11.3	21.0	9D	16/16	12	316	#1,0-6"	16/16	19.3	158	2R,0-6"	6/6	9.9	25.4
Beryllium	2/2	0.39	0.53	14D	3/3	0.23	0.39	17	4/4	0.31	0.43	9D	13/16	0.06	0.83	#3INLET	5/16	0.17	0.58	2R,0-6"	3/6	0.21	0.29
Cadmium	0/2				0/3				0/4				3/16	0.93	3.7	#1,0-6"	16/16	0.50	2.7	BD#2,6-12"	6/6	0.29	0.84
Calcium	2/2	12,800	63,400	13D	3/3	18,900	72,000	18	4/4	1,230	39,200	10D	16/16	1,740	56,300	#1,0-6"	16/16	3,020	22,900	SD(A),0-6"	6/6	17,400	106,000
Chromium(T)	2/2	5.9	11.8	14D	3/3	6.3	30.0	16	4/4	5.2	11.5	11D	16/16	1.9	33.8	#1,0-6"	16/16	2.8	18.5	#3IN,0-6"	6/6	29.3	1,820
Cobalt	2/2	1.9	3.0	14D	3/3	2.2	3.0	16	4/4	1.6	4.0	11D	14/16	2.5	39.3	#1,0-6"	16/16	1.7	13.1	2R,0-6"	5/6	2.2	8.5
Copper	2/2	4.5	10.1	14D	3/3	5.0	7.1	17	4/4	4.3	9.1	10D	15/16	1.4	43.2	#3INLET	15/16	0.61	26.4	#3IN,0-6"	6/6	5.4	17.2
Iron	2/2	4,890	9,710	14D	3/3	6,290	9,280	16	4/4	4,660	11,100	9D	16/16	6,100	121,000	#1,0-6"	16/16	5,290	39,700	2R,0-6"	6/6	5,840	8,640
Lead	2/2	1.7	3.8	14D	3/3	2.6	7.8	16	4/4	1.7	3.6	12D	16/16	2.7	17.8	#1,0-6"	16/16	2.8	62.4	#4,6-12"	6/6	3.3	53.4
Magnesium	2/2	3,100	5,780	14D	3/3	1,500	6,660	17	4/4	704	2,060	10D	16/16	602	3,910	#1,0-6"	16/16	536	3,510	MP,0-6"	6/6	1,590	2,880
Manganese	2/2	106	188	14D	3/3	120	188	17	4/4	78.5	224	12D	16/16	41.6	4,220	#1,6-12"	16/16	79.4	2,640	2R,0-6"	6/6	71.5	155
Mercury	0/2				0/3				0/4				0/16				6/16	0.10	0.43	#3IN,0-6"	2/6	0.14	0.22
Nickel	2/2	4.4	10.9	14D	3/3	4.6	7.1	16	4/4	4.0	6.6	9D	14/16	1.6	60.5	#1,0-6"	16/16	3.0	21.6	#1,6-12"	6/6	4.4	8.2
Potassium	2/2	1,080	1,610	14D	3/3	864	1,030	18	4/4	303	786	11D	16/16	279	1,790	#1,0-6"	16/16	160	817	SD(A),0-6"	6/6	276	594
Selenium	0/2				0/3				0/4				6/16	0.43	1.8	#1,6-12"	1/16		0.71	#1,6-12"	1/6		0.33
Silver	0/2				0/3				0/4				0/16				2/16	0.86	2.2	SD(A),0-6"	0/6		
Sodium	2/2	348	395	14D	3/3	343	507	17	4/4	239	365	10D	16/16	105	668	#1,0-6"	16/16	53.4	356	SD(A),0-6"	6/6	82.2	269
Thallium	1/2		0.21	14D	0/3				2/4	0.23	0.26	10D	1/16		0.3	#1,6-12"	0/16				1/6		0.24
Vanadium	2/2	7.1	17.3	14D	3/3	10.3	15.1	16	4/4	6.6	16.2	11D	16/16	7.1	45.7	#1,0-6"	16/16	4.9	29.8	BD#2,6-12"	6/6	4.9	10.0
Zinc	2/2	12.5	18.9	14D	3/3	13.6	32.6	16	4/4	11.3	22.3	9D	16/16	13.1	95.7	#1,0-6"	16/16	12	190	BD#2,6-12"	6/6	24.7	108
Cyanide	NT				0/3				NT				3/16	1.1	1.4	#2,0-6"	1/16		5.7	#3IN,0-6"	0/6		
Hexchrome	0/2				0/3				0/4				2/16	0.06	0.66	#1,0-6"	1/16		0.71	#1,0-6"	0/6		
INORG. (mg/Kg)																							
Sulfate	NT				1/3		250	17	0/4				12/16	81.8	577	#2,6-12"	0/16				3/6	274	337
COD	NT				3/3	5,420	80,800	17	4/4	2,810	11,000	12D	16/16	8,360	347,000	#1,0-6"	16/16	10,700	456,000	BD#2,0-6"	6/6	2,000	62,500
TOC	NT				NT								NT				11/16	7,370	>80,000	BD,SD	4/4	8,740	58,850
Ammonia-N	NT				NT								NT				16/16	18.6	987	2R,0-6"	4/4	23.8	36.3

Notes:
FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,STATION = Sample location where highest concentration of analyte was detected
NT = Not tested

UPGRADIENT BORINGS :	MWs 5,6,7,13,14
DOWNGRADIENT BORINGS	MWs 1,2,3,4,8,9,10,11,12
LANDFILL BORINGS :	MWs 16,17,18

Table · 2A : Nature and Source of Contaminants Profile
TCL Volatile Organic Compounds
Groundwater and Surface Water
Johnstown Landfill, Johnstown, New York

	GROUND WATER UPGRADIENT WELLS				GROUND WATER LANDFILL WELLS				GROUND WATER DOWNGRADIENT WELLS				GROUND WATER RESIDENTIAL WELLS				SURFACE WATER MATHEW CREEK				SURFACE WATER LaGRANGE PIT		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	RESIDENCE	FREQ	LOW	HIGH	STAT#	FREQ	LOW	HIGH
VOC's (µg/L)																							
Acetone	12/27(B)	2	2,900	7D	1/3		130	16	22/51(B)	2	1,700	1D	6/52(B)	3	6	Gunnison	4/12(B)	12	24	#2	1/2		120
Methylene Chloride	8/27(B)	2	76	7D	1/3		26	16	14/51(B)	0.8	44	2D	3/52(B)	1	2	PTRC,Gunnison	3/12(B)	2	3	#1	1/2(B)		8
Trichloroethylene	0/27				0/3				0/51				1/52		2	LaGrange	1/12		1	#3	0/2		
1,1,1 Trichloroethane	1/27		3	5S	0/3				0/51				1/52		3	Schreppel	0/12				0/2		
Chloroform	4/27(B)	0.8	3	7D	0/3				9/51(B)	0.5	20	1M	0/52				0/12				0/2		
Vinyl Chloride	1/27		30	7S	0/3				1/51		3	3D	0/52				0/12				0/2		
Xylene	2/27	2	12	6D	2/3	5	230	16	5/51	0.3	4	3S	0/52				0/12				0/2		
Benzene	1/27		0.8	6D	2/3	0.9	9	16	7/51	0.2	2	3S,8D	0/52				0/12				1/2		2
Ethylbenzene	2/27	0.7	2	6D	2/3	7	110	16	4/51	0.6	2	3S	0/52				0/12				0/2		
Chlorobenzene	1/27		1	6D	0/3				2/51	0.7	2	3S	0/52				1/12		0.7	#4	0/2		
2-Butanone	0/27				0/3				1/51		41	1D	0/52				0/12				1/2		250
4-Methyl-2-Pentanone	0/27				0/3				1/51		7	3S	0/52				0/12				1/2		49
Vinyl Acetate	1/27		0.7	5D	0/3				0/51				0/52				0/12				0/2		
1,1-Dichloroethane	0/27				0/3				2/51		0.2	15D,3S	0/52				0/12				0/2		
Styrene	0/27				0/3				2/51	1	2	3M	0/52				0/12				0/2		
Carbon Disulfide	1/27		2	6D	0/3				5/51	0.1	2	3M,D	4/52	0.3	3	LaGrange	0/12				0/2		
Toluene	4/27	0.6	6	6D	0/3				5/51	0.7	62	3S	1/52		2	Schreppel	4/12(B)	1	2	#1,2R	1/2		18
Tetrachloroethylene	0/27				0/3				0/51				0/52				1/12		7	#3	0/2		
1,1-Dichloroethylene	0/27				0/3				0/51				0/52				0/12				0/2		
1,2-Dichloroethylene	1/27		2	6S	0/3				0/51				0/52				0/12				0/2		

Notes:
FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,RESIDENCE,STAT# = Sample location where highest concentration of analyte was detected
(B) = Flag indicates analyte was detected in method blanks for one or more of the samples

UPGRADIENT WELLS :	CLUSTER MWs 5,6,7,13,14
DOWNGRADIENT WELLS :	CLUSTER MWs 1,2,3,4,8,9,10,11,12,15
LANDFILL WELLS :	MWs 16,18,19

Table 2B: Nature and Source of Contaminants Profile
TCL Volatile Organic Compounds
Soil and Sediment Samples
Johnstown Landfill, Johnstown, New York

	SOIL BORINGS UPGRADIENT WELLS				SOIL BORINGS LANDFILL WELLS				SOIL BORINGS DOWNGRADIENT WELLS				SEDIMENT MATHEW CREEK ROUNDS 1 & 2				SEDIMENT MATHEW CREEK ROUND 3				SEDIMENT LaGRANGE PIT ROUNDS 2 & 3		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	STATION	FREQ	LOW	HIGH	STATION	FREQ	LOW	HIGH
VOC's (µg/Kg)																							
Acetone	5/5(B)	5	160	7S	3/3(B)	13	440	16	9/9(B)	7	75	1D	16/16(B)	14	380	#1,0-6"	16/16(B)	18	130	#3INLET	6/6(B)	16	99
Methylene Chloride	3/5(B)	2	6	13D	3/3(B)	4	7	16	7/9(B)	2	5	2D	15/16(B)	2	28	#1,0-6"	15/16(B)	6	23	#3INLET	5/6(B)	4	8
Trichloroethylene	0/5				0/3				2/9	7	9	12D	0/16				1/16		18	SD(B),6-12"	0/6		
1,1,1 Trichloroethane	0/5				0/3				2/9	4	5	10D	0/16				0/16				0/6		
Chloroform	3/5	1	1	5,6,7	0/3				1/9		1	1D	4/16(B)	0.8	2	#1,6-12"	0/16				0/6		
Vinyl Chloride	0/5				0/3				0/9				0/16				0/16				0/6		
Xylene	0/5				2/3	10	15	16	2/9	3	9	12D	0/16				0/16				0/6		
Benzene	0/5				1/3		13	16	1/9		0.6	12D	1/16		3	#2,0-6"	0/16				0/6		2
Ethylbenzene	0/5				2/3	3	5	17	2/9	1	2	12D	0/16				0/16				0/6		
Chlorobenzene	0/5				0/3				0/9				0/16				0/16				0/6		
2-Butanone	3/5(B)	2	4	5D	2/3(B)	7	350	16	3/9(B)	2	3	12D	8/16	6	100	#3 INLET	11/16(B)	2	32	#3INLET	3/6(B)	3	96
4-Methyl-2-Pentanone	0/5				1/3(B)		14	16	0/9				0/16				0/16				1/6		15
Vinyl Acetate	0/5				0/3				0/9				0/16				0/16				0/6		
1,1-Dichloroethane	0/5				0/3				0/9				0/16				0/16				0/6		
Styrene	0/5				0/3				0/9				0/16				0/16				0/6		
Carbon Disulfide	0/5				0/3				0/9				1/16		31	#3 INLET	1/16				0/6		
Toluene	3/5(B)	0.5	2	14D	2/3	10	51	16	5/9	0.6	2	3D	3/16	2	3	#1,#3IN.	2/16	4	5	#4,0-6"	2/6	3	23
Tetrachloroethylene	1/5		3	7S	0/3				5/9	0.7	2	1D,3D	0/16				0/16				0/6		
1,1-Dichloroethylene	0/5				0/3				2/9		0.9	3D,11D	0/16				0/16				0/6		
1,2-Dichloroethylene	0/5				0/3				0/9				0/16				0/16				0/6		

Notes:
FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,STATION = Sample location where highest concentration of analyte was detected
(B) = Flag indicates analyte was detected in method blanks for one or more of the samples

UPGRADIENT BORINGS :	MWs 5,6,7,13,14
DOWNGRADIENT BORINGS :	MWs 1,2,3,4,8,9,10,11,12
LANDFILL BORINGS :	MWs 16,17,18

Table 3A : Nature and Source of Contaminants Profile
TCL Semi-Volatile Organics and Pesticides
Groundwater and Surface Water
Johnstown Landfill, Johnstown, New York

	GROUND WATER UPGRADIENT WELLS				GROUND WATER LANDFILL WELLS				GROUND WATER DOWNGRADIENT WELLS				GROUND WATER RESIDENTIAL WELLS				SURFACE WATER MATHEW CREEK				SURFACE WATER LaGRANGE PIT		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	RESIDENCE	FREQ	LOW	HIGH	STAT#	FREQ	LOW	HIGH
SVOC's (µg/L)																							
Phenol	0/19				0/3				0/37				0/39				0/8				1/1		41
Benzyl alcohol	0/19				0/3				0/37				0/39				0/8				1/1		4
1,2-Dichlorobenzene	0/19				1/3		2	16	0/37				0/39				0/8				0/1		
4-Methylphenol	0/19				0/3				1/37		4	3S	0/39				0/8				1/1		10
Benzoic acid	0/19				2/3	2	6	19	7/37	2	4	15S,9	0/39				0/8				1/1		190
Naphthalene	1/19		0.6	6D	2/3	1	21	16	0/37				0/39				0/8				0/1		
2-Methylnaphthalene	0/19				1/3		2	16	0/37				0/39				0/8				0/1		
Dimethylphthalate	1/19		0.7	6S	0/3				1/37		0.4	2S	0/39				0/8				0/1		
Diethylphthalate	6/19(B)	0.8	2	5S,D	1/3		2	19	15/37(B)	0.6	6	11D	1/39		2	Forester	7/8(B)	0.4	1	#1,3	1/1(B)		21
N-Nitrosodiphenylamine(1)	0/19				0/3				1/37		4	11D	0/39				0/8				0/1		
Phenanthrene	0/19				1/3		1	16	2/37	0.5	3	11D	0/39				0/8				0/1		
Anthracene	0/19				0/3				2/37	0.6	3	11D	0/39				0/8				0/1		
Di-n-butylphthalate	6/19(B)	0.5	3	5D	2/3	1	2	16	16/37(B)	0.4	11	11D	6/39(B)	0.8	2	Forester	5/8(B)	0.4	0.7	#4	1/1(B)		2
Fluoranthene	0/19				1/3		2	16	2/37	0.7	7	11D	0/39				0/8				0/1		
Pyrene	0/19				1/3		2	16	2/37(B)	1	7	11D	0/39				0/8				0/1		
Butylbenzylphthalate	2/19	0.2	0.4	6D	0/3				4/37(B)	0.3	7	11D	0/39				0/8				1/1		0.2
3,3'-Dichlorobenzidine	0/19				0/3				1/37		7	11D	0/39				0/8				0/1		
Benzo(a)anthracene	0/19				0/3				2/37	0.8	4	11D	0/39				0/8				0/1		
Chrysene	0/19				0/3				2/37	1	2	11D	0/39				0/8				0/1		
bis(2-Ethylhexyl)phthalate	18/19(B)	2	33	6S	3/3(B)	9	24	16	37/37(B)	2	150	3D	34/39(B)	2	66	Palmateer	7/8(B)	0.7	16	#1	1/1(B)		9
Di-n-octylphthalate	4/19	0.3	4	5M	1/3		0.6	19	8/37(B)	0.3	8	11D	5/39	3	16	Paul	0/8				1/1		0.2
Benzo(b)fluoranthene	0/19				0/3				2/37(B)	0.6	5	11D	0/39				0/8				0/1		
Benzo(k)fluoranthene	0/19				0/3				1/37(B)		0.8	15S	0/39				0/8				0/1		
Benzo(a)pyrene	0/19				0/3				2/37(B)	0.7	4	11D	0/39				0/8				0/1		
Indeno(1,2,3-cd)pyrene	0/19				0/3				1/37(B)			11D	0/39				0/8				0/1		
PESTICIDES (µg/L)																							
delta-BHC	0/19				0/3				1/37		0.04	9S	0/39				0/8				0/1		
Endosulfan 1	0/19				0/3				1/37		0.05	11D	0/39				0/8				0/1		
Dieldrin	0/19				1/3		0.01	16	0/37				0/39				0/8				0/1		
4,4'-DDE	0/19				1/3		0.19	16	0/37				0/39				0/8				0/1		
4,4'-DDD	0/19				1/3		0.35	16	0/37				0/39				0/8				0/1		
4,4'-DDT	0/19				1/3		0.03	16	0/37				0/39				0/8				0/1		
alpha-Chlordane	0/19				1/3		0.06	16	0/37				0/39				0/8				0/1		
gamma-Chlordane	0/19				1/3		0.05	16	0/37				0/39				0/8				0/1		
gamma-BHC	0/19				0/3				0/37				0/39				0/8				0/1		
Heptachlor	0/19				0/3				0/37				0/39				0/8				0/1		
Aldrin	0/19				0/3				0/37				0/39				0/8				0/1		
Heptachlor Epoxide	0/19				0/3				0/37				0/39				0/8				0/1		
Endrin	0/19				0/3				0/37				0/39				0/8				0/1		

Notes:
FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,RESIDENCE,STAT# = Sample location where highest concentration of analyte was detected
(B) = Flag indicates analyte was detected in method blanks for one or more of the samples

UPGRADIENT WELLS :	CLUSTER MWs 5,6,7,13,14
DOWNGRADIENT WELLS :	CLUSTER MWs 1,2,3,4,8,9,10,11,12,15
LANDFILL WELLS :	MWs 16,18,19

Table 3B : Nature and Source of Contaminants Profile
TCL Semi-Volatile Organics and Pesticides
Soil and Sediment Samples
Johnstown Landfill, Johnstown, New York

	SOIL BORINGS LANDFILL WELLS				SEDIMENT SAMPLES MATHEW CREEK ROUND 1				SEDIMENT SAMPLES MATHEW CREEK ROUND 2				SEDIMENT SAMPLES LaGRANGE PIT ROUNDS 1 & 2		
Parameter	FREQ	LOW	HIGH	MW	FREQ	LOW	HIGH	STAT	FREQ	LOW	HIGH	STAT	FREQ	LOW	HIGH
SVOC's (µg/Kg)															
Acenaphthene	0/3				0/3				0/3				1/2		44
Dibenzofuran	0/3				0/3				0/3				1/2		48
Fluorene	0/3				0/3				0/3				2/2	15	91
Acenaphthylene	0/3				0/3				1/8		12	#4,6-12	2/2	11	42
Benzoic acid	2/3	120	380	16	6/8	32	4,500	#1,0-6	7/8	28	480	#1,6-12	0/2		
Naphthalene	1/3		410	16	0/3				1/8		15	#4,6-12	2/2	170	1,400
2-Methylnaphthalene	0/3				0/3				1/8		9	#4,6-12	2/2	40	320
Dimethylphthalate	0/3				0/3				1/8		18	#3,OUT	0/2		
Diethylphthalate	1/3		700	16	2/8	80	82	#4,6-12	6/8(B)	19	58	#1,0-6	2/2(B)	52	71
N-Nitrosodiphenylamine(1)	0/3				0/3				0/3				0/2		
Phenanthrene	0/3				2/8(B)	31	160	#1,0-6	4/8	37	220	#4,6-12	2/2	56	170
Anthracene	0/3				0/3				3/8	20	51	#4,6-12	2/2	16	51
Di-n-butylphthalate	1/3		760	16	1/8(B)		67	#4,6-12	8/8(B)	23	90	#1,0-6	1/2(B)		41
Fluoranthene	0/3				3/8(B)	40	370	#1,0-6	8/8	16	260	#4,6-12	2/2	69	150
Pyrene	0/3				4/8(B)	21	210	#1,0-6	6/8(B)	16	210	#4,6-12	2/2	71	150
Butylbenzylphthalate	1/3		700	17	0/8				3/8(B)	9	35	#3,IN	0/2		
3,3'-Dichlorobenzidine	0/3				0/8				0/8				0/2		
Benzo(a)anthracene	0/3				1/8(B)		170	#1,0-6	4/8	22	93	#4,6-12	2/2	46	84
Chrysene	0/3				1/8(B)		170	#1,0-6	4/8	22	110	#4,6-12	2/2	45	99
bis(2-Ethylhexyl)phthalate	3/3(B)	400	1,100	18	8/8(B)	44	180	#4,6-12	8/8(B)	69	140	#3,IN	2/2(B)	430	850
Di-n-octylphthalate	1/3		42	16	1/8		15	#4,6-12	8/8	12	190	#3,IN	2/2(B)	45	270
Benzo(b)fluoranthene	0/3				2/8(B)	16	150	#1,0-6	3/8	48	75	#4,0-6	2/2	43	240
Benzo(k)fluoranthene	0/3				0/8				2/8	56	59	#3,OUT	1/2		160
Benzo(a)pyrene	0/3				1/8		15	#4,6-12	3/8	48	70	#4,6-12	1/2		43
Indeno(1,2,3-cd)pyrene	0/3				1/8		8	#4,6-12	0/8				0/2		
Benzo(g,h,i)perylene	0/3				0/8				1/8		4	#4,6-12	0/2		
Isophorone	0/3				0/8				2/8	7	8	#3,OUT	0/2		
PESTICIDES (µg/Kg)															
gamma-BHC	1/3		4.1	18	0/8				0/8				0/2		
delta-BHC	1/3		4.5	18	1/8		13	#3,IN	0/8				0/2		
Endosulfan 1	1/3		14	18	0/8				0/8				0/2		
Dieldrin	1/3		17	18	0/8				0/8				0/2		
4,4'-DDE	2/3	11	25	16	4/8	2.1	9.8	#1,0-6	4/8	2.5	12	#1,0-6	2/2	38	170
4,4'-DDD	1/3		37	16	0/8				0/8				2/2	13	69
4,4'-DDT	2/3	14	18	16	0/8				0/8				0/2		
alpha-Chlordane	0/3				0/8				0/8				0/2		
gamma-Chlordane	0/3				0/8				0/8				0/2		
Heptachlor	1/3		4.4	18	0/8				0/8				1/2		3.7
Aldrin	1/3		5.8	18	0/8				0/8				1/2		1.8
Heptachlor Epoxide	1/3		14	18	0/8				0/8				0/2		
Endrin	1/3		21	18	0/8				0/8				0/2		

Notes:
FREQ = Frequency of analyte detected above sample detection limits
LOW = Lowest concentration detected in each sampling category
HIGH = Highest concentration detected in each sampling category
MW,STAT# = Sample location where highest concentration of analyte was detected

UPGRADIENT BORING : MWs 5,6,7,13,14
DOWNGRADIENT BORING : MWs 1,2,3,4,8,9,10,11,12
LANDFILL BORING : MWs 16,17,18
(B) = Flag indicates analyte was detected in method blanks for one or more of the samples

Table 4 : Summary Results of 3-Hour Air Quality Sampling For VOCs
Johnstown Landfill, Johnstown, New York, September, 1989.

	Station No. ST-1				Station No. ST-2				Station No. ST-3				Occupat. Value* (24-HR)	AGC** (annual)
Date Sampled	9/13	9/13	9/21	9/21	9/13	9/13	9/21	9/21	9/13	9/13	9/21	9/21		
Sample Number	T-2	T-3	T-8	T-9	T-4	T-5	T-10	T-11	T-6	T-7	T-12	T-13		
Pump Flow Rate (L/min)	0.104	0.251	0.100	0.251	0.100	0.253	0.102	0.253	0.102	0.252	0.104	0.252		
Parameter														
Acetone	3.05	2.44	6.11	ND	ND	1.00	1.22	ND	4.44	20.56	ND	ND	1.78E6	35,600(c)
Benzene	1.84	1.02	1.11	0.64	1.89	0.74	ND	ND	0.69	1.44	1.53	0.62	30,000	100(a)
Toluene	1.26	1.00	ND	0.49	1.17	0.61	1.22	0.57	0.62	ND	ND	0.62	375,000	7,500(c)
2-Butanone	ND	ND	ND	ND	1.61	0.63	ND	ND	ND	ND	ND	ND	590,000	1,967(b)
1,1,1-Trichloroethane	1.05	0.84	ND	0.69	1.39	0.83	1.50	0.98	0.69	1.22	ND	0.62	1.90E6	38,000(c)
Carbon Tetrachloride	ND	ND	ND	0.47	ND	ND	ND	ND	ND	ND	ND	ND	30,000	100(a)
Totals	7.20	5.30	7.22	2.29	6.06	3.81	3.94	1.57	6.44	23.22	1.53	1.86		

Notes :
All concentration values expressed in micrograms per cubic meter (ug/cu. m)
(a) = High Toxicity Air Contaminants
(b) = Moderate Toxicity Air Contaminants
(c) = Low Toxicity Air Contaminants
* = Short Term 1989 ACGIH TWA-TLV
** = Long Term Ambient Guideline Concentration – (derived from ACGIH TWA-TLV)
ND = Not Detectable

Table 5 : Summary Results of Airborne Chromium Sampling
Johnstown Landfill, Johnstown, New York
September and October, 1989.

Station Number	Date	Filter Number	Total Chromium (µg)	Total Flow (cu. m)	Chromium Concentration (µg/cu. m)	Average Chromium Concentration (µg/cu. m)	AGC* (µg/cu. m)	Occupational Value** (µg/cu. m)
HV-1-P	9/14/89	2872	6.0	1,898.9	0.003	0.004	0.167	50
	10/1/89	2881	9.9	1,929.3	0.005			
	10/6/89	2885	6.9	1,937.6	0.004			
HV-1-C	9/14/89	2873	5.9	1,815.1	0.003	0.004	0.167	50
	10/1/89	2882	9.2	1,875.4	0.005			
	10/6/89	2886	6.4	1,821.3	0.004			
HV-2	9/14/89	2875	4.6	1,592.3	0.003	0.003	0.167	50
	10/1/89	2883	4.6	1,672.2	0.003			
	10/6/89	2887	5.5	1,670.7	0.003			
HV-3	9/14/89	2874	5.3	1,569.9	0.003	0.003	0.167	50
	10/1/89	2884	3.5	1,705.3	0.002			
	10/6/89	2889	6.8	1,692.7	0.004			

Notes :
* = Ambient Guideline Concentration – Annual Average – derived from 1989 ACGIH TWA–TLV
** = 1989 ACGIH Short Term TWA–TLV

Table 6
Study Chemicals, with Abbreviations and Common Synonyms
Johnstown Landfill, Johnstown, NY

Chemical	Abbreviation	Synonym 1	Synonym 2	CAS Number
Metals and Cyanide				
aluminum	Al			7429-90-5
antimony	Sb			7440-36-0
arsenic	As			7440-38-2
barium	Ba			7440-39-3
beryllium	Be			7440-41-7
cadmium	Cd			7440-43-9
chromium	Cr (III)			
chromium VI	Cr (VI)			18540-29-9
cobalt	Co			7440-48-4
copper	Cu			7440-50-8
lead	Pb			7439-92-1
mercury	Hg			7439-97-6
nickel	Ni			7440-02-0
selenium	Se			7782-49-2
silver	Ag			7440-22-4
strontium	Sr			7440-24-6
thallium	Tl			7440-28-0
titanium	Ti			7440-32-6
vanadium	V			7440-62-2
zinc	Zn			7440-66-6
cyanide				57-12-5
Volatile Organic Compounds				
methylene chloride	DCM	dichloromethane		75-09-2
chloroform		trichloromethane		67-66-3
carbon tetrachloride		perchloromethane		56-23-5
carbon disulfide				75-15-0
1,1,1-trichloroethane	1,1,1-TCA	methyl chloroform		71-55-6
vinyl chloride		chloroethene	chloroethylene	75-01-4
trichloroethylene	TCE	trichloroethene		79-01-6
tetrachloroethylene	PCE	tetrachloroethene	perchloroethylene	127-18-4
acetone		dimethyl ketone	2-propanone	67-64-1
2-butanone	MEK	methyl ethyl ketone		78-93-3
4-methyl-2-pentanone	MIBK	methyl isobutyl ketone		108-10-1
benzene		benzol		71-43-2
ethylbenzene		phenylethane		100-41-4
toluene		methylbenzene		108-88-3
xylenes (total)		xylene, mixed	xylenes [total]	1330-20-7
styrene		vinylbenzene		100-42-5
Semi-Volatile Organic Compounds				
benzoic acid		benzene carboxylic acid		65-85-0
phenol		carbolic acid		108-95-2
4-methylphenol		p-cresol	4-cresol	106-44-5
di-n-butylphthalate				84-74-2
di-n-octylphthalate				117-84-0
bis(2-ethylhexyl)phthalate	DEHP	di(2-ethylhexyl)phthalate		117-81-7
butylbenzylphthalate				85-68-7
naphthalene				91-20-3
Pesticides and PCBs				
ΣDDTR		Total DDT Residue (sum of DDT, DDD, DDE)		

Table 7
Summary of Exposure Scenarios
Johnstown Landfill, Johnstown, NY

	Scenario 1: Nearby Residents Current Conditions (Landfill Closed and Unremediated)			Scenario 2: Nearby Residents Future Conditions (Landfill Capped and Fenced, with no Ground Water Interception and Treatment)			Scenario 3: Nearby Residents Future Conditions (Landfill Capped and Fenced, with Ground Water Interception and Treatment)		
	1a Trespassing on the Landfill	1b Wading/ Fishing in Matthew Creek	1c Living at Home	2a Trespassing on the Landfill	2b Wading/ Fishing in Matthew Creek	2c Living at Home	3a Trespassing on the Landfill	3b Wading/ Fishing in Matthew Creek	3c Living at Home
Exposures to Soil from the Landfill									
Incidental Ingestion of Soil on Landfill	Yes	No	No	No	No	No	No	No	No
Dermal Contact with Soil on Landfill	Yes	No	No	No	No	No	No	No	No
Inhalation of Fugitive Dust on Landfill	Yes	No	No	No	No	No	No	No	No
Exposures to Matthew Creek									
Incidental Ingestion of Sediments	No	Yes	No	No	Yes	No	No	Yes	No
Dermal Contact with Sediments	No	Yes	No	No	Yes	No	No	Yes	No
Incidental Ingestion of Surface Water	No	Yes	No	No	Yes	No	No	Yes	No
Dermal Contact with Surface Water	No	Yes	No	No	Yes	No	No	Yes	No
Ingestion of Fish	No	Yes	No	No	Yes	No	No	Yes	No
Exposures to Ground Water									
Use of Ground Water as Household Water	No	No	Yes	No	No	Yes	No	No	Yes
Exposures to Outdoor Air									
Inhalation of Outdoor Air	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8
Summary of Key Toxicological Properties of Study Chemicals
Johnstown Landfill, Johnstown, NY

Chemical	Chronic Noncarcinogenic Toxicity by Ingestion: Reference Dose (RfD) (mg/(kg-day))	Confidence in RfD	Species Tested in Critical Study	Chronic Noncarcinogenic Toxicity by Inhalation: Reference Concentration (RfC) (mg/m3)	Reference Dose (RfD) (mg/(kg-day))	Confidence in RfD	Species Tested in Critical Study
Metals and Cyanide							
aluminum							
antimony	4E-04	low	rat				
arsenic	3E-04	med	human				
barium	7E-02	med	human	5E-04	1E-04		rat
beryllium	5E-03	low	rat				
cadmium	5E-04	high	human				
chromium III	1E+00	low	rat	2E-06	6E-07		human
chromium VI	5E-03	low	rat	2E-06	6E-07		human
cobalt							
copper	~~4E-02~~		human				
lead	5E-04						
mercury	3E-04		rat	3E-04	9E-05		human
nickel	2E-02	med	rat				
selenium	5E-03	high	human				
silver	5E-03	low	human				
strontium							
thallium	7E-05		rat				
titanium							
vanadium	7E-03		rat				
zinc	2E-01		human				
cyanide	2E-02	med	rat				
Volatile Organic Compounds							
methylene chloride	6E-02	med	rat	3E+00	9E-01		rat
chloroform	1E-02	med	dog		1E-02		
carbon tetrachloride	7E-04	med	rat		7E-04		
carbon disulfide	1E-01	med	rabbit	1E-02	3E-03		rat
1,1,1-trichloroethane	9E-02		guinea pig	1E+00	3E-01		guinea pig
vinyl chloride							
trichloroethylene							
tetrachloroethylene	1E-02	med	mouse; rat		1E-02		
acetone	1E-01	low	rat		1E-01		
2-butanone							
4-methyl-2-pentanone							
benzene							
ethylbenzene	1E-01	low	rat	1E+00	3E-01	low	rat, rabbit
toluene	2E-01	med	rat	2E+00	6E-01		human
xylenes (total)	2E+00	med	rat	3E-01	9E-02		human
styrene	2E-01	med	dog		2E-01		
Semi-Volatile Organic Compounds							
benzoic acid	4E+00	med	human		4E+00		
phenol	6E-01	low	rat		6E-01		
4-methylphenol							
di-n-butylphthalate	1E-01	low	rat		1E-01		
di-n-octylphthalate							
bis(2-ethylhexyl)phthalate	2E-02	med	guinea pig		2E-02		
butylbenzylphthalate	2E-01		rat		2E-01		
naphthalene	4E-03		rat		4E-03		
Pesticides and PCBs							
ΣDDTR	5E-04				5E-04		
4,4'-DDD							
4,4'-DDE							
4,4'-DDT	5E-04	med	rat		5E-04		

Table 9
Summary of Noncancer Risks
Current Land Use Scenario

	Total HI as a Child	Total HI as a Youth			Total HI as an Adult	
	Living at Home	Trespassing	Wading / Fishing	Living at Home	Wading / Fishing	Living at Home
Chemical	(ratio)	(ratio)	(ratio)	(ratio)	(ratio)	(ratio)
Metals and Cyanide						
aluminum						
antimony	2.4E+00		4.5E-04	1.2E+00	2.7E-04	9.5E-01
arsenic	2.1E-01	3.2E-04	2.1E-03	1.1E-01	1.3E-03	8.6E-02
barium	1.6E-01	6.0E-05	5.1E-02	7.9E-02	4.5E-02	6.3E-02
beryllium	4.3E-03	1.8E-06	7.1E-06	2.1E-03	4.3E-06	1.7E-03
cadmium		6.2E-05	2.5E-04		1.5E-04	
chromium	1.1E-04	7.3E-01	6.7E-04	5.3E-05	6.0E-04	4.3E-05
chromium VI			3.9E-05		2.4E-05	
cobalt						
copper	1.5E-02	1.6E-05	1.1E-02	7.6E-03	1.0E-02	6.1E-03
lead	2.2E-01	2.8E-03	8.6E-01	1.1E-01	7.7E-01	8.7E-02
mercury		2.0E-05	1.3E-01		1.2E-01	
nickel	1.5E-02	1.6E-05	6.4E-05	7.3E-03	3.9E-05	5.9E-03
selenium	1.2E-02	2.5E-06	1.3E-05	6.0E-03	8.1E-06	4.8E-03
silver	2.3E-02			1.2E-02		9.4E-03
strontium						
thallium	2.5E+00			1.3E+00		1.0E+00
titanium						
vanadium	2.8E-02	5.1E-05	2.9E-04	1.4E-02	1.7E-04	1.1E-02
zinc	4.0E-02	1.9E-05	4.4E-02	2.0E-02	3.9E-02	1.6E-02
cyanide	2.2E-02		2.7E-05	1.1E-02	1.6E-05	8.9E-03
Volatile Organic Compounds						
methylene chloride		1.5E-07	3.7E-07		2.6E-07	
chloroform						
carbon tetrachloride	6.8E-01	2.9E-03	1.3E-04	3.8E-01	6.7E-05	1.9E-01
carbon disulfide	5.3E-02		1.7E-07	2.6E-02	1.2E-07	2.1E-02
1,1,1-trichloroethane	3.5E-03	1.5E-05	6.9E-07	1.9E-03	3.5E-07	9.7E-04
vinyl chloride						
trichloroethylene						
tetrachloroethylene	3.0E-02		9.3E-06	1.5E-02	6.1E-06	1.2E-02
acetone	6.0E-02	2.6E-04	1.3E-05	3.3E-02	7.0E-06	1.7E-02
2-butanone						
4-methyl-2-pentanone						
benzene						
ethylbenzene						
toluene	1.6E-03	6.8E-06	3.8E-07	8.7E-04	2.1E-07	4.3E-04
xylenes (total)						
styrene						
Semi-Volatile Organic Compounds						
benzoic acid			1.5E-07		1.0E-07	
phenol						
4-methylphenol						
di-n-butylphthalate						
di-n-octylphthalate						
bis(2-ethylhexyl)phthalate			3.9E-04		2.7E-04	
butylbenzylphthalate						
naphthalene		5.0E-05				
Pesticides and PCBs						
ΣDDTR		6.6E-05	1.4E-01		1.2E-01	
	6.5E+00	7.3E-01	1.2E+00	3.3E+00	1.1E+00	2.5E+00

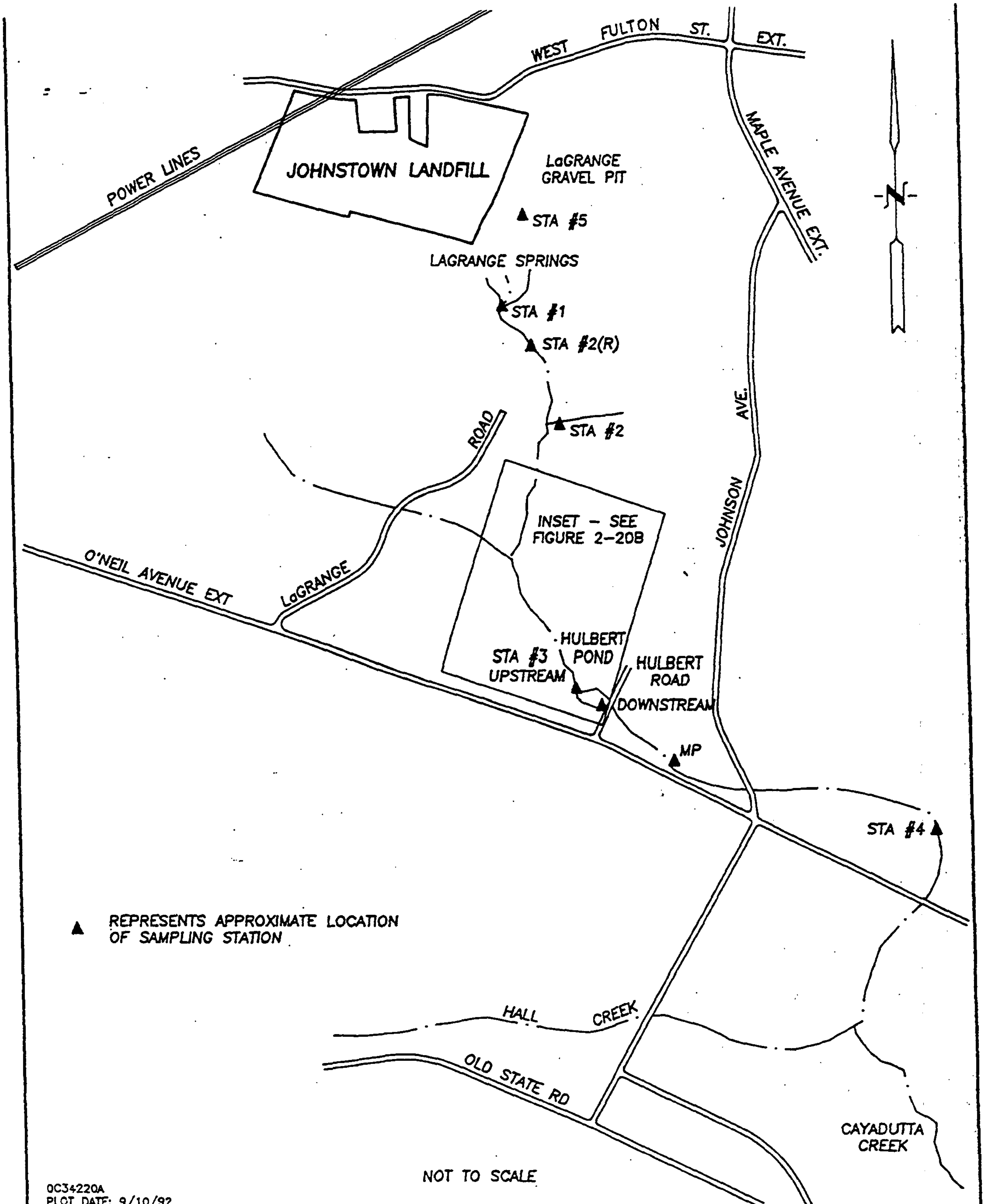
Table 10
Carcinogenic Toxicity Values

	Carcinogenicity by Ingestion			Carcinogenicity by Inhalation		
Chemical	Weight-of-Evidence Classification	Drinking Water Unit Risk ((µg/l)-1)	Cancer Potency Factor (CPF) (mg/(kg•day))-1	Weight-of-Evidence Classification	Inhalation Unit Risk (µg/m3)-1	Cancer Potency Factor (CPF) (mg/(kg•day))-1
Metals and Cyanide						
aluminum						
antimony						
arsenic	A			A	4.3E-03	5.0E+01
barium						
beryllium	B2	1.2E-04	4.3E+00	B2	2.4E-03	8.4E+00
cadmium				B1	1.8E-03	6.3E+00
chromium III						
chromium VI				A	1.2E-02	4.1E+01
cobalt						
copper	D			D		
lead	B2			B2		
mercury	D			D		
nickel				A	2.4E-04	8.4E-01
selenium	D			D		
silver	D			D		
strontium						
thallium						
titanium						
vanadium						
zinc	D			D		
cyanide	D			D		
Volatile Organic Compounds						
methylene chloride	B2	2.1E-07	7.5E-03	B2	4.7E-07	1.6E-03
chloroform	B2	1.7E-07	6.1E-03	B2	2.3E-05	8.1E-02
carbon tetrachloride	B2	3.7E-06	1.3E-01	B2	1.5E-05	1.3E-01
carbon disulfide						
1,1,1-trichloroethane	D			D		
vinyl chloride	A	5.4E-05	1.9E+00	A	8.4E-05	2.9E-01
trichloroethylene	B2	3.2E-07	1.1E-02	B2	1.7E-06	1.7E-02
tetrachloroethylene	B2	1.5E-06	5.1E-02	B2	5.2E-07	1.8E-03
acetone	D			D		
2-butanone						
4-methyl-2-pentanone						
benzene	A	8.3E-07	2.9E-02	A	8.3E-06	2.9E-02
ethylbenzene	D			D		
toluene	D			D		
xylenes (total)	D			D		
styrene	B2	8.6E-07	3.0E-02	B2	5.7E-07	2.0E-03
Semi-Volatile Organic Compounds						
benzoic acid	D			D		
phenol	D			D		
4-methylphenol	C			C		
di-n-butylphthalate	D			D		
di-n-octylphthalate						
bis(2-ethylhexyl)phthalate	B2	4.0E-07	1.4E-02	B2		1.4E-02
butylbenzylphthalate	C					
naphthalene	D			D		
Pesticides and PCBs						
ΣDDTR	B2	9.7E-06	3.4E-01	B2	9.7E-05	3.4E-01
4,4'-DDD	B2	6.9E-06	2.4E-01			2.4E-01
4,4'-DDE	B2	9.7E-06	3.4E-01	B2		3.4E-01
4,4'-DDT	B2	9.7E-06	3.4E-01	B2	9.7E-05	3.4E-01

Table 11
Summary of Cancer Risks
Current Land Use Scenario

	Total ILCR				
Chemical	Trespassing (prob)	Wading / Fishing (prob)	Living at Home (prob)	All Activities (prob)	Percent of Summary ILCR (%)
Metals and Cyanide					
aluminum					
antimony					
arsenic	2.8E-09			2.8E-09	0.0%
barium					
beryllium	4.6E-09	4.2E-08	2.2E-05	2.2E-05	40.7%
cadmium	1.1E-10			1.1E-10	0.0%
chromium					
chromium VI					
cobalt					
copper					
lead					
mercury					
nickel	1.5E-10			1.5E-10	0.0%
selenium					
silver					
strontium					
thallium					
titanium					
vanadium					
zinc					
cyanide					
Volatile Organic Compounds					
methylene chloride	7.6E-12	4.9E-11		5.6E-11	0.0%
chloroform					
carbon tetrachloride	3.0E-08	3.1E-09	1.4E-05	1.4E-05	25.9%
carbon disulfide					
1,1,1-trichloroethane					
vinyl chloride					
trichloroethylene		4.9E-11		4.9E-11	0.0%
tetrachloroethylene		1.3E-09	2.1E-06	2.1E-06	3.9%
acetone					
2-butanone					
4-methyl-2-pentanone					
benzene	1.8E-08	1.9E-09	8.4E-06	8.4E-06	15.4%
ethylbenzene					
toluene					
xylenes (total)					
styrene					
Semi-Volatile Organic Compounds					
benzoic acid					
phenol					
4-methylphenol					
di-n-butylphthalate					
di-n-octylphthalate					
bis(2-ethylhexyl)phthalate		3.2E-08		3.2E-08	0.1%
butylbenzylphthalate					
naphthalene					
Pesticides and PCBs					
ΣDDTR	1.3E-09	7.7E-06		7.7E-06	14.1%
	5.7E-08	7.7E-06	4.7E-05	5.5E-05	100.0%
	0.1%	14.2%	85.7%	100.0%	

APPENDIX C – FIGURE 5A APPROXIMATE LOCATION OF SAMPLING STATIONS ON LAGRANGE SPRINGS AND MATHEW CREEK



0C34220A
PLOT DATE: 9/10/92

JOHNSTOWN LANDFILL
JOHNSTOWN, NEW YORK

Thermo Consulting Engineers
(formerly Normandeau Engineers)

FIGURE 5a

APPROXIMATE LOCATIONS OF SAMPLING STATIONS
ON LaGRANGE SPRINGS AND MATHEW CREEK

NOVEMBER 1991

APPENDIX D – ANALYTICAL DATA (GROUNDWATER, SURFACE WATER, AND SEDIMENT 1996 TO CURRENT)

TABLE 1
MW-1D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
Toluene	5	ND	NA	NA	NA	NA	NA	0.4 J	NA	5 U	NA
Trichloroethene	5	ND	NA	NA	NA	NA	NA	0.5 J	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
ND = Parameter not detected

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	16.1 B	NA	22.0 U	NA
Arsenic	25	3.3 B	NA	NA	NA	NA	NA	3 U	NA	3.0 U	NA
Barium	1,000	104 B	NA	NA	NA	NA	NA	146 B	NA	134 B	NA
Boron	1,000	37.2 B	NA	NA	NA	NA	NA	58.2 B	NA	NA	NA
Calcium		49,800 0	47,500 0	47,300 0	47,300	49,600 0	51,500 0	44,300	43,400	38,600	46,100
Chromium	50	2 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.0 U	NA	2.0 U	
Copper	200	20.8 B	NA	NA	NA	NA	NA	1.1 B	NA	1.0 U	NA
Iron	300	**447 0**	**491 0**	194 0	**305**	214 0	179 0	**1,240**	**829**	**663**	**486**
Lead	25	1.5 U	2.7 B	1.6 U	2.8 B	1 U	1 U	2.7 B	2 U	2.0 U	3 U
Magnesium		16,700 0	16,800 0	16,200 0	16,900	16,600 0	18,000 0	15,100	15,300	13,600	16,400
Manganese	300	**332 0**	**439 0**	**390 0**	**361**	**317 0**	**309 0**	**323**	291	233	**316**
Nickel		1.3 B	NA	NA	NA	NA	NA	6.5 B	NA	3.0 U	NA
Potassium		1,070 U	2,320 B	1,100 B	803 B	851 BE	919 B	646 JB	692 B	678. B	813 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	4.0 UN	NA
Silver	50	11	NA	NA	NA	NA	NA	1 U	NA	2.0 U	NA
Sodium	20,000	12,600 0	10,700 0	10,800 0	8,180	10,200 E	10,100 0	8,310	8,220	6,580	7,920
Zinc		18 B	NA	NA	NA	NA	NA	41	NA	5.0 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Concentration < the CRQL and > the IDL
J or E = Concentration is an estimated value
NA = Parameter not analyzed
N = Spiked sample recovery not within control limits
+/- = Additionally estimated

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		208 0	192 0	189 0	235	183 0	190 0	188	180	172	184
Ammonia Nitrogen (mg/l)	2	0.05 U	0.27 0	0.05 U	0.05 U	0.176 0	0.146 0	0.208	0.27	0.279	.294
BOD (mg/l)		3 U	4 U	4 U	6.07	2.55 0	6.3 0	7.12	10	3.54	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	2 0	0.1 U	2 U	2 U	2 U	2 U	2 U	
COD (mg/l)		3 U	3 U	3 U	3 U	10 U	10 U	10 U	10 U	10 U	
Chloride (mg/l)	250	3.3 0	7.59 0	5.52 0	27.5	7.02 0	7.51 0	8.3	7.4	5.4	6.69
Color	15	**40**	NA	NA	NA	NA	NA	**35**	NA	**20**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.01 J	NA
Hardness (mg/l)		193 0	188 0	184.4 0	188	185 0	203 0	173	171	152	183
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.01 U	
Nitrate Nitrogen (mg/l)	10	2.39 0	0.16 0	2.66 0	0.08	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Phenols (mg/l)	0.001	**0.02 0**	**0.025 0**	**0.012 0**	**0.016**	**0.006 0**	**0.015 0**	0.005 U	**0.028**	0.05 U	0.05 U
Sulfate (mg/l)	250	3.4 0	3 U	3 U	12.1	10 U	10 U	10 U	10 U	10 U	10 U
Total Dissolved Solids (mg/l)		202 0	294 0	181 0	250	200 0	173 0	196 J	146	203	208
Total Kjeldahl Nitrogen (mg/l)		0.23 0	0.35 0	0.28 0	0.22	0.347 0	0.298 0	0.616	0.95	0.409	0.421
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.79	1 U	3.09 0	1 U	1.16	1.00 U	1.7

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected
B = Concentration < the CRQL and > the IDL
J or E = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-1D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Acetone	50	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U		
Methylene Chloride	5	NA	2 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA
Toluene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA
Trichloroethene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 UJ	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
ND = Parameter not detected

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Aluminum		NA	10.0 U	20.1 U	20.1 U	187 B	NA	NA	60.4 B	101	NA
Arsenic	25	NA	2.5 U	5.8 B	5.8 B	7.7 B	NA	NA	3.5 U	5.1	NA
Barium	1,000	NA	152 B	153 B	153 B	178	NA	NA	160	178	NA
Boron	1,000	NA	35.1 B	50.0 U	50.0 U	50.0 U	50.0 U	NA	33.2 B	32.7	NA
Calcium		41,100	41,100	46,700	43,000	44,500	43,400	44,300	43,900	44,500	44,100
Chromium	50	NA	1.0 U	0.9 U	0.9 U	2.8 B	NA	NA	1.4 U	1.7	NA
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	1.5 U	1.5 U	1.7 U		NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	10.9	NA	NA	2.6 U	6.5	NA
Iron	300	**735**	**2,010**	**2,950**	**2,390**	**5,180**	**2,280**	**2,230**	**1,760**	**5,290**	**711**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	8 B	3.4 U	3.6 U	3.6 U	7.1	3 U
Magnesium		14,500	15,000	16,300	15,100	16,100	16,100	16,200	16,400	15,600	15,700
Manganese	300	276	267	280	266	285	270	296	**314**	254	208
Nickel		NA	1.5 U	1.3 U	1.3 U	1.9 U	1.9 U	1.9 U	1.8 U		NA
Potassium		688 B	968 B	1,060 B	1,060	1,250	1,080	741	596	756	763
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	6.9 U	6.9 U	5 U		NA
Silver	50	NA	1.0 U	1.0 U	1.0 U	1.4 U	1.4 U	1.4 U	0.93 U		NA
Sodium	20,000	7,160	7,060	8,260	7,930	9,040 J	8,960	8,990	8,610 E	8,550	8,970
Zinc		NA	5.0 U	4.9 U	4.9 U	20.9 B	NA	NA	11 U	12.6	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Concentration < the CRQL and > the IDL
J or E = Concentration is an estimated value
NA = Parameter not analyzed
N = Spiked sample recovery not within control limits
+/- = Additionally estimated

CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Alkalinity (mg/l)		189	183	189	187	185	192	194	191	196	196
Ammonia Nitrogen (mg/l)	2	0.250	0.252	0.42	0.41	0.45	0.37	0.43	0.48	0.38	0.19
BOD (mg/l)		2.3	2.0 U	2 U	1.8 B	5.9	8.7	4.9	4.8	2.3	3.2
Bromide (mg/l)	2		0.1 U	0.1 U	0.042 B	0.1 U	0.1 U	0.053 B	0.1 U	0.051 B	0.044 B
COD (mg/l)			10 U	10 U	10 U	27.9	10 U	10 U	10 U	11.4	10.2
Chloride (mg/l)	250	5.58	5.25	5.8	5.5	5.7	5.7	5.7	5.96	5.84	5.93
Color	15	NA	**40**	**75**	**75**	**100**	NA	NA	**50**	**40**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		162	164	184	170	177	175	177	177	175	175
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.002 B	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	0.054 B	0.039 B	0.1 U	0.1 U	0.04 B	0.037 B
Phenols (mg/l)	0.001	**0.006**	**0.006**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.013**	0.005 U	0.005 U
Sulfate (mg/l)	250	1 U	1.0 U	1 U	0.67 B	0.48 B	0.19 B	0.33 B	1 U	0.411 B	0.339 B
Total Dissolved Solids (mg/l)		172	179	191	190	200	200	200	200	180	160
Total Kjeldahl Nitrogen (mg/l)		0.42	0.4	0.44	0.403	2.6	0.524	0.544	0.336	0.84	0.486
Total Organic Carbon (mg/l)		3.39	3.83	4.77	2.2	1.1	0.72 B	2.8	0.57 B	1.7	1.4

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected
B = Concentration < the CRQL and > the IDL
J or E = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-1D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/04/07	10/29/08	12/08/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50									21.0	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA	5 U	NA
Toluene	5				NA		NA	5 U	NA	5 U	NA
Trichloroethene	5				NA		NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
ND = Parameter not detected

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/04/07	10/29/08	12/08/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		92 U	NA	148 B	NA	100 UJ	NA	100 U	NA	100 U	NA
Arsenic	25	3.9 U	NA	6.1 B	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	192	NA	166	NA	155	NA	194	NA	172	NA
Boron	1,000	36.7 B	NA	33.1 JB	NA	500 U	NA	500 U	NA	500 U	NA
Calcium		50,000	44,600	47,400	44,000	33,300	39,500	38,500 J	30,000	30,200	32,100
Chromium	50	1.3 U	NA	1.3 U	NA	5.00 U	NA	5.00 U	NA	5 U	NA
Cobalt		1.8 U	1.8 U	1.8 U	1.8	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**2,460**	**1,420**	**1,710**	**2,530**	**1,370**	**847**	**1,360**	**936**	**1,620 J**	**1,040**
Lead	25	4.7 B	**29.4**	19.2	6.5 B	3.00 UJ	6.46	3.00 U	3.00 U	3 U	3 U
Magnesium		17,600	16,200	17,500	16,000	12,900	14700	15,100	11,700	11,700	12,800
Manganese	300	238 J-	213	**338**	182	157	145	157 J	144	135	148
Nickel		1.9 U	1.9 U	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		967	1,030	713 J	753	1,000 U	1,000 U	1,000 U	1,090	1000 UJ	5,000 U
Selenium	10	5 U	5 U	5 U	NA	10.0 J	NA	5.00 U	NA	5 U	NA
Silver	50	1.1 UJ-	1.1 UJ-	1.1 UJ-	NA	10.0 U	NA	10.0 UJ	NA	10 UJ	NA
Sodium	20,000	10,400 J+	10,200	7,760	9,010	7,120 J	10,400	**31,300**	**40,100**	**37,800**	**32,800**
Zinc		11 U	NA	11.9 B	NA	10 UJ	NA	10.0 U	NA	10 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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+/- = Additionally estimated

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/04/07	10/29/08	12/08/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		187	192	198	193	180	200	210	220	200	210
Ammonia Nitrogen (mg/l)	2	0.2	0.39	0.42	0.38	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		4.4	7.4	4.5	3.6	4 U	4 U	5	10.0	5.0	10
Bromide (mg/l)	2	0.1 U	0.072 B	0.085 B	0.014 B	0.20 U	1.00 U	2.0 U	2.0 U	0.2 U	2.0 U
COD (mg/l)		6.55 B	7.01 B	10 U	10 U	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	5.85	6.28	5.94	5.73	2.58	6.73	6.58	7.19	8.69	7.78
Color	15	**30**	NA	**50**	NA	**58**	NA	**40**	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		197	178	190	176	136	159	158	123	123	133
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.037 B	0.043 B	0.1 U	0.039 B	0.254	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	0.638 B	0.619 B	0.327 B	0.266 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Total Dissolved Solids (mg/l)		180	180	180	200	210	222	228	188	250	210
Total Kjeldahl Nitrogen (mg/l)		0.72	0.54	0.578	0.723	0.547	0.599	0.500 U	0.500 U	0.5 U	0.500 U
Total Organic Carbon (mg/l)		1	3.2	2.5	2.8	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected
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NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-1D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Acetone	50	10 UJ	NA	10.0 U	NA	NS
Methylene Chloride	5	5 UJ	NA	5 U	NA	NS
Toluene	5	5 UJ	NA	5 U	NA	NS
Trichloroethene	5	5 UJ	NA	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
ND = Parameter not detected

	NYSDEC Class GA Standards	SAMPLING DATE				
		06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NA	100 U	NA	NS
Arsenic	25	5.0 UJ	NA	5 U	NA	NS
Barium	1,000	241 J	NA	348	NA	NS
Boron	1,000	500 UJ	NA	500 U	NA	NS
Calcium		38,400 J	38,000	40,800	46,800	NS
Chromium	50	10.0 UJ	NA	10 U	NA	NS
Cobalt		20 UJ	NA	20 U	NA	NS
Copper	200	10.0 UJ	NA	10 U	NA	NS
Iron	300	**1,710 J**	**1,050**	**1,930**	**1,890**	NS
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	NS
Magnesium		15,000 J	14,800	15,900	16,300	NS
Manganese	300	193 J	180	150 J	212	NS
Nickel		30 UJ	NA	30 U	NA	NS
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3 UJ	NA	3 U	NA	NS
Silver	50	35.4 J	NA	10 UJ	NA	NS
Sodium	20,000	**34,000 J**	**28,500**	**20,500 J**	19,800	NS
Zinc		10 UJ	NA	10 UJ	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
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J or E = Concentration is an estimated value
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	NYSDEC Class GA Standards	SAMPLING DATE				
		06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		200 J	190	230	210	NS
Ammonia Nitrogen (mg/l)	2	0.500 UJ	0.500 U	0.581	0.682	NS
BOD (mg/l)		4.0 UJ	4.0 U	4.0 U	4.0 U	NS
Bromide (mg/l)	2	0.8 UJ	4.0 U	8.0 U	8.0 U	NS
COD (mg/l)		20 UJ	20 U	20 U	20 U	NS
Chloride (mg/l)	250	8.84 J	8.18	9.15	11.7	NS
Color	15	7.00 J	NA	**55**	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 UJ	NA	10 U	NA	NS
Hardness (mg/l)		158 J	156	167	184	NS
Hexavalent Chromium (mg/l)	0.05	0.01 UJ	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.050 UJ	0.066	0.129	0.054	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	5.00 UJ	5.00 U	5.00 U	5.00 U	NS
Total Dissolved Solids (mg/l)		200 J	220	200	240	NS
Total Kjeldahl Nitrogen (mg/l)		0.500 UJ	0.592	0.500 U	0.853	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-1M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.0 U	NA	3.0 U	
Barium	1,000	45.7 B	NA	NA	NA	NA	NA	40.8 B	NA	36.1 B	NA
Boron	1,000	44.6 B	NA	NA	NA	NA	NA	48.5 B	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.1 B	1 U	1.3 B	1 U
Calcium		104,000 0	102,000 0	89,900 0	80,200	81,000 0	85,200 0	73,800	76,100	77,600	80,300
Chromium	50	6 U	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	
Cobalt		1.5 B	NA	NA	NA	NA	NA	2 U	NA	2.0 U	NA
Copper	200	36.8	NA	NA	NA	NA	NA	1 U	NA	1.0 B	NA
Iron	300	**842 0**	**1,240 0**	**1,100 0**	**907**	**914 0**	**743 0**	**844**	**845**	**963**	**861**
Lead	25	1.5 U	2.4 B	1.6 U	3.1	1 U	1 U	2 U	2 U	2.0 U	3 U
Magnesium		11,500 0	11,900 0	9,830 0	9,140	8,790 0	9,360 0	7,960	8,380	8680	8,800
Manganese	300	**566 0**	**574 0**	**522 0**	**469**	**433 0**	**441 0**	**426**	**429**	**412**	**417**
Mercury	2	0.22	NA	NA	NA	NA	NA	0.1 U	NA	0.10 U	NA
Nickel		2.9 B	NA	NA	NA	NA	NA	7.8 B	NA	3.0 U	NA
Potassium		1,070 U	3,790 B	2,100 B	1,780 B	1,990 BE	2,330 B	1,600 JB	1,380 B	1,260 B	1,070 B
Selenium	10	4 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NA
Silver	50	8,950	NA	NA	NA	NA	NA	1 U	NA	2.0 U	NA
Sodium	20,000	8,950 0	16,400 0	14,600 0	10,200	6,240 E	5,250 0	3,460 B	3,660 B	3,720 B	3,280 B
Zinc		22.8	NA	NA	NA	NA	NA	32.6	NA	5.0 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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+/- = Additionally estimated
* = Samples are filtered due to matrix interference

CONVENTIONAL PARAMETERS

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
Alkalinity (mg/l)		376 0	283 0	254 0	184	252 0	244 0	240	231	255	228
Ammonia Nitrogen (mg/l)	2	**13.3 0**	**7.49 0**	**9.57 0**	**2.53**	**10.3 0**	**10.8 0**	**10.3**	**8.47**	**5.22**	**3.12**
BOD (mg/l)		3 U	3 U	4.7 0	3.7 U	2 U	2.4 0	3.57	2 U	2.00 U	2 U
Bromide (mg/l)		0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2.0 U	2.00 U	
COD (mg/l)		3 U	3 U	7.1 0	3 U	10 U	10 U	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	12.9 0	12.8 0	14.2 0	7.51	11 0	6.08 0	10.4	14.7	8.64	12.1
Color	15	**40**	NA	NA	NA	NA	NA	**20**	NA	**25**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 J	NA
Hardness (mg/l)		308 0	305 0	265 0	238	234 0	251 0	217	225	230	237
Hexavalent Chromium		0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.1 0	0.59 0	2.67 0	0.04 U	0.1 U	0.1 U	0.1 U	0.1 U	0.233	.4
Phenols (mg/l)	0.001	**0.02 0**	**0.018 0**	**0.007 0**	**0.029**	**0.009 0**	**0.018 0**	0.005 U	**0.021**	0.0500 U	.05 U
Sulfate (mg/l)	250	35.4 0	15.1 0	12.9 0	3 U	34.8 0	16.6 0	13.4	10 U	13.8	17.3
Total Dissolved Solids (mg/l)		351 0	298 0	263 0	172	274 0	220 0	237 J	478	288	286
Total Kjeldahl Nitrogen (mg/l)		13.1 0	6.02 0	12.1 0	2.66	9.29 0	12.8 0	9.83	10.3	5.84	3.34
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.49	1 U	1 U	1.01	1.99	1.00	1.54

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-1M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	NA	4 U	10 U	10 U	10 U	10 U	10 U	10 U		
Methylene Chloride	5	NA	2 U	0.7 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
INORGANIC PARAMETERS (µg/L)											
Arsenic	25		2.5 U	4.9 U	4.9 U	7 U	7 U	7 U	4 U		
Barium	1,000	NA	40.7 B	32.6 B	32.6 B	33.9	NA	NA	39.9	33.7	NA
Boron	1,000	NA	32.5 B	50 U	50 U	50 U	50 U	50 U	27 U		
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		85,800	105,000	85,400	84,100	92,800	91,500	95,000	95,000	86,100	89,600
Chromium	50		1.00 U	0.9 U	0.9 U	2.2 B	NA	NA	1.4 U	1.3 U	NA
Cobalt		NA	2.7 B	2.4 B	2.4 B	2.9 B	NA	NA	2.7 B	2.4	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	1.4 U	1.4 U	1.4 U	2.6 U		
Iron	300	**1,130**	**1,620**	**2,470**	**2,180**	**2,370**	**2,030**	**2,220**	**2,680**	**2,150**	**4,050**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		9,520	12,000	9,330	9,070	10,200	9,980	10,200	10,500	8,880	9,300
Manganese	300	**482**	**609**	**503**	**478**	**434**	**542**	**574**	**606**	**534**	**473**
Mercury	2	NA	0.1 U	0.1 U	0.1 U	0.18 U	0.18 U	NA	0.18 U	0.07 U	NA
Nickel		NA	2.9 B	3.0 B	3.0 B	1.9 U	1.9 U	NA	3.1 B	1.9 U	NA
Potassium		785 B	1,260 B	846 B	965	963	1,030	737	602	613	944
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	6.9 U	6.9 U	5 U		
Silver	50	NA	1.0 U	1.0 U	1.0 U	1.4 U	1.4 U	1.4 U	0.93 U		
Sodium	20,000	4,200 B	4,810 B	7,770	6,690	4,640 J	4,580	6,070	7,420 E	6,390	5,590
Zinc		NA	5.0 U	5.9 B	5.9 B	16.2 U	16.2 U	NA	11 U	11 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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+/- = Additionally estimated

* = Samples are filtered due to matrix interference

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		278	298	244	239	258	257	277	278	263	245
Ammonia Nitrogen (mg/l)	2	**2.54**	**2.87**	2	2	1.7	1.6	**2.2**	**2.2**	**2.1**	1.9
BOD (mg/l)		2 U	2.0 U	2 U	2 U	0.78 B	2.2	3.8	0.57 B	0.24 B	2 U
Bromide (mg/l)			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	11.8	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5.67 B
Chloride (mg/l)	250	5.97	7.16	11.1	12	8.7	10	10	15.7	10.2	11.6
Color	15	NA	**30.0**	**75**	**75**	**35**	NA	NA	**50**	**50**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA U
Hardness (mg/l)		253	312	252	247	274	270	279	280	252	262
Hexavalent Chromium			0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.027 B	0.13	0.1 U	0.32	0.1 U	0.043 B	0.031 B
Phenols (mg/l)	0.001	**0.005**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.008**	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	11	13.7	13.1	13	12	13	13	11.8	12.8	14.4
Total Dissolved Solids (mg/l)		289	323	294	280	290	300	330	340	290	260
Total Kjeldahl Nitrogen (mg/l)		3.1	2.9	2.1	1.9	1.83	1.76	2.07	2.2	2.06	1.93
Total Organic Carbon (mg/l)		1 U	1.0 U	2.39	1.5	0.55 B	0.4 B	2.5	0.49 B	0.6 B	0.75 B

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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NA = Parameter not analyzed

R = Rejected by data validator

TABLE 1
MW-1M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	08/05/09	10/27/09
Acetone	50										
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	07/14/09	10/27/09
Arsenic	25				NA	10 U	NA	10.6	NA	10 U	NA
Barium	1,000	32.2	NA	35.1	NA	50 U	NA	66.5	NA	50 U	NA
Boron	1,000				NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5.00 U	5.00 U	5 U	5 U
Calcium		82,200	87,400	88,300	88,300	65,700	67,300	80,100 J	79,100	73,900	79,700
Chromium	50	1.3 U	NA	1.3 U	NA	5 J	NA	5.00 U	NA	5 U	NA
Cobalt		1.8 U	NA	2.6 B	NA	20 U	NA	20.0 U	NA	20 U	NA
Copper	200				NA	10 U	NA	10.0 U	NA	10 U	NA
Iron	300	**1,700**	**1,680**	**2,100**	**2,830**	**1,990**	**1,110**	**2,580**	**2,300**	**2,230 J**	**2,290**
Lead	25	3 U	3 U	3 U	10.1	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		9,090	9,130	9,560	9,150	7,270	7,170	9,130	8,970	8,340	9,360
Manganese	300	**359**	**469**	**550**	126	**426**	228	**596 J**	**537**	**491**	**535**
Mercury	2	0.07 U	NA	0.07 U	NA	0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel		2.3 B	NA	2.5 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		849	785	659 J	869	1,000 U	1000 U	1,000 U	1,000 U	1,000 UJ	5,000 U
Selenium	10				NA	**10.1 J**	NA	5.00 U	NA	5 U	NA
Silver	50				NA	10.0 U	NA	11.4 J	NA	10 UJ	NA
Sodium	20,000	6,680 J+	6,440	5,610	5,240	10,400 J	7,170	5,840	5,530	6,860	5,540
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	12.5 J	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

H = Holding times for preparation or analysis exceeded

B = Concentration < the CRQL and > the IDL

J or E = Concentration is an estimated value

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+/- = Additionally estimated

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE 07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	07/14/09	10/27/09
Alkalinity (mg/l)		242	228	250	245	240	230	230	230	230	220
Ammonia Nitrogen (mg/l)	2	1.6	1.4	1.6	0.062	1.74	1.36	**2.16**	**2.28**	**2.55**	**2.47**
BOD (mg/l)		0.72 B	3.7	0.93 B	3.3	4 U	4 U	4.00 U	4.00 U	4 U	4 U
Bromide (mg/l)		0.1 U	0.1 U	0.1 U	0.1 U	0.20 U	1.00 U	2.0 U	2.0 U	2 U	2 U
COD (mg/l)		10 U	5.73 B	6.25 B	10 U	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	9.8	13.4	11	11.6	6.72	10.2	11.9	11.9	8.96	11.1
Color	15	**50**	NA	**50**	NA	**58.0**	NA	**50.0**	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	**2.1 B**	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		243	256	260	258	194	198	238	235	219	238
Hexavalent Chromium		0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.23	0.143	0.045 B	0.385	0.200 U	0.622	0.200 U	0.200 U	0.2 U	0.2 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	11.6	12.4	12.1	12.7	8.21	9.09	9.50	12.1	12.1	15.3
Total Dissolved Solids (mg/l)		270	240	270	310	293	327	276	293	300	290
Total Kjeldahl Nitrogen (mg/l)		1.44	1.39	1.73	0.0736 B	1.90	1.66	2.21	2.66	2.69	2.64
Total Organic Carbon (mg/l)		0.6 B	1.6	3.8	5	3 U	3 U	3.0 U	3 U	3 U	3 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

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TABLE 1
MW-1M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
Acetone	50			10 U	NA	NS
Methylene Chloride	5	5 UJ	NA	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
Arsenic	25	5.0 UJ	NA	5 U	NA	NS
Barium	1,000	50.0 UJ	NA	50 U	NA	NS
Boron	1,000	500 UJ	NA	500 U	NA	NS
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	NS
Calcium		74,300 J	80,500	81,500	85,500	NS
Chromium	50	10.0 UJ	NA	10 U	NA	NS
Cobalt		20.0 UJ	NA	20 U	NA	NS
Copper	200	10.0 UJ	NA	10 U	NA	NS
Iron	300	**2,490 J**	**2,570**	**2,580**	**2,420**	NS
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	NS
Magnesium		9,150 J	9,880	10,700	9,770	NS
Manganese	300	**532 J**	**582**	**523 J**	**539**	NS
Mercury	2	0.200 UJ	NA	0.2 U	NA	NS
Nickel		30 UJ	NA	30 U	NA	NS
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.0 UJ	NA	3 U	NA	NS
Silver	50	10.0 UJR	NA	10 UJ	NA	NS
Sodium	20,000	7,470 J	7,930	7,270 J	6,880	NS
Zinc		19.3 J	NA	10 UJ	NA	NS

NOTES:

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CONVENTIONAL PARAMETERS	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
Alkalinity (mg/l)		231 J	210	280 J	260	NS
Ammonia Nitrogen (mg/l)	2	1.99 J	**2.07**	1.67	1.67	NS
BOD (mg/l)		4.0 UJ	4.0 U	4.0 U	4.0 U	NS
Bromide (mg/l)		0.8 UJ	1.6 U	8 U	8 U	NS
COD (mg/l)		20 UJ	20 U	20 U	20 U	NS
Chloride (mg/l)	250	10.7 J	12.9	12	13.5	NS
Color	15	**35 J**	NA	160	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 UJ	NA	10 U	NA	NS
Hardness (mg/l)		223 J	242	247	254	NS
Hexavalent Chromium		0.01 UJ	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.112 J	0.068	0.083	0.052	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	11.7 J	12.6	12.6	18	NS
Total Dissolved Solids (mg/l)		250 J	300	270	290	NS
Total Kjeldahl Nitrogen (mg/l)		3.03 J	2.70	1.41	1.83	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-1S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/18/99
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	0.4 U	NA	5 U	NS
Toluene	5	ND	NA	NA	NA	NA	NA	0.3 J	NA	5 U	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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NA = Parameter not analyzed
NS = Well not sampled
N = Spiked recovery sample not within control limits

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/18/99
Aluminum		22.9 U	NA	NA	NA	NA	NA	23.6 B	NA	26.1 B	NS
Barium	1,000	14.4 B	NA	NA	NA	NA	NA	23.9 B	NA	19.1 B	NS
Boron	1,000	29.7 B	NA	NA	NA	NA	NA	32.6 B	NA	NA	NS
Calcium		104,000 0	102,000 0	93,800 0	101,000	116,000 0	98,300 0	93,000	112,000	110,000	NS
Chromium	50	0.7 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NS
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.0 U	NA	2.0 U	NS
Copper	200	29.2	NA	NA	NA	NA	NA	1 U	NA	1.2 B	NS
Iron	300	51.3 B	**370 0**	162 0	15.3 U	11.7 B	38.2 B	18.4 B	17.8 B	91.0 B	NS
Lead	25	1.5 U	1.8 B	1.6 U	9.7	1 U	1 U	2 U	2 U	2.0 U	NS
Magnesium		5,340 0	7,160 0	5,990 0	7,420	8,290 0	6,710 0	8,040	10,200	9,320	NS
Manganese	300	3.6 B	23.8 0	19.1 0	3.5 B	7 U	4.5 B	5.5 B	7.8 B	10.3 B	NS
Nickel	100	1.2 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	NS
Potassium		1,070 U	2,270 B	2,060 B	2,200 B	2,780 BE	1,760 B	1,390 JB	1,280 B	495. B	NS
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NS
Sodium	20,000	1,830 B	9,040 0	16,400 0	8,740	7,420 E	3,680 B	2,860 B	3,710 B	3430 B	NS
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	2.0 U	NS
Zinc		22.6	NA	NA	NA	NA	NA	24.1	NA	26.4	NS

NOTES:
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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/18/99
Alklalinity (mg/l)		219 0	24.1 0	239 0	250	282 0	250 0	266 U	282	298	NS
Ammonia Nitrogen (mg/l)	2	0.05 U	0.12 0	0.48 0	1.9	**6.05 0**	**2.75 0**	2.9 U	**2.62**	0.324	NS
BOD (mg/l)		3 U	4 U	4 U	3.7 U	2 U	3 0	2.97	4	2.00 U	NS
Bromide (mg/l)	2	0.621 0	0.41 0	0.1 U	0.1 U	2 U	2 U	2 U	2 U	2.00 U	NS
COD (mg/l)		3 U	19.6 0	3 U	3 U	10 U	10 U	10.0	12.7	10.0 U	NS
Chloride (mg/l)	250	1 U	8.91 0	13.1 0	10	8.16 0	3 U	8.02	8.9	4.10	NS
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	5 U	NS
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.0130	NA	0.0100 J	NS
Hardness (mg/l)		281 0	284 0	258.9 0	283	327 0	273 0	265	322	314	NS
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	NS
Nitrate Nitrogen (mg/l)	10	2.03 0	1.04 0	3.34 0	2.06	8.01 0	1.12 0	1.97	7.78	7.27	NS
Phenols (mg/l)	0.001	**0.012 0**	**0.032 0**	**0.006 0**	**0.016**	**0.007 0**	**0.008 0**	0.014 U	0.01 U	0.0500 U	NS
Sulfate (mg/l)	250	26 0	22 0	10.8 0	13.3	13.3 0	14.8 0	10.0	10 U	15.7	NS
Total Dissolved Solids (mg/l)		264 0	313 0	250 0	270	360 0	251 0	295 J	320	379	NS
Total Kjeldahl Nitrogen (mg/l)		0.29 0	0.44 0	1.02 0	4.15	5.73 0	2.76 0	4.00	3.0	0.642	NS
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.26	1 U	1 U	1.13	2.69	1.08	NS

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TABLE 1
MW-1S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Methylene Chloride	5	NA	5 U	**6**	NA	NS	NS	NA	5 U	5 U	NA
Toluene	5	NA	5 U	5 U	NA	NS	NS	NA	5 U	5 U	NA

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INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Aluminum		NA	16.2 B	43.1 B	43.1 B	NS	NS	NA	3,000	2,000	NA
Barium	1,000	NA	20.9 B	19 B	19 B	NS	NS	NA	51.7	49.9	NA
Boron	1,000	NA	24.8 B	50 U	50 U	NS	NS	NA	28 B	27.8	NA
Calcium		105,000	122,000	105,000	100,000	NS	NS	159,000	167,000	185,000	346,000
Chromium	50	NA	1.0 U	0.9 U	0.9 U	NS	NS	NA	11.6	12	NA
Cobalt		NA	1.0 U	1.2 U	1.2 U	NS	NS	NA	4 B	3.5	NA
Copper	200	NA	1.0 U	1.7 B	1.7 B	NS	NS	NA	9.8 B	7.6	NA
Iron	300	44.1 B	146	200	128 B	NS	NS	**6,150**	**6,550**	**5,670**	**3,790**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	NS	NS	3.6 U	3.6 U	4.3	7.4 B
Magnesium		5,780	9,540	9,180	8,640	NS	NS	11,600	12,500	17,800	17,000
Manganese	300	9.5 B	18.0	19.6	11.1 B	NS	NS	**336**	252	265	**617**
Nickel	100	NA	1.6 B	2.4 B	2.4 B	NS	NS	NA	11.8	9.4	NA
Potassium		359 B	818 B	915 B	1,170	NS	NS	1,810	1,790	2,430	2,330
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	4.6 UN	4.6 UN	NS	5 U	5 U	5 U
Sodium	20,000	2,130 B	3,390 B	6,490	5,150	NS	NS	6,930	13,400	6,000	7,020
Vanadium		NA	1.0 U	1.0 U	1.0 U	NS	NS	NA	7.9	7.4	NA
Zinc		NA	5.0 U	5.1 B	5.1 B	NS	NS	NA	17.1 B	17	NA

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
Alklalinity (mg/l)		284	319	282	277	NS	NS	312	380	312	296
Ammonia Nitrogen (mg/l)	2	0.04 U	0.04 U	0.04 U	0.04 U	NS	NS	0.24	0.33	1.6	**2.1**
BOD (mg/l)		2 U	2.0 U	2 U	2 U	NS	NS	2.6	1.1 B	2.3	0.24 B
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	NS	NS	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	10.0 U	10 U	10 U	NS	NS	10 U	10 U	10 U	6.58 B
Chloride (mg/l)	250	2.39	4.47	9.94	11	NS	NS	16	12.9	7.52	10.6
Color	15	NA	**20**	10	10	NS	NS	NA	**500**	**100**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	NS	NS	NA	10 UJ	10 U	NA
Hardness (mg/l)		286	344	300	285	NS	NS	445	468	535	935
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	0.01 U	0.01 U	NS	NS	NA	0.002 B	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	3.05	0.358	0.594	2.3	NS	NS	0.095 B	0.135	0.368	0.687
Phenols (mg/l)	0.001	**0.005**	0.005 U	0.005 U	0.005 U	NS	NS	**0.006**	**0.004 B**	0.005 U	0.005 U
Sulfate (mg/l)	250	14.5	12.8	12.3	12	NS	NS	12	10.6	11.8	12.2
Total Dissolved Solids (mg/l)		290	360	294	330	NS	NS	380	400	320	100
Total Kjeldahl Nitrogen (mg/l)		0.14	0.1 U	0.11	0.1 U	NS	NS	0.863	1.14	1.69	3.9
Total Organic Carbon (mg/l)		4.81	1.0 U	2.49	5.5	NS	NS	0.43 B	1.8	0.96 B	1.2

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TABLE 1
MW-1S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	08/05/09	10/27/09
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NS	5 U	NA
Toluene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NS	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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NA = Parameter not analyzed
NS = Well not sampled
N = Spiked recovery sample not within control limits

	NYSDEC Class	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	7/14/2009*	10/27/09
Aluminum		209 B	NA	1,540	NA	117 J+	NA	502	NS	578	NA
Barium	1,000	29.5	NA	42.3	NA	50.0 U	NA	50.0 U	NS	61.8	NA
Boron	1,000	27 U	NA	27 UJ	NA	500 U	NA	500 U	NS	500 U	NA
Calcium		104,000	129,000	135,000	123,000	87,600	135,000 J	107,000 J	NS	161,000	110,000
Chromium	50	1.3 U	NA	5.4 B	NA	5.00 J	NA	5.00 U	NS	10 U	NA
Cobalt		1.8 U	NA	1.8 U	NA	20.0 U	NA	20.0 U	NS	20 U	NA
Copper	200	4.3 U	NA	6.1 B	NA	10.0 U	NA	10.0 U	NS	20 J	NA
Iron	300	**430**	**535**	**3,940**	**1,220**	241	**4,590**	**1,200** J	NS	**1,450 J**	193
Lead	25	3 U	3 U	3 U	6 B	3.00 UJ	3.00 UJ	3.00 U	NS	3 U	3.00 U
Magnesium		9,750	9,730	10,400	10,100	7,400 U	9,300 J	9,630	NS	12,800	10,300
Manganese	300	121	174	**304**	**609**	**458**	**581** J	**627** J	NS	**789**	**769**
Nickel	100	2.7 B	NA	7.3 B	NA	30.0 U	NA	30.0 U	NS	30 U	NA
Potassium		1,200	1,110	1,230 J	974	2290	3,420 J	1,600	NS	1,510 J	5,000 U
Selenium	10	5 U	5 U	5 U	5 U	**14.3 J**	NA	5.00 U	NS	5 U	NA
Sodium	20,000	6,760 J+	6,040	4,710	9,420	13,700 J	13,800 J	5,760	NS	6,540 J	5,000 U
Vanadium		1.5 U	NA	5.1 B	NA	30.0 U	NA	30.0 U	NS	30 U	NA
Zinc		11 U	NA	16.1 B	NA	11.8 J	NA	1500	NS	46.3 J	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
H = Holding times for preparation or analysis exceeded
B = Concentration < the CRQL and > the IDL
J or E = Concentration is an estimated value
NA = Parameter not analyzed
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+/- = Additionally estimated
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	NYSDEC Class	SAMPLING DATE									
CONVENTIONAL PARAMETERS	GA Standards	07/21/05	11/03/05	07/19/06	01/02/07	09/26/07	12/05/07	10/29/08	12/08/08	07/14/09	10/27/09
Alklalinity (mg/l)		293	280	295	321	300	270	280	NS	280	290
Ammonia Nitrogen (mg/l)	2	1.3	1.1	0.69	0.57	**3.06**	**6.03**	**4.64**	NS	**2.58**	**2.29**
BOD (mg/l)		1.5 B	5.2	9.6	6.6	4 U	4	4.00 U	NS	4 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.20 U	1.00 U	2.0 U	NS	20.00 U	0.2 U
COD (mg/l)		10 U	3.16 B	2.57 B	10 U	20	20 U	20 U	NS	20 U	20 U
Chloride (mg/l)	250	6.8	13.7	8.41	9.5	10.5	25.7	11.8	NS	8.28	9.95
Color	15	5	NA	**200**	NA	11.0	NA	20.0	NS	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NS	0.01 U	NA
Hardness (mg/l)		300	362	380	349	249	376	308	NS	423	316
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NS	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.196	0.914	0.292	0.044 B	0.200 U	0.318	0.317	NS	0.359	0.222
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.006**	0.005 U	0.005 U	0.005 U	0.005 U	NS	0.005 U	0.005 U
Sulfate (mg/l)	250	9.43	12.7	10.5	10.7	7.96	20 U	9.67	NS	10.7	14.1
Total Dissolved Solids (mg/l)		1	340	360	370	360	415	312	NS	360	490
Total Kjeldahl Nitrogen (mg/l)		1.7	1.15	1.37	0.825	4.11	6.65	4.85	NS	2.76	1.92
Total Organic Carbon (mg/l)		1	2	7.3	9.1	3.0 U	72.2	3.0 U	NS	3.0 U	3.0 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Well not sampled
R = Rejected by data validator

TABLE 1
MW-1S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	5 UJ	NA	5 U		NS
Toluene	5	5 UJ	NA	5 U		NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Well not sampled

N = Spiked recovery sample not within control limits

	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NA	100 U	NA	NS
Barium	1,000	50.0 UJ	NA	50 U	NA	NS
Boron	1,000	500 UJ	NA	500 U	NA	NS
Calcium		109,000 J	104,000	105,000	114,000	NS
Chromium	50	10.0 UJ	NA	10 U	NA	NS
Cobalt		20.0 UJ	NA	20 U	NA	NS
Copper	200	10.0 UJ	NA	10 U	NA	NS
Iron	300	60.0 UJ	75.1	97.7	75.6	NS
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	NS
Magnesium		10,100 J	9,720	10,900	10,300	NS
Manganese	300	**614** J	**680**	**903 J**	**1040**	NS
Nickel	100	30.0 UJ	NA	30 U	NA	NS
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.0 UJ	NA	3 U	NA	NS
Sodium	20,000	6,410 J	6,570	5,930 J	6,480	NS
Vanadium		30.0 UJ	NA	30 U	NA	NS
Zinc		10.0 UJ	NA	10 UJ	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

H = Holding times for preparation or analysis exceeded

B = Concentration < the CRQL and > the IDL

J or E = Concentration is an estimated value

NA = Parameter not analyzed

NS = Well not sampled

R = Reported data qualified as unusable

+/- = Additionally estimated

* = Samples are filtered due to matrix interference

	NYSDEC Class GA Standards	SAMPLING DATE 06/29/10	11/01/10	11/09/11	12/27/11	07/23/14
CONVENTIONAL PARAMETERS						
Alklalinity (mg/l)		288 J	240	320 J	320	NS
Ammonia Nitrogen (mg/l)	2	0.932 J	0.810	0.755	0.674	NS
BOD (mg/l)		4.0 UJ	4.0 U	4.0 U	4.0 U	NS
Bromide (mg/l)	2	1.6 UJ	0.8 U	0.8 U	0.8 U	NS
COD (mg/l)		20 UJ	20 U	20 U	20 U	NS
Chloride (mg/l)	250	7.20 J	11.1	8.79	11.2	NS
Color	15	5.00 J	NA	6	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 UJ	NA	10 U	NA	NS
Hardness (mg/l)		313 J	301	307	328	NS
Hexavalent Chromium (mg/l)	0.05	0.01 UJ	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.181 J	0.341	0.103	0.05 U	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	13.2 J	12.0	10.2	10.1	NS
Total Dissolved Solids (mg/l)		340 J	360	380	370	NS
Total Kjeldahl Nitrogen (mg/l)		1.47 J	1.34	0.502	0.835	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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TABLE 1
MW-2D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
1,1,2,2-Tetrachloroethane	5	5 U	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
1,2-Dibromo-3-Chloropropane	0.04	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Chloromethane	5	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	0.5 U	NA	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		95.3 B	NA	NA	NA	NA	NA	19.0 B	NA	22.0 U	NA
Antimony	3	**13.6 B**	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.0 U	NA	3.0 U	NA
Barium	1,000	284	NA	NA	NA	NA	NA	323	NA	317	NA
Boron	1,000	97 B	NA	NA	NA	NA	NA	106	NA	NA	NA
Calcium		40,400 0	47,600 0	50,600 0	42,900	50,700 0	56,900 0	41,800	45,600	42,900	45,600
Chromium	50	3.6 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.0 U	NA	2.0 U	
Copper	200	4.1 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Iron	300	131 0	38.3 B	77.4 B	88 B	87.8 B	12 U	44.9 B	80.5 B	87.6 B	192
Lead	25	1.5 U	1.8 U	1.6 U	1.9 U	1.6 B	1 U	2.4 B	2 U	2.0 U	3 U
Magnesium		17,800 0	19,600 0	19,400 0	16,500	18,300 0	21,000 0	15,200	16,700	15,500	17,100
Manganese	300	121 0	208 0	65.1 0	150	193 0	46.9 0	118	197	57.3	164
Mercury	2	0.2 U	NA	NA	NA	NA	NA	0.10 U	NA	0.10 U	
Nickel	100	1.8 B	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Potassium		4,470 B	5,130 0	2,920 B	1,670 B	1,650 BE	2,040 B	1,200 JB	1170 B	1,120 B	1,230 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	4.0 UN	NA
Sodium	20,000	10,900 0	10,700 0	10,300 0	7,630	10,200 E	11,100 0	7,830	8,970	7,450	8,030
Zinc		55	NA	NA	NA	NA	NA	33.7	NA	5.0 U	NA

NOTES:
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	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		372 0	171 0	160 0	176	175 0	199 0	135	176	180	181
Ammonia Nitrogen (mg/l)	2	0.49 0	0.27 0	0.07 0	0.2	0.374 0	0.089 0	0.453	0.78	0.151	.431
BOD (mg/l)		3.1 0	4 U	3 U	3.7 U	2 U	5.4 0	3.27	6	3.54	2 U
Bromide (mg/l)	2	0.492 0	0.1 U	0.1 U	0.9	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		3 U	3 U	3 U	3 U	10 U	10 U	35.7	10 U	10.0 U	10 U
Chloride (mg/l)	250	18.3 0	25.5 0	23.6 0	24	24.9 0	24.5 0	25.7	24.3	23.4	24.1
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 J	NA
Hardness (mg/l)		174 0	199 0	206.2 0	175	194 0	229 0	167	183	171	184
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.24 0	0.55 0	2.49 0	0.18	0.22 0	0.437 0	0.1 U	0.1 U	0.576	1 U
Phenols (mg/l)	0.001	0.0035 U	0.005 U	**0.007 0**	0.005 U	**0.012 0**	**0.022 0**	0.009 U	0.1 U	0.0500 U	.05 U
Sulfate (mg/l)	250	3 U	3 U	3 U	3 U	10 U	10 U	10 U	10.0 U	10.0 U	
Total Dissolved Solids (mg/l)		283 0	174 0	193 0	193	224 0	208 0	181 J	165	225	303
Total Kjeldahl Nitrogen (mg/l)		0.83 0	0.6 0	0.36 0	1.25	0.452 0	0.227 0	1.13	1.40	0.336	.354
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1 U	1 U	2.02 0	1 U	1 U	1.00 U	1 U

NOTES:
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TABLE 1
MW-2D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
VOLATILE COMPOUNDS (μg/L)											
1,1,2,2-Tetrachloroethane	5	NA	0.5 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
1,2-Dibromo-3-Chloropropane	0.04	NA	2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
Acetone	50	NA	4 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Chloromethane	5	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Methylene Chloride	5	NA	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
INORGANIC PARAMETERS (μg/L)											
Aluminum		NA	15.8 B	22.1 B	22.1 B	92.3 B	NA	NA	400 B	185	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	5.9 U	5.9 U	4.6 U		
Arsenic	25	NA	3.00 B	4.9 U	4.9 U	7 U	7 U	7 U	3.5 U		
Barium	1,000	NA	403	387	387	404	NA	NA	377	405	NA
Boron	1,000	NA	132	123	123	115	NA	NA	76.6	105	NA
Calcium		44,100	44,500	52,200	46,100	47,700	47,500	46,500	52,800	49,600	102,000
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	1.5 U	1.5 U	1.4 U		
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	1.5 U	1.5 U	1.7 U		
Copper	200	NA	1.0 U	1.5 U	1.5 U	1.4 U	1.4 U	1.4 U	3.9 B	6.6	NA
Iron	300	158	**1,020**	107	124 B	**486**	211	80.2 B	**1,380**	**613**	54 U
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	7 B	3.6 U	6.4	3 U
Magnesium		16,000	17,000	17,900	16,500	17,700	17,800	17,500	19,600	17,700	8,660
Manganese	300	41.8	**476**	61.4	92.2	99.6	295	50.4	**368**	154	42.1
Mercury	2		0.10 U	0.1 U	0.1 U	0.18 U	0.18 U	0.18 U	0.18 U		
Nickel	100	NA	1.5 U	1.3 U	1.3 U	1.9 U	1.9 U	1.9 U	1.8 U		
Potassium		1,130 B	1,660 B	1,830 B	1,750	1,710	1,700	1,280	1,130	1,240	798
Selenium	10	NA	5.0 U	6.3 N	6.3 N	6.9 U	6.9 U	6.9 U	5 U		
Sodium	20,000	8,020 E	8,460	9,070	8,160	8,680 J	9,050	8,850	8,870 E	8,860	3,610
Zinc		NA	5.7 B	5.7 B	5.7 B	16.2 U	16.2 U	16.2 U	11 U	11 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		176	181	184	185	136	183	187	194	195	273
Ammonia Nitrogen (mg/l)	2	0.129	1.04	0.091	0.54	0.067	0.24	0.047	1.4	0.011 B	0.066
BOD (mg/l)		2.2	2.0 U	2 U	1.2 B	4.1	4.1	3.1	3	2.9	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.058 B	0.060 B	0.1 U	0.06 B	0.1 U	0.057 B	0.064 B
COD (mg/l)		10 U	10.0 U	10.6	10 U	10 U	10 U	10 U	10 U	10 U	6.58 B
Chloride (mg/l)	250	22.3	20.5	21.8	22	22	21	21	24	20.1	20.3
Color	15	NA	**20**	5 U	5 U	**30**	NA	NA	15	15	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		176	181	204	183	192	192	188	213	197	197
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.63	0.1 U	0.641	0.17	0.32	0.029 B	0.46	0.1 U	0.629	0.082 B
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.004 B	0.005 U
Sulfate (mg/l)	250		1.0 U	1 U	0.8 B	0.5 B	0.14 B	0.52 B	0.499 B	0.522 B	0.417 B
Total Dissolved Solids (mg/l)		209	209	232	210	210	230	230	240	220	260
Total Kjeldahl Nitrogen (mg/l)		0.23	1.0	0.2	0.51	0.13	0.547	0.2	1.18	0.171	0.1 U
Total Organic Carbon (mg/l)		2.75	1.0 U	3.42	0.22 B	0.27 B	0.36 B	2.6 B	0.092 B	0.73 B	0.89 B

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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TABLE 1
MW-2D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
1,1,2,2-Tetrachloroethane	5	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA	5 U	NA
1,2-Dibromo-3-Chloropropane	0.04	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA	10 U	NA
Acetone	50	3.1 J	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Chloromethane	5	2 JB	NA	5 U	NA	5 U	NA	5 UJ	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Well not sampled

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/13/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		92 U	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25					10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	396	NA	418	NA	325	NA	471	NA	451	NA
Boron	1,000	113	NA	115	NA	500 U	NA	500 U	NA	500 U	NA
Calcium		45,700	49,000	46,700	50,800	36,200	44,100	47,900 J	40,100	43,100	40,900
Chromium	50					5.00 U	NA	5.00 U	NA	5 U	NA
Cobalt						20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	124	NA	88.8	NA	10.0 U	NA	18.7	NA	10 U	NA
Iron	300	131 B	180 B	**781**	285	191	**483**	**393**	256	**614 J**	293
Lead	25	3 U	3 U	3 U	5.1 B	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		18,200	18,200	18,200	18,600	14,500	17,500	19,500	16,900	16,600	17,200
Manganese	300	224	235	**456**	133	161	119	54.2 UJ	82.4	91.9	67.4
Mercury	2					0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100					30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,380	1,530	1,220	1,520	1,120	1,590	1,510	1,090	1,150 UJ	5,000 U
Selenium	10				NA	8.14 J	NA	5.00 U	NA	5 U	NA
Sodium	20,000	9,720 J+	9,650	8,370 J	8,070	6,100 J	8,990	9,050	7,880	15,800	9,150
Zinc		36.1 B	NA	23.9 B	NA	10.0 UJ	NA	10.0 U	NA	22 J	NA

NOTES:
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/13/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		185	190	194	2 U	190	190	180	190	180	170
Ammonia Nitrogen (mg/l)	2	0.28	0.61	0.22	0.04 U	0.500 U	0.671	0.500 U	1.00	1.25	0.50 U
BOD (mg/l)		5.8	3.8	6.4	4.2	4	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.098 B	0.041 B	0.084 B	0.2 U	1 U	2.0 U	2.0 U	0.2 U	2.0 U
COD (mg/l)		5.26 B	6.05 B	8.19 B	10 U	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	18.6	19	24.5	18.3	11.6	14.5	15.7	13.7	19.2	38.6
Color	15	5	NA	15	NA	15.0	NA	8.00	NA	7	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		189	197	192	203	150	182	200	170	176	173
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.499	0.065 B	0.332	0.338	0.463	0.392	0.698	0.200 U	0.261	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 UJ	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	0.253 B	0.266 B	0.448 B	0.341 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Total Dissolved Solids (mg/l)		200	210	230	220	212	235	192	155	250	180
Total Kjeldahl Nitrogen (mg/l)		0.697	0.696	0.599	0.396	0.500 U	0.749	0.500 U	1.04	1.37	0.50 U
Total Organic Carbon (mg/l)		1.3	2	2.1	4.6	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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R = Rejected by data validator

TABLE 1
MW-2D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
1,1,2,2-Tetrachloroethane	5	5 UJ	NS	5 U	NA	0.5 U
1,2-Dibromo-3-Chloropropane	0.04	10 UJ	NS	10 U	NA	2.5 U
Acetone	50	10 UJ	NS	10 U	NA	1.0 J
Chloromethane	5	5 UJ	NS	5 U	NA	2.5 U
Methylene Chloride	5	5 UJ	NS	5 U	NA	2.5 U

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NS	316	NA	25.1
Antimony	3	5.0 UJ	NS	5.0 U	NA	0.31 J
Arsenic	25	5.0 UJ	NS	5.0 U	NA	1.64
Barium	1,000	499 J	NS	121	NA	63.34
Boron	1,000	500 UJ	NS	500 U	NA	29.0 J
Calcium		43,100 J	NS	79,000	87,500	80,000
Chromium	50	10.0 UJ	NS	10.0 U	NA	1.18
Cobalt		20.0 UJ	NS	20.0 U	NA	0.87
Copper	200	10.0 UJ	NS	10.0 U	NA	1.68
Iron	300	231 J	NS	**3,510**	**3,420**	**1,750**
Lead	25	3.0 UJ	NS	3.0 U	3.0 U	1.00 U
Magnesium		18,100 J	NS	14,000	12,900	11,000
Manganese	300	72.4 J	NS	223 J	262	234.5
Mercury	2	0.208 J	NS	0.2 U	NA	0.20 U
Nickel	100	30.0 UJ	NS	30.0 U	NA	3.40
Potassium		5,000 UJ	NS	5,000 UJ	5,000 U	705
Selenium	10	3.0 UJ	NS	3.0 U	NA	5.00 U
Sodium	20,000	10,500 J	NS	11,900 J	12,000	12,100
Zinc		10.0 UJ	NS	10.0 UJ	NA	7.08 J

NOTES:
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NS = Well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		184 J	NS	300 J	300	271
Ammonia Nitrogen (mg/l)	2	0.872 J	NS	**7.10**	**8.00**	**4.87**
BOD (mg/l)		4.0 J	NS	4.00 U	4.00 U	2.00 U
Bromide (mg/l)	2	0.8 UJ	NS	8.00 U	8.00 U	0.02 J
COD (mg/l)		20 UJ	NS	20.00 U	20.00 U	10.0 U
Chloride (mg/l)	250	17.2 J	NS	17.00	19.90	16.8
Color	15	5.00 J	NS	**180.00**	NA	**100**
Cyanide, Total (mg/l)	0.2	0.010 UJ	NS	10.00 U	NA	0.001 J
Hardness (mg/l)		182 J	NS	255	272	240
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NS	0.01 U	NA	0.010 U
Nitrate Nitrogen (mg/l)	10	0.648 J	NS	0.10	0.06	0.340
Phenols (mg/l)	0.001	0.005 UJ	NS	0.01 RU	0.01 U	**0.01 J**
Sulfate (mg/l)	250	5.00 UJ	NS	7.70	11.80	11.5
Total Dissolved Solids (mg/l)		220 J	NS	280	280	290
Total Kjeldahl Nitrogen (mg/l)		0.819 J	NS	7.86	7.73	5.70
Total Organic Carbon (mg/l)		3.0 UJ	NS	3.0 U	3.0 U	2.65

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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TABLE 1
MW-2M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/08/97	2/18//98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Carbon Disulfide	60							5 U		5 U	
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Well not sampled

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/08/97	2/18//98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
Aluminum		43.1 B	NA	NA	NA	NA	NA	16.4 B	NA	22.0 U	NA
Antimony	3	19.8 B	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Arsenic	25	2.1 B	NA	NA	NA	NA	NA	3 U	NA	3.0 U	NA
Barium	1,000	110 B	NA	NA	NA	NA	NA	111 B	NA	102 B	NA
Boron	1,000	25.2 B	NA	NA	NA	NA	NA	37.4 B	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.75 B	0.3 U	2 U	1 U	1.3 B	1 U	1.4 B	1 U
Calcium		85,700 0	102,000 0	99,900 0	90,100	102,000 0	102,000 0	80,700	86,700	74,600	80,200
Chromium	50	4.6 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.0 U	NA	2.0 U	
Copper	200	4.1 B	NA	NA	NA	NA	NA	1.2 B	NA	1.0 U	NA
Iron	300	**718 0**	**555 0**	**1,560 0**	**519**	**837 0**	**510 0**	**464**	**499**	**507**	**344**
Lead	25	1.5 U	1.8 U	3.4 0	1.9 U	1.1 B	1 U	3.7	2 U	2.0 U	3 U
Magnesium		15,500 0	18,700 0	17,700 0	16,100	17,600 0	18,100 0	13,900	15,200	13,100	14,300
Manganese	300	15.8 0	20.8 0	21.8 0	18.3	23.3 0	17 0	17.3	18	17.0	19.1
Nickel	100	1.9 B	NA	NA	NA	NA	NA	5.9 B	NA	3.0 U	NA
Potassium		3,900 B	7,480 0	4,180 B	3,520 B	4,440 BE	4,570 B	3,330 JB	3,460 B	3,560 B	3,640 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	4.0 UN	NA
Sodium	20,000	**21,100 0**	**21,800 0**	**21,700 0**	18,200	**22,900 E**	**22,100 0**	17,200	19,200	15,400	15,800
Zinc		287.8	NA	NA	NA	NA	NA	32	NA	5.0 U	NA

NOTES:

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/08/97	2/18//98	05/27/98	08/18/98	11/04/98	05/11/99	10/19/99
Alkalinity (mg/l)		377 0	251 0	272 0	276	285 0	297 0	305	292	290	276
Ammonia Nitrogen (mg/l)	2	1.89 0	**2.21 0**	1.73 0	1.19	**3.43 0**	**3.63 0**	**3.42**	**3.86**	**4.69**	**4.42**
BOD (mg/l)		3 U	4 U	7.2 0	3.7 U	2 U	3 0	2 U	2 U	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2 U	2.00 U	
COD (mg/l)		3 U	7.1 0	11 0	3 U	13.6 0	10 U	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	16.5 0	23.3 0	26.2 0	26.3	25.3 0	23.8 0	23.4	21.2	18.8	18.1
Color	15	**40**	NA	NA	NA	NA	NA	15	NA	10	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 J	NA
Hardness (mg/l)		278 0	332 0	322.2 0	291	331 0	328 0	259	279	240	259
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.04 U	0.04 U	2.9 0	0.05	0.1 U	0.1 U	0.1 U	0.1 U	0.100 U	.100 U
Phenols (mg/l)	0.001	0.0035 U	0.005 U	**0.008 0**	0.005 U	**0.006 0**	**0.017 0**	0.018 U	**0.021**	0.0500 U	.05 U
Sulfate (mg/l)	250	24.5 0	18.8 0	21.4 0	22.2	21.6 0	25.5 0	21.4	17.9	20.7	22.9
Total Dissolved Solids (mg/l)		426 0	416 0	311 0	298	353 0	319 0	308 J	283	333	546
Total Kjeldahl Nitrogen (mg/l)		3.04 0	3.38 0	3.26 0	1.18	3.8 0	3.93 0	4.44	4.45	4.81	4.32
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.36	1 U	3.48 0	1 U	1 U	2.55	1 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-2M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
Acetone	50	NA	4 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Carbon Disulfide	60		5 U	4 J	NA	5 U	NA	NA	5 U	5 U	NA
Methylene Chloride	5	NA	3 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:
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INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
Aluminum		NA	27.2 B	43.6 B	43.6 B	83.3 U	83.3 U	NA	60 U	92 U	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	5.9 U	5.9 U	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	7 U	7 U	3.5 U		
Barium	1,000	NA	111 B	117 B	117 B	139	NA	NA	116	112	NA
Boron	1,000	NA	81.0 B	50 U	50 U	50 U	50 U	NA	34.8 B	31.4	NA
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		79,300	82,200	90,700	82,200	88,200	84,600	84,300	84,000	84,000	84,300
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	1.5 U	1.5 U	1.4 U		
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	1.5 U	1.5 U	1.7 U		
Copper	200	NA	1.0 U	1.5 U	1.5 U	5.6 B	NA	NA	2.6 U	1.1 U	NA
Iron	300	**820**	**700**	**1,490**	**907**	**5,540**	**3,810**	**791**	**587**	**84,000**	**781**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	10.4	7.2 B	3.6 U	3.6 U	3 U	10.8
Magnesium		13,800	14,700	15,400	14,000	15,200	15,400	14,900	15,000	14,300	14,400
Manganese	300	19.4	18.7	21.8	20.9	33.9	21..5	17.1	32.1	21.1	22.5
Nickel	100	NA	1.5 U	1.5 B	1.5 B	2.2 B	NA	NA	1.8 U	1.9 U	NA
Potassium		3,330 B	4,770 B	5,200	5,180	5,960	4,020	3,410	3,200	3,290	3,160
Selenium	10	NA	5.0 U	4.6 JN	4.6 JN	6.9 U	6.9 U	6.9 U	5 U		
Sodium	20,000	14,600 E	15,000	14,200	13,000	13,500 J	13,600	12,200	11,900 E	11,400	11,900
Zinc		NA	5.0 U	4.9 B	4.9 B	16.2 U	16.2 U	NA	11 U	11 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
Alkalinity (mg/l)		274	273	280	278	264	277	284	281	291	280
Ammonia Nitrogen (mg/l)	2	**3.59**	**3.96**	**3.73**	**4.2**	1.7	**3.8**	**3.6**	**4.6**	**3.7**	2
BOD (mg/l)		2 U	2.0 U	2.5	2 U	7.4	4.4	2.5	0.27 B	0.54 B	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.026 B	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5.97 B
Chloride (mg/l)	250	14.4	13.9	14.1	14	14	14	14	13.9	12.3	13.7
Color	15	NA	10.0	**30**	**30**	**30**	NA	NA	10	10	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		255	266	290	263	283	275	272	272	269	270
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	1.1	0.035 B	0.1 U	0.1 U	0.105	0.664
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	**0.003 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	18	19.9	17.7	18	17	17	17	16.9	16.2	16.9
Total Dissolved Solids (mg/l)		326	310	312	310	310	320	310	330	310	310
Total Kjeldahl Nitrogen (mg/l)		4.5	2.2	4.4	4.53	1.98	3.54	3.58	3.97	3.9	2.23
Total Organic Carbon (mg/l)		3.18	1.0 U	4.55	1.3	0.53 B	1.9	1.7	0.58 B	0.46 B	0.58 B

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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TABLE 1
MW-2M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	08/05/09	10/27/09
Acetone	50	10 U	10 U	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Carbon Disulfide	60	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/13/09	10/27/09
Aluminum		92 U	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25				NA	11.5	NA	10.0 U	NA	10 U	NA
Barium	1,000	119	NA	116	NA	105	NA	146	NA	109	NA
Boron	1,000	34.4 B	NA	35.1 B	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		84,400	89,200	82,600	86,500	73,400	74,600	92,900 J	75,800	74,200	76,400
Chromium	50				NA	5 UJ	NA	5.00 U	NA	5 U	NA
Cobalt					NA	20 U	NA	20.0 U	NA	20 U	NA
Copper	200	7.3 U	NA	4.3 U	NA	10 U	NA	10.0 U	NA	10 U	NA
Iron	300	**1,500**	**2,590**	**1,240**	**895**	**586**	**1,300**	**2,730**	**1,530**	**788 J**	**740**
Lead	25	3 U	3 U	3 U	7.8 B	3.00 UJ	3.00 U	3.00 U	**194**	3.00 U	3.00 U
Magnesium		15,300	15,200	14,100	14,500	12900	12,600	17,000	13,800	13,600	14,300
Manganese	300	6.9 U	30.9	37.8	26.9	19.0	24.1	33.7 UJ	37.4	22.8	22.8
Nickel	100	1.9 U	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		3,460	3,030	2,750	3,030	3,140	3,080	3,580	2,600	3,100 J	5,000 U
Selenium	10				NA	**12.2 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	12,300 J+	11,600	9,630 J	9,620	8,040 J	8,060	9,990	7,800	8,830	8,450
Zinc		11 U	NA	11 U	NA	27.2 J	NA	10.0 U	NA	13.5 J	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J or E = Concentration is an estimated value

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		07/20/05	11/03/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/13/09	10/27/09
Alkalinity (mg/l)		280	274	280	267	260	260	260	270	250	240
Ammonia Nitrogen (mg/l)	2	**4.6**	**3.5**	**5.2**	**4.3**	**3.89**	**4.48**	**3.63**	**3.29**	**3.82**	**3.65**
BOD (mg/l)		4.3	11	30	17	4 U	15	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.011 B	0.1 U	0.20 U	1.00 U	2.0 U	2.0 U	0.2 U	0.2 U
COD (mg/l)		10 U	10 U	2.75 B	10 U	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	12.5	13.7	14.1	14.3	7.50	12.3	12.6	12.2	13.7	12.4
Color	15	10	NA	5	NA	12.0	NA	10.0	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		274	285	264	276	236	238	302	246	241	250
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.077 B	0.328	0.200 U	1.01	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	15.2	15.3	14.2	16.9	12.4	12.5	11.8	13.7	16.1	18.7
Total Dissolved Solids (mg/l)		290	290	300	320	252	345	304	280	320	330
Total Kjeldahl Nitrogen (mg/l)		3.76	3.15	5.44	5.58	2.53	5.14	3.88	4.03	4.03	3.99
Total Organic Carbon (mg/l)		0.5 B	1.6	1.9	10	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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TABLE 1
MW-2M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/22/14
Acetone	50	10 UJ	NS	10 U	NA	1.8 J
Carbon Disulfide	60	5 UJ	NS	5 U	NA	0.5 U
Methylene Chloride	5	5 UJ	NS	5 U	NA	2.5 U

NOTES:
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B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Well not sampled

INORGANIC PARAMETERS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/22/14
Aluminum		100 UJ	NS	405	NA	23.30
Antimony	3	5.0 UJ	NS	5.0 U	NA	0.130 J
Arsenic	25	5.0 UJ	NS	5.0 U	NA	0.350 J
Barium	1,000	115 J	NS	57.8	NA	30.26
Boron	1,000	500 UJ	NS	500 U	NA	25.00 J
Cadmium	5	5.00 UJ	NS	5.00 U	5.00 U	0.200 U
Calcium		78,500 J	NS	95,100	86,800	79,000
Chromium	50	10.0 UJ	NS	10.0 U	NA	1.500
Cobalt		20.0 UJ	NS	20.0 U	NA	0.170 J
Copper	200	10.0 UJ	NS	10.0 U	NA	1.760
Iron	300	**656 J**	NS	**5,270**	**5090**	**1,590**
Lead	25	3.0 UJ	NS	3.0 U	3.0 U	0.460 J
Magnesium		15,100 J	NS	11,500	9,550	8400
Manganese	300	27.8 J	NS	**449 J**	**401**	199.7
Nickel	100	30.0 UJ	NS	30.0 U	NA	1.56
Potassium		5,000 UJ	NS	5,000 UJ	5,000 U	963
Selenium	10	3.0 UJ	NS	3.0 U	NA	0.49 J
Sodium	20,000	10,600 J	NS	12,700 J	12,100	13,200
Zinc		10.0 UJ	NS	10.0 UJ	NA	9.16 J

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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NS = Well not sampled

CONVENTIONAL PARAMETERS	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/02/10	11/09/11	12/28/11	07/22/14
Alkalinity (mg/l)		239 J	NS	300 J	290	226
Ammonia Nitrogen (mg/l)	2	**3.48 J**	NS	**4.05**	**4.36**	1.15
BOD (mg/l)		4.0 UJ	NS	4.0 U	4.0 U	2.70
Bromide (mg/l)	2	0.8 UJ	NS	8.0 U	8.0 U	0.04 J
COD (mg/l)		20 UJ	NS	20.0 U	20.0 U	5.00 J
Chloride (mg/l)	250	14.0 J	NS	20.8	23.4	21.1
Color	15	12.0 J	NS	**190.0**	NA	6.00
Cyanide, Total (mg/l)	0.2	0.010 UJ	NS	10.0 U	NA	0.002 J
Hardness (mg/l)		258 J	NS	285	256	230
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NS	0.010 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.074 J	NS	0.109	0.1 U	3.90
Phenols (mg/l)	0.001	0.005 UJ	NS	0.005 RU	0.0 U	0.03 U
Sulfate (mg/l)	250	13.3 J	NS	7.6	10.2	16.6
Total Dissolved Solids (mg/l)		270 J	NS	320.0	300.0	310
Total Kjeldahl Nitrogen (mg/l)		4.63 J	NS	4.2	4.3	1.40
Total Organic Carbon (mg/l)		3.0 UJ	NS	3.0 U	3.0 U	2.58

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TABLE 1
MW-2S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NS
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NS

NOTES:
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		52.8 B	NA	NA	NA	NA	NA	11.2 B	NA	882	NS
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	NS
Arsenic	25	2 B	NA	NA	NA	NA	NA	3 U	NA	3.9 B	NS
Barium	1,000	51.1 B	NA	NA	NA	NA	NA	52.1 B	NA	65.4 B	NS
Boron	1,000	112	NA	NA	NA	NA	NA	97.7 B	NA	NA	NS
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.1 B	1 U	2.7 B	NS
Calcium		126,000 0	127,000 0	110,000 0	95,500	145,000 0	142,000 0	129,000	137,000	141,000	NS
Chromium	50	2 B	NA	NA	NA	NA	NA	1.1 B	NA	5.8 B	NS
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.8 B	NA	7.4 B	NS
Copper	200	4.5 B	NA	NA	NA	NA	NA	2.1 B	NA	7.1 B	NS
Iron	300	**406 0**	**709 0**	**741 0**	**350**	51 B	55 B	**398**	**23,700**	**22,500**	NS
Lead	25	2 U	2 U	2 U	2 U	1 U	1 B	2 U	13.1	15.4	NS
Magnesium		10,700 0	12,000 0	10,700 0	11,200	14,100 0	12,900 0	12,400	13300	11,900	NS
Manganese	300	202 0	**360 0**	**605 0**	**804**	**1,010 0**	**645 0**	**724**	**1,380**	**683**	NS
Mercury	2	0.25	NA	NA	NA	NA	NA	0.1 U	NA	0.10 U	NS
Nickel	100	7.4 B	NA	NA	NA	NA	NA	15.2 B	NA	18.4 B	NS
Potassium		2,640 B	10,000 0	5,730 0	4,130 B	4,230 BE	3,550 B	2,440 JB	1,550 B	2,000 B	NS
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	4.0 UN	NS
Silver	50	1 U	NA	NA	NA	NA	NA	1.0 U	NA	2.0 U	NS
Sodium	20,000	**34,200 0**	**25,700 0**	**42,200 0**	14,000	14,900 E	11,600 0	10,900	9,460	9,970	NS
Thallium	4	2.1 U	NA	NA	NA	NA	NA	6.0 U	NA	3.0 U	NS
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	4.2 B	NS
Zinc		22.3	NA	NA	NA	NA	NA	25.2	NA	16.1 B	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/27/98	08/18/98	11/04/98	05/11/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		372 0	477 0	460 0	414	462 0	425 0	395	413	450	NS
Ammonia Nitrogen (mg/l)	2	**15.2 0**	**42.9 0**	**42.7 0**	**41.2**	**26.1 0**	**19.7 0**	**22.3**	**19.6**	**8.40**	NS
BOD (mg/l)		14.8 0	4 0	23.6 0	5.5	2 U	3.3 0	3.27	40	12.9	NS
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2.0 U	2.00 U	
COD (mg/l)		9.4 0	7.7 0	32.8 0	3 U	10 U	10 U	10 U	15.8	10.0 U	NS
Chloride (mg/l)	250	50 0	28.3 0	27.9 0	22.6	25.9 0	19.9 0	23.9	22.8	23.4	NS
Color	15	**40**	NA	NA	NA	NA	NA	15	NA	30	NS
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 J	NS
Hardness (mg/l)		360 0	366 0	318.3 0	285	411 0	407 0	373	268	401	NS
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	5.38 0	0.94 0	2.48 0	1.75	2.56 0	0.529 0	0.294	0.28	0.355	NS
Phenols (mg/l)	0.001	0.0035 U	**0.041 0**	**0.012 0**	0.005 U	0.005 U	**0.041 0**	0.009 U	**0.015**	0.0500 U	NS
Sulfate (mg/l)	250	31.3 0	15.1 0	12.9 0	10.8	14.1 0	21 0	16.3	10 U	15.3	NS
Total Dissolved Solids (mg/l)		575 0	384 0	472 0	418	435 0	390 0	386 J	396	491	NS
Total Kjeldahl Nitrogen (mg/l)		17.8 0	48.7 0	54.6 0	1.34	26.8 0	20.7 0	21.9	46.1	10.8	NS
Total Organic Carbon (mg/l)		1 U	1 U	2.16 0	2.57	1.58 0	8.12 0	3.84	3.97	1.00 U	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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** Filtered Sample
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TABLE 1
MW-2S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Methylene Chloride	5	NA	2 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	10.0 U	24.9 B	24.9 B	83.3 U	83.3 U	NA	372 B	92 U	NA
Antimony	3		5.00 U	4.6 U	4.6 U	5.9 U	5.9 U	5.9 U	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	7 U	NA	3.5 U	3.5 U	NA
Barium	1,000	NA	54.4 B	54.3 B	54.3 B	54	NA	NA	50.7	45.9	NA
Boron	1,000	NA	56.6 B	61.9 B	61.9 B	50 U	50 U	NA	43.4 B	39	NA
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		154,000	145,000	133,000	125,000	137,000	148,000	129,000	127,000	121,000	120,000
Chromium	50	NA	1.0 U	1.0 B	1.0 B	1.5 U	1.5 U	NA	1.6 B	1.3 U	NA
Cobalt		NA	4.2 B	6.4 B	6.4 B	4.5 B	NA	NA	2.5 B	3.4	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	1.4 U	1.4 U	NA	3.1 B	4.3 U	NA
Iron	300	**377**	**482**	**4,640**	**9,040**	**5,230**	**7,200**	**7,900**	**2,590**	**3,600**	**4,700**
Lead	25	1.3 U	2.0 U	4.4	2.2 U	3.4 U	3.4 U	3.6 U	**31.6**	3.7	3 U
Magnesium		11,100	10,600	10,400	10,000	10,300	11,500	8,240	8,570	8,560	9,610
Manganese	300	**397**	**952**	**1,080**	**1,180**	**883**	**917**	**580**	**381**	**1,150**	**1,380**
Mercury	2		0.10 U	0.1 U	0.1 U	0.18 U	0.18 U	0.18 U	0.18 U	8	8
Nickel	100	NA	10.4 B	13.6 B	13.6 B	8.2 B	NA	NA	8.3 B	8	NA
Potassium		1,620 B	2,480 B	2,400 B	2,210	1,410	1,460	1,430	1,580	1,350	1,230
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	6.9 U	NA	5 U	5 U	NA
Silver	50		1.00 U	1.0 U	1.0 U	1.4 U	1.4 U	NA	0.93 U	1.1 U	NA
Sodium	20,000	9,050	12,600	14,200	12,000	8,650 J	10,100	14,200	13,200 E	8,550	10,500
Thallium	4		**8.80 B**	9.9 U	9.9 U	16.1 U	16.1 U	16.1 U	13 UJ	10 U	
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	1.3 U	NA	1.3 B	1.5 U	NA
Zinc		NA	5.0 U	4.9 U	4.9 U	16.2 U	16.2 U	NA	11 U	11 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/05/01	10/24/02	12/12/02	09/17/03	11/05/03	05/11/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		468	411	393	386	386	428	380	376	377	377
Ammonia Nitrogen (mg/l)	2	**2.55**	**6.07**	**16.3**	**15**	**7.3**	**7**	**5.4**	**5.9**	**9**	**8.9**
BOD (mg/l)		10.7	2.0 U	2 U	2.7	2.9	3.5	2.6	3.9	2.3	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		11	10.0 U	10 U	15.6	10 U	10 U	10 U	10 U	10 U	7.49 B
Chloride (mg/l)	250	13.9	23.0	21.6	22	18	19	29	15.3	12.8	19.3
Color	15	NA	10.0	**100**	**100**	**50**	NA	NA	15	**75**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		430	406	375	353	385	417	356	352	337	339
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.002 B	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.117	0.1 U	0.1 U	0.82	0.76	0.032 B	0.061 B	0.128	0.033 B	0.052 B
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	15.6	14.5	9.99	10	9	7.5	9.4	7.26	8.23	5.7
Total Dissolved Solids (mg/l)		476	464	406	400	420	470	430	410	370	360
Total Kjeldahl Nitrogen (mg/l)		3.2	7.9	18.5	13.7	7.32	6.21	5.45	5.55	8.55	10.2
Total Organic Carbon (mg/l)		5.85	1.49	9.02	6.2	1.6	2.4	2.8	1.8	1.2	1.3

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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** Filtered Sample

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TABLE 1
MW-2S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/02/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	1.9 J	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
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NS = Well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/02/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		129 B	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	3.5 U	NA	3.5 U	NA	10.3	NA	10.0 U	NA	10 U	NA
Barium	1,000	38.3	NA	33	NA	50 U	NA	56.1	NA	50 U	NA
Boron	1,000	27 U	NA	27 U	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		110,000	127,000	108,000	121,000	89,700	102,000	113,000 J	104,000	113,000	108,000
Chromium	50	1.3 U	NA	10.5	NA	5.00 U	NA	5.00 U	NA	5 U	NA
Cobalt		2.8 B	NA	1.8 U	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**6,230**	**5,680**	**1,890**	**4,530**	**9,190**	**7,460**	**3,850**	**2,650**	**3,910** J	**4,220**
Lead	25	3 U	5.1 B	3 U	3 U	3.00 UJ	7.51	3.00 U	3.00 U	3 U	3 U
Magnesium		8,520	10,600	6,890	8,690	7,780	8,950	10,600	9,980	9,700	10,000
Manganese	300	**685**	**679**	195	**775**	**1,700**	**1,810**	**710** J	**695**	**609**	**517**
Mercury	2	7.6 B	7.6 B	7.6 B	**8**	0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	7.6 B	NA	4.6 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,130	942	1,880	1,000	1,990	1,600	1,230	1,130	1,000 UJ	5,000 U
Selenium	10	5 U	NA	5 U	NA	**15.4 J**	NA	5.00 U	NA	5 U	NA
Silver	50	1.1 U	NA	1.1 U	NA	10.0 U	NA	**129 J**	NA	10 UJ	NA
Sodium	20,000	11,400 J+	10,500	5,520 J	12,100	14,700 J	11,700	10,500	7,980	8,650	9,250
Thallium	4	10 UJ-	10 UJ-	10 UJ-	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		1.5 U	NA	1.5 U	NA	30 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	29.4 J	NA	10.0 U	NA	16.3 J	NA

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	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/02/05	07/25/06	01/02/07	09/26/07	12/05/07	10/29/08	12/09/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		338	373	304	354	320	360	330	340	330	330
Ammonia Nitrogen (mg/l)	2	**4.6**	**4.2**	0.55	**3.8**	**12.5**	**14.3**	**6.56**	**6.09**	**2.55**	**3.44**
BOD (mg/l)		12	12	2.6	4.8	4 U	14	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.20 U	1.00 U	2.0 U	2.0 U	20.0 U	2.0 U
COD (mg/l)		11.7	3.8 B	4.67 B	8.45 B	20 U	20 U	20 U	20 U	20 U	21
Chloride (mg/l)	250	19.2	15.3	12.2	17.4	13.1	19.2	18.6	17.4	15.6	16.6
Color	15	**75**	NA	5	NA	**130**	NA	**20.0**	NA	15	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 U	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		310	361	298	338	256	291	327	302	322	311
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.020 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.852	0.085 B	0.032 B	0.2 U	0.272	0.200 U	0.237	0.423	0.367
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	4.57	5.78	6.47	5.08	5.00 U	10.0 U	5.00 U	5.00 U	7.14	5.00 U
Total Dissolved Solids (mg/l)		360	380	330	390	320	385	328	385	420	460
Total Kjeldahl Nitrogen (mg/l)		4.58	4.33	0.859	5.26	14.3	14.5	7.42	7.04	2.68	3.64
Total Organic Carbon (mg/l)		1.2	2.8	3.7	17	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

NOTES:
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TABLE 1
MW-2S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE						
	GA Standards	06/30/10	11/02/10	11/09/11	11/09/11**	12/28/11	12/28/2011**	07/22/14
VOLATILE COMPOUNDS (µg/L)								
Acetone	50	10 UJ	NS	10 U	NA	NA	NA	1.6 J
Methylene Chloride	5	5 UJ	NS	5 U	NA	NA	NA	2.5 U

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	06/30/10	11/02/10	11/09/11	11/9/2011**	12/28/11	12/28/2011**	07/22/14
INORGANIC PARAMETERS (µg/L)								
Aluminum		100 UJ	NS	5120	100 RU	NA	NA	159
Antimony	3	5.0 UJ	NS	5.0 U	5.0 RU	NA	NA	0.120 J
Arsenic	25	5.0 UJ	NS	5.0 U	5.0 RU	NA	NA	11.06
Barium	1,000	50.0 UJ	NS	259.0	53.7 R	NA	NA	62.55
Boron	1,000	500 UJ	NS	500 U	R	NA	NA	35.00
Cadmium	5	5.00 UJ	NS	5.00 U	5.00 R	5.00 U	5.00 U	0.200 U
Calcium		114,000 J	NS	655,000	151,000 R	197,000	144,000	130,000
Chromium	50	10.0 UJ	NS	13.3	10.0 RU	NA	NA	3.830
Cobalt		20.0 UJ	NS	21.2	20.0 RU	NA	NA	2.910
Copper	200	10.0 UJ	NS	29.0	10.0 RU	NA	NA	1.300
Iron	300	**4,690** J	NS	**24,600**	92 R	**17,000**	109.0	**28,700**
Lead	25	3.0 UJ	NS	5.9	3.0 RU	3.0 U	3.0 U	1.120
Magnesium		10,000 J	NS	18,700	10,700 R	11,800	9,760	9,100
Manganese	300	**634** J	NS	**1,740**	884 R	**887**	**723**	**680**
Mercury	2	0.200 UJ	NS	0.200 U	30.000 RU	NA	NA	0.200 U
Nickel	100	30.0 UJ	NS	59.5	30.0 RU	NA	NA	8.330
Potassium		5,000 UJ	NS	5,000 UJ	5,000 RU	5,000 U	5,000 U	1,150
Selenium	10	3.0 UJ	NS	3.0 U	10.0 R	NA	NA	0.710 J
Silver	50	10.0 UJR	NS	10.0 UJ	10.0 RU	NA	NA	0.400 U
Sodium	20,000	10,900 J	NS	19,900 J	17,800 R	**29,200**	19,200	13,900
Thallium	4	3.0 UJ	NS	3.0 U	3.0 RU	NA	NA	0.500 U
Vanadium		30.0 UJ	NS	30.0 U	30.0 RU	NA	NA	0.910 J
Zinc		10.0 UJ	NS	51.0 J	23.2 R	NA	NA	10.02

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	06/30/10	11/02/10	11/09/11	11/9/2011**	12/28/11	12/28/11	07/22/14
CONVENTIONAL PARAMETERS								
Alkalinity (mg/l)		296 J	NS	430 J	NA	390	NA	445
Ammonia Nitrogen (mg/l)	2	1.64 J	NS	**2.18**	NA	**3.91**	NA	**3.31**
BOD (mg/l)		4.0 UJ	NS	13	NA	4	NA	2.00 U
Bromide (mg/l)	2	4.0 UJ	NS	8 U	NA	8 U	NA	0.05 U
COD (mg/l)		20 UJ	NS	20 U	NA	38	NA	19.0
Chloride (mg/l)	250	17.7 J	NS	22	NA	32.8	NA	26.9
Color	15	**35.0 J**	NS	**120**	NA	NA	NA	**170**
Cyanide, Total (mg/l)	0.2	0.010 UJ	NS	10 U	NA	NA	NA	0.002 J
Hardness (mg/l)		326 J	NS	1,710	NA	540	NA	370
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NS	0.01 U	NA	NA	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.187 J	NS	0.145	NA	0.104	NA	0.078 J
Phenols (mg/l)	0.001	0.005 UJ	NS	0.005 U	NA	0.005 U	NA	0.03 U
Sulfate (mg/l)	250	5.00 UJ	NS	5 U	NA	5 U	NA	6.14
Total Dissolved Solids (mg/l)		310 J	NS	590	NA	450	NA	460
Total Kjeldahl Nitrogen (mg/l)		2.13 J	NS	6.87	NA	10.3	NA	4.00
Total Organic Carbon (mg/l)		3.0 UJ	NS	4.8	NA	3.0 U	NA	3.74

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TABLE 1
MW-3D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Benzene		ND	NA	NA	NA	NA	NA	0.7 J	NA	5 U	NA
Methylene Chloride	50	1 JB	NA	NA	NA	NA	NA	5 U	NA	1 J	NA
2-Butanone		ND	NA	NA	NA	NA	NA	2 J	NA	10 U	NA
Toluene	5	ND	NA	NA	NA	NA	NA	0.5 J	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		182 B	NA	NA	NA	NA	NA	161 B	NA	22.0 U	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5 U	NA	**3.0 B**	NA
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3 U	NA	3.0 U	NA
Barium	1,000	384	NA	NA	NA	NA	NA	480	NA	472.	NA
Boron	1,000	506	NA	NA	NA	NA	NA	478	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.2 JB	1.5 B	1.4 B	1 U
Calcium		48,900 0	47,100 0	38,900 0	36,300	37,700 0	37,100 0	30,900	54,900	47,000	49,300
Chromium	50	1.4 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2 U	NA	2.0 U	
Copper	200	7.6 B	NA	NA	NA	NA	NA	2.7 B	NA	1.1 B	NA
Iron	300	**459 0**	**572 0**	**804 0**	**663**	**796 0**	**716 0**	**706**	**354**	32.2 B	240
Lead	25	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.3
Magnesium		22,800 0	24,800 0	20,700 0	20,200	19,600 0	20,200 0	15,600	23,600	20,300	21,900
Manganese	300	**489 0**	**742 0**	**552 0**	**530**	**492 0**	**451 0**	**444**	**304**	**353**	**512**
Nickel	100	1.4 B	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Potassium		2,410 B	5,090 0	2,220 B	1,800 B	1,990 3E	2,180 B	1,480 JB	2,160 B	1,990 B	2,190 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NA
Sodium	20,000	**31,500 0**	**30,400 0**	**30,100 0**	**26,900**	**28,600 E**	**29,000 0**	**22,500**	**28,100**	**24,600**	**25,300**
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	2.0 U	
Zinc		25.4	NA	NA	NA	NA	NA	28.4	NA	5.0 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		297 0	268 0	227 0	232	226 0	222 0	232	264	255	243
Ammonia Nitrogen (mg/l)	2	0.86 0	1.24 0	1.49 0	**10.6**	**2.38 0**	**2.49 0**	**11.7 J**	1.68	1.66	1.47
BOD (mg/l)		3 0	3 0	4.2 0	3.7 U	2 U	2.4 0	2 U	5	2.04	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2.00 U	2.0 U	2.00 U	NA
COD (mg/l)		3 0	3 U	6.8 0	3 U	10 U	10 U	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	2.45 0	6.19 0	5.2 0	4.6	5.52 0	5.6 0	6.54	5.5	6.00	5.66
Color	15	**40**	NA	NA	NA	NA	NA	**10**	NA	5 U	NA
Cyanide, Total	0.2		NA	NA	NA	NA	NA	NA	NA	0.0100 J	NA
Hardness (mg/l)		216 0	219 0	182.1 0	174	169 0	176 0	141	234	201	213
Hexavalent Chromium								0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.586 0	0.04 0	2.59 0	0.1	0.1 U	0.1 U	0.1 U	1.51	0.100 U	.100 U
Phenols (mg/l)	0.001	0.0035 U	**0.06 0**	**0.01 0**	**0.017**	**0.013 0**	**0.018 0**	NA	0.01 U	0.0500 U	.05 U
Sulfate (mg/l)	250	24.4 0	11.5 0	6.6 0	5.99	10 U	10 U	10 U	26.3	28.9	10.2
Total Dissolved Solids (mg/l)		345 0	249 0	224 0	409	230 0	203 0	222 J	279	288	278
Total Kjeldahl Nitrogen (mg/l)		1.53 0	2.79 0	3.09 0	99.4	2.84 0	2.58 0	3.26 J	2.93	1.92	1.57
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.04	1 U	1 U	1 U	1.49	1.00 U	10.3

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TABLE 1
MW-3D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	NA	10 U	3 J	NA	10 U	NA	NA	10 U	10 U	NA
Benzene		NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA
Methylene Chloride	50	NA	2 U	**6**	NA	5 U	NA	NA	5 U	5 U	NA
2-Butanone		NA		10 U	NA	10 U	NA	NA	10 U	10 U	NA
Toluene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	86.4 B	41.1 B	41.1 B	83.3 U	NA	NA	60 U	92 U	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	5.9 U	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	7 U	NA	3.5 U	3.9 U	NA
Barium	1,000	NA	470	376	376	380	NA	NA	429	413	NA
Boron	1,000	NA	573	588	588	558	NA	NA	554	523	NA
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	2.1 B	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		50,900	55,300	53,100	50,600	47,500	48,500	42,900	43,100	39,200	39,400
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	1.5 U	NA	1.4 U	1.4 U	NA
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	1.5 U	NA	1.7 U		
Copper	200	NA	2.6 B	1.5 U	1.5 U	1.4 U	1.4 U	NA	2.6 U		
Iron	300	64.4 B	168	242	63.5 U	234	**2,430**	53 U	209	204	254
Lead	25	1.3 B	1 U	2.3 U	2.2 U	3.4 U	20.8	3.6 U	3.6 U	3 U	3 U
Magnesium		21,600	24,300	22,600	21,500	22,300	21,400	20,200	21,000	18,700	19,000
Manganese	300	**460**	**468**	**521**	**565**	**628**	**750**	**637**	**645**	**586**	**578**
Nickel	100	NA	1.5 U	2.2 B	2.2 B	1.9 U	NA	NA	1.8 U	1.9 U	NA
Potassium		1,870 B	3,000 B	2,700 B	3,240	2,820	3,320	1,920	1,830	1,820	1,870
Selenium	10	NA	5.0 UJN	4.6 UN	4.6 UN	6.9 U	6.9 U	NA	5 U		NA
Sodium	20,000	**25,500**	**31,000**	**28,200**	**27,200**	**29,800 J**	**29,600**	**28,500**	**29,300 E**	**27,500 J**	**28,500**
Vanadium			1.0 U	1.0 U	1.0 U	1.3 U	1.3 U	NA	1 U		
Zinc		NA	5.0 U	7.4 B	7.4 B	16.2 U	NA	NA	11 U	11 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		256	243	249	251	240	246	245	241	242	239
Ammonia Nitrogen (mg/l)	2	0.742	0.852	1.03	1.3	1.3	1.3	1.7	1.8	1.8	2
BOD (mg/l)		2.3	2.0 U	2 U	2.7	2.2	5	2.8	1.2 B	1.4 B	2 U
Bromide (mg/l)	2	NA	0.1	0.112	0.12	0.11	0.11	0.11	0.109	0.116	0.116
COD (mg/l)		11	10.0 U	10 U	10 U	10 U	8.83 B	10 U	10 U	10 U	10 U
Chloride (mg/l)	250	4.79	4.6	5.14	5.1	5.2	5.1	5.3	5.32	5	5.44
Color	15	NA	5.0 U	10	10	5	NA	NA	5	5	NA
Cyanide, Total	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		216	238	226	215	210	209	190	194	175	177
Hexavalent Chromium			0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.154	0.1 U	0.1 U	0.1 U	0.036 B	0.1 U	0.1 U	0.034 B	0.1 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	36	33.3	34.5	32	24	21	17	15.3	11.6	10
Total Dissolved Solids (mg/l)		10 U	318	303	300	300	290	250	270	250	230
Total Kjeldahl Nitrogen (mg/l)		1.2	0.97	1.2	1.12	1.29	1.9	1.62	1.77	1.91	1.85
Total Organic Carbon (mg/l)		1.49	3.22	2.36	1.7	0.35 B	0.42 B	0.72 B	0.61 B	0.31 B	0.46 B

NOTES:
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TABLE 1
MW-3D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	NS	NS	10 UJ	NS
Benzene		5 U	NA	5 U	NA	5 U	NA	NS	NS	5 U	NS
Methylene Chloride	50	5 U	NA	5 U	NA	5 U	NA	NS	NS	5 U	NS
2-Butanone		10 U	NA	10 U	NA	10 U	NA	NS	NS	10 U	NS
Toluene	5	5 U	NA	5 U	NA	5 U	NA	NS	NS	5 U	NS

NOTES:
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/09/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		92 U	NA	92 U	NA	100 UJ+	NA	NS	NS	490	NS
Antimony	3				NA	15.0 U	NA	NS	NS	15 UJ	NS
Arsenic	25	3.9 U	NA	4.3 B	NA	10.0 U	NA	NS	NS	10 U	NS
Barium	1,000	488	NA	498	NA	482	NA	NS	NS	458	NS
Boron	1,000	505	NA	526 J	NA	500 U	NA	NS	NS	580	NS
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	NS	NS	5 U	NS
Calcium		36,200	37,800	38,200	39,000	29,700	33,500	NS	NS	55,500	NS
Chromium	50	1.5 B	NA	1.3 U	NA	5.00 U	NA	NS	NS	5 U	NS
Cobalt						20.0 U	NA	NS	NS	20 U	NS
Copper	200					10.0 U	NA	NS	NS	10 U	NS
Iron	300	**325**	135 B	**354**	**508**	**537**	**630**	NS	NS	**751 J**	NS
Lead	25	3 U	3 U	3 U	3 U	3 UJ	6.50	NS	NS	3 U	NS
Magnesium		18,600	18,700	19,900	19,500	15,600	16,600	NS	NS	26,900	NS
Manganese	300	**538**	**519**	**553**	**507**	**404**	**361**	NS	NS	**489**	NS
Nickel	100	1.9 U	NA	1.9 U	NA	30.0 U	NA	NS	NS	30 U	NS
Potassium		1,840	1,860	1,740 J	1,860	1,900	1,800	NS	NS	2,560 UJ	NS
Selenium	10		NA		NA	6.2 J	NA	NS	NS	5 U	NS
Sodium	20,000	**28,900 J+**	**28,800**	**27,700**	**27,300**	**22,800 J**	**25,000**	NS	NS	**31,000**	NS
Vanadium						30.0 U				30 U	NS
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	NS	NS	10 U	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/09/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		229	242	241	235	220	230	NS	NS	250	NS
Ammonia Nitrogen (mg/l)	2	1.9	1.9	2	1.9	2.00	**2.23**	NS	NS	1.39	NS
BOD (mg/l)		1.9 B	4.9	3	4	4 U	4 U	NS	NS	9	NS
Bromide (mg/l)	2	0.134	0.1 U	0.167	0.08 B	0.20 U	1.0 U	NS	NS	20 U	NS
COD (mg/l)		10 U	3.48 B	3.24 B	10 U	20 U	20 U	NS	NS	108	NS
Chloride (mg/l)	250	13.3	5.47	5.56	5.01	2.37	5.98	NS	NS	6.07	NS
Color	15	15	NA	10	NA	**19.0**	NA	NS	NS	7	NS
Cyanide, Total	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	NS	NS	0.01 U	NS
Hardness (mg/l)		167	171	177	178	139	152	NS	NS	249	NS
Hexavalent Chromium		0.01 U	NA	0.01 U	NA	0.01 U	NA	NS	NS	0.01 UJ	NS
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	0.200 U	0.257	NS	NS	0.824	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	**0.005 B**	0.005 U	0.005 U	NS	NS	0.005 U	NS
Sulfate (mg/l)	250	7.91	7.54	9.34	8.76	5.00 U	5.00 U	NS	NS	43.9	NS
Total Dissolved Solids (mg/l)		220	240	240	0.91 B	180	248	NS	NS	340	NS
Total Kjeldahl Nitrogen (mg/l)		2.02	2.08	2.03	2.12	2.47	2.27	NS	NS	5.58	NS
Total Organic Carbon (mg/l)		0.45 B	1.6	2.8	0.91 B	3.0 U	3.0 U	NS	NS	3.0 U	NS

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TABLE 1
MW-3D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE		
	GA Standards	07/01/10	11/01/10	07/23/14
VOLATILE COMPOUNDS (µg/L)				
Acetone	50	10 UJ	NS	2.5 U
Benzene		5 UJ	NS	0.5 U
Methylene Chloride	50	5 UJ	NS	2.5 U
2-Butanone		10 UJ	NS	2.5 U
Toluene	5	5 UJ	NS	2.5 U

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NS = Well not sampled

	NYSDEC Class	SAMPLING DATE		
	GA Standards	07/01/10	11/01/10	07/23/14
INORGANIC PARAMETERS (µg/L)				
Aluminum		280 J	NS	9.77 J
Antimony	3	5.0 UJ	NS	0.28 J
Arsenic	25	5.0 UJ	NS	0.33 J
Barium	1,000	366 J	NS	221.5
Boron	1,000	585 J	NS	595
Cadmium	5	5.00 UJ	NS	0.20 U
Calcium		62,700 J	NS	58,000
Chromium	50	10.0 UJ	NS	0.98 J
Cobalt		20.0 UJ	NS	0.34
Copper	200	10.0 UJ	NS	0.88 J
Iron	300	**467 J**	NS	59.9
Lead	25	3.0 UJ	NS	0.32 J
Magnesium		29,200 J	NS	26,000
Manganese	300	**347 J**	NS	**572.6**
Nickel	100	30.0 UJ	NS	2.46
Potassium		5,000 UJ	NS	713
Selenium	10	3.8 J	NS	5.00 U
Sodium	20,000	**36,500 J**	NS	**28,600**
Vanadium		30.0 UJ	NS	0.27 J
Zinc		10.0 UJ	NS	4.07 J

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	NYSDEC Class	SAMPLING DATE		
	GA Standards	07/01/10	11/01/10	07/23/14
CONVENTIONAL PARAMETERS				
Alkalinity (mg/l)		260 J	NS	273
Ammonia Nitrogen (mg/l)	2	0.500 UJ	NS	1.3
BOD (mg/l)		8.0 J	NS	2.0 U
Bromide (mg/l)	2	0.8 UJ	NS	0.076
COD (mg/l)		20 UJ	NS	10 U
Chloride (mg/l)	250	6.96 J	NS	5.85
Color	15	**40.0 J**	NS	5.0
Cyanide, Total	0.2	0.010 UJ	NS	0.001 J
Hardness (mg/l)		277,000 J	NS	250
Hexavalent Chromium		0.010 UJ	NS	0.01 U
Nitrate Nitrogen (mg/l)	10	0.315 J	NS	0.035 J
Phenols (mg/l)	0.001	0.005 UJ	NS	0.03 U
Sulfate (mg/l)	250	64.8 J	NS	50.5
Total Dissolved Solids (mg/l)		330 J	NS	350
Total Kjeldahl Nitrogen (mg/l)		0.657 J	NS	1.5
Total Organic Carbon (mg/l)		3.0 UJ	NS	1.5

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TABLE 1
MW-3M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
2-Butanone	50							10 U		10 U	
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Benzene	1							5 U		5 U	
Bromochloromethane	5										
Methylene Chloride	5	1 JB	NA	NA	NA	NA	NA	0.5 U	NA	5 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		56.2 B	NA	NA	NA	NA	NA	18.9 B	NA	22.0 U	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	
Arsenic	25	3.4 B	NA	NA	NA	NA	NA	3 U	NA	3.2 B	NA
Barium	1,000	107 B	NA	NA	NA	NA	NA	33.6 B	NA	57.4 B	NA
Boron	1,000	39.1 B	NA	NA	NA	NA	NA	28.4 B	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.0 U	1.0 U	2.1 B	1 U
Calcium		104,000 0	98,100 0	87,000 0	74,900	76,200 0	83,100 0	113,000	81,200	78,500	129,000
Chromium	50	0.6 U	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	NA
Copper	200	6 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Iron	300	**13,800 0**	**11,600 0**	**9,710 0**	**8,320**	**8,210 0**	**8,110 0**	**396**	**8,740**	**8,740**	**15300**
Lead	25	1.5 U	3.8 0	1.6 U	3.3	2.4 B	1.5 B	2 U	2 U	2.0 B	3 U
Magnesium		12,100 0	12,200 0	9,790 0	9,330	9,150 0	9,560 0	7,750	9,140	8,830	14,200
Manganese	300	247 0	230 0	204 0	175	173 0	186 0	252	201	187	**338**
Mercury	2	0.2 U	NA	NA	NA	NA	NA	0.10 U	NA	0.10 U	
Nickel	100	4.4 B	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Potassium		3,270 B	7,200 0	4,460 B	2,830 B	3,040 BE	3,340 B	3,040 JB	2,660 B	2,340 B	3,020 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NA
Sodium	20,000	**37,900 0**	**31,600 0**	**33,500 0**	**23,900**	**24,600 E**	**21,600 0**	3,550 B	19,400	16,100	**23,600**
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	2.0 U	NA
Zinc		28.2	NA	NA	NA	NA	NA	14.3 B	NA	5.0 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
CONVENTIONAL PARAMETERS											
Alklalinity (mg/l)		424 0	241 0	336 0	200	282 0	280 0	258	294	308	409
Ammonia Nitrogen (mg/l)	2	**32 0**	**23.4 0**	**33 0**	**37.4**	**19 0**	**20.6 0**	**20.4**	**19.8**	**15.1**	**15.8**
BOD (mg/l)		3.8 0	3 0	10 U	4.4 U	2 U	2 U	2 U	4	2.64	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2.0 U	2.00 U	
COD (mg/l)		10.1 0	4 0	3 U	3 U	10 U	10 U	16.7	10 U	10.0 U	10 U
Chloride (mg/l)	250	43.9 0	44.4 0	42.3 0	32.4	32.7 0	35.3 0	35.1	34.8	31.0	34.4
Color	15	**100**	NA	NA	NA	NA	NA	**62**	NA	**40**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 J	NA
Hardness (mg/l)		310 0	295 0	257.5 0	225	227 0	247 0	314	240	232	381
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.061 0	0.15 0	2.65 0	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.100 U	.100 U
Phenols (mg/l)	0.001	0.0035 U	**0.07 0**	**0.016 0**	**0.019**	**0.014 0**	**0.027 0**	0.005 U	**0.011**	0.0500 U	.05 U
Sulfate (mg/l)	250	40.1 0	8.6 0	7.6 0	8.02	10 U	10 U	11.1	10 U	10.0 U	10 U
Total Dissolved Solids (mg/l)		506 0	303 0	387 0	318	306 0	275 0	292 J	266	333	415
Total Kjeldahl Nitrogen (mg/l)		40.2 0	36.1 0	36.4 0	52.2	19.9 0	22.1 0	19.4	25.7	17.6	16.2
Total Organic Carbon (mg/l)		1 U	3.26 0	1.17 0	2.36	1 U	1 U	3.09	2.54	1.94	5.16

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City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
VOLATILE COMPOUNDS (µg/L)											
2-Butanone	50			8 J	NA	NS	NS	NA	5 U	10 U	NA
Acetone	50	NA	10 U	6 J	NA	NS	NS	NA	10 U	10 U	NA
Benzene	1		0.6 U	0.6 J	NA	NS	NS	NA	0.9 J	0.7 J	NA
Bromochloromethane	5										
Methylene Chloride	5	NA	1 U	**6**	NA	NS	NS	NA	5 U	5 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	472	528	528	NS	NS	NA	893	1,440	NA
Antimony	3		5.0 U	4.6 U	4.6 U	NS	NS	4.6 U	4.6 U		
Arsenic	25	NA	2.9 B	4.9 U	4.9 U	NS	NS	NA	4.9 B	3.9 U	NA
Barium	1,000	NA	91 B	63.9 B	63.9 B	NS	NS	NA	71.5	71	NA
Boron	1,000	NA	55.9 B	50 U	50 U	NS	NS	NA	34 B	37.8	NA
Cadmium	5	0.20	0.5 U	0.8 U	1.2 U	NS	NS	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		107,000	121,000	98,400	94,600	NS	NS	97,200	104,000	112,000	93,100
Chromium	50	NA	1.3 B	0.9 U	0.9 U	NS	NS	0.9	1.4 U	1.4 U	NA
Copper	200	NA	1.0 B	1.5 U	1.5 U	NS	NS	1.5	2.6 U		
Iron	300	**13,600**	**14,500**	**10,500**	**9,830**	NS	NS	**11,100**	**11,700**	**12,400**	**9,250**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	NS	NS	**144**	**126**	22.7	15.7
Magnesium		11,800	12,200	8,940	8,300	NS	NS	10,800	12,500	11,400	9,510
Manganese	300	266	**312**	251	241	NS	NS	230	270	292	236
Mercury	2		0.1 U	0.1 U	0.1 U	NS	NS	NA	0.18 U		
Nickel	100	NA	2.0 B	1.8 B	1.8 B	NS	NS	NA	3.7 B	3.1	NA
Potassium		2,300 B	4,310 B	3,030 B	3,460 B	NS	NS	1,900	1,870	2,060	1,680
Selenium	10	NA	5.0 UJN	4.7 BN	4.7 BN	NS	NS	NA	5 U		
Sodium	20,000	19,200	**27,800**	17,100	15,300	NS	NS	17,700	17,500 E	19,700 J	16,500
Vanadium		NA	1.2 B	1.0 U	1.0 U	NS	NS	NA	1.6 B	1.9	NA
Zinc		NA	5.8 B	6.8 B	6.8 B	NS	NS	NA	30.7 B	13	NA

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		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
CONVENTIONAL PARAMETERS											
Alklalinity (mg/l)		380	355	295	318	NS	NS	313	301	320	270
Ammonia Nitrogen (mg/l)	2	**14.8**	**17.4**	**13.4**	**15**	NS	NS	**11**	**10**	**11**	**8.5**
BOD (mg/l)		2 U	2 U	2 U	3.9	NS	NS	2.8	0.57 B	2.2	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	NS	NS	0.1 U	0.1 U	0.04 B	0.032 B
COD (mg/l)		13.5	11.9	10 U	4.49 B	NS	NS	10 U	10 U	10 U	9.61 B
Chloride (mg/l)	250	35.6	40.9	33.1	30	NS	NS	33	33.7	29.3	29.6
Color	15	NA	**120**	**200**	**200**	NS	NS	NA	**120**	**100**	NA
Cyanide, Total (mg/l)	0.2	NA	.01 U	10 U	10 U	NS	NS	NA	10 UJ	10 U	NA
Hardness (mg/l)		316	352	283	270	NS	NS	287	311	327	272
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	NS	NS	NA	0.01 U	0.001 B	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	NS	NS	0.1 U	0.1 U	0.031 B	0.036 B
Phenols (mg/l)	0.001	0.005 U	**0.007**	0.005 U	0.005 U	NS	NS	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	6.09	6.88	8.91	9.1	NS	NS	7.2	7.8	6.81	10.7
Total Dissolved Solids (mg/l)		388	381	343	340	NS	NS	350	350	350	280
Total Kjeldahl Nitrogen (mg/l)		32.1	15.7	17.2	14.7	NS	NS	9.24	9.1	10.6	8.44
Total Organic Carbon (mg/l)		2.42	11	3.4	4.9	NS	NS	1.5	0.58 B	0.99 B	0.88 B

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City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/08/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
2-Butanone	50	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	NA
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Benzene	1	5 U	NA	0.53 J	NA	5 U	NA	5 U	NA	5 U	NA
Bromochloromethane	5										
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/08/08	07/13/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		414 B	NA	123 B	NA	174 J+	NA	100 U	NA	100 U	NA
Antimony	3				NA	15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	3.9 U	NA	4.3 B	NA	12.7	NA	10.0 U	NA	10 U	NA
Barium	1,000	52.4	NA	63.9	NA	50.0 U	NA	63.0	NA	50 U	NA
Boron	1,000	27 U	NA	29.5 JB	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		82,700	112,000	110,000	106,000	67,900	74,700	93,500 J	71,700	83,800	90,900
Chromium	50	2.6 B	NA	1.3 U	NA	5.00 U	NA	5.00 U	NA	5 U	NA
Copper	200				NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**8,910**	**10,000**	**10,800**	**10,900**	**7,210**	**3,230**	**9,460 J**	**7,090**	**7,890 J**	**8,090**
Lead	25	15.1	9.6 B	22.8	3.6 B	23.5 J	448	14.5	3.00 U	3.00 U	3.00 U
Magnesium		9,390	11,000	11,700	10,600	6,230	8,430	9,070	7,840	8,460	9,160
Manganese	300	216	292	274	268	181	201	**441 J**	197	225	243
Mercury	2				NA	0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	2.9 B	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,490	1,500	1,420 J	1,660	1,420	1,580	1,600	1,050	1,430 J	5,000 U
Selenium	10				NA	**11.8 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	15,600 J+	17,100	16,400	18,700	13,800 J	13,900	15,400	12,600	14,300	14,500
Vanadium		1.5 U	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	10.6 J	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/05/07	10/28/08	12/08/08	07/13/09	10/26/09
CONVENTIONAL PARAMETERS											
Alklalinity (mg/l)		259	289	335	312	250	250	260	250	270	270
Ammonia Nitrogen (mg/l)	2	**7.2**	**7.1**	**6.9**	**7.2**	**8.32**	**7.22**	**7.02**	**6.28**	**6.84**	**5.45**
BOD (mg/l)		0.72 B	5.6	2 U	9.7	4 U	14	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.052 B	0.1 U	2.0 U	1.0 U	2.0 U	2.0 U	20.0 U	2.0 U
COD (mg/l)		10 U	5.09 B	10 U	7.22 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	29.7	31.8	29.6	31.8	20.1	19.3	23.7	21.7	23.4	98.2
Color	15	**100**	NA	**200**	NA	**220**	NA	**25.0**	NA	**17**	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 U	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		245	325	323	308	195	221	271	211	244	265
Hexavalent Chromium (mg/l)	0.05	0.001 B	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.046 B	0.1 U	0.026 B	0.04 B	0.200 U	0.791	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	8.91	7.02	4.9	6.05	5.80	8.83	5.00 U	13.1	5.0 U	6.83
Total Dissolved Solids (mg/l)		290	520	360	2	352	347	435	295	340	340
Total Kjeldahl Nitrogen (mg/l)		6.9	6.56	6.62	8.96	9.75	7.20	7.98	6.87	6.69	6.91
Total Organic Carbon (mg/l)		0.82 B	1.7	7.4	2	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

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TABLE 1
MW-3M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	11/09/11	12/27/11	07/23/14
2-Butanone	50	10 UJ	NA	10 U	NA	5.0 U
Acetone	50	10 UJ	NA	10 U	NA	5.0 U
Benzene	1	5 UJ	NA	5 U	NA	0.2 J
Bromochloromethane	5			5 U		2.5 U
Methylene Chloride	5	5 UJ	NA	5 U	NA	2.5 U

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B = Analyte detected in method blank

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INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	11/09/11	12/27/11	07/23/14
Aluminum		100 UJ	NA	100 U	NA	7.48 J
Antimony	3	5.0 UJ	NA	5 U	NA	0.29 J
Arsenic	25	5.0 UJ	NA	5 U	NA	1.58
Barium	1,000	53.9 J	NA	50.4	NA	45.57
Boron	1,000	500 UJ	NA	500 U	NA	23.0 J
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		92,800 J	99,000	94,700	95,800	100,000
Chromium	50	10.0 UJ	NA	10 U	NA	0.98 J
Copper	200	10.0 UJ	NA	10 U	NA	0.19 J
Iron	300	**8,530 J**	**8,840**	**8,660**	**7,970**	**8,590**
Lead	25	3.0 UJ	5.7	3.0 U	3.0 U	13.4
Magnesium		10,200 J	10,500	10,600	9,210	10,000
Manganese	300	256 J	248	221 J	215	198.9
Mercury	2	0.238 J	NA	0.2 U	NA	0.20 U
Nickel	100	30.0 UJ	NA	30 U	NA	0.95
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	1,030
Selenium	10	3.0 UJ	NA	3 U	NA	5.00 U
Sodium	20,000	17,900 J	17,000	15,400 J	15,600	16,100
Vanadium		30.0 UJ	NA	30 U	NA	5.00 U
Zinc		10.0 UJ	NA	10 UJ	NA	2.35 J

NOTES:

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	11/09/11	12/27/11	07/23/14
Alklalinity (mg/l)		271 J	260	320 J	280	293
Ammonia Nitrogen (mg/l)	2	**4.58 J**	**4.76**	**4.71**	**4.99**	**3.35**
BOD (mg/l)		5.0 J	4.0 U	4.0 U	4.0 U	2.00 U
Bromide (mg/l)	2	8.0 UJ	8.0 U	8.0 U	8.0 U	0.05 U
COD (mg/l)		20 UJ	20 U	20 U	20 U	10.0 U
Chloride (mg/l)	250	26.1 J	23.6	39.2	58.4	29.8
Color	15	**35.0 J**	NA	**100**	NA	**120**
Cyanide, Total (mg/l)	0.2	0.010 UJ	NA	10 U	NA	0.001 J
Hardness (mg/l)		274 J	290	280	277	300
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.078 J	0.058	0.050 U	0.053	0.036 J
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	5.00 UJ	7.86	6.3	8.4	5.25
Total Dissolved Solids (mg/l)		400 J	320	360	340	370
Total Kjeldahl Nitrogen (mg/l)		6.26 J	4.66	5.07	5.41	3.90
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	2.14

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TABLE 1
MW-3S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	11 0	NA	NA	NA	NA	NA	10 U	NA	10 U	NS
Benzene	1	ND	NA	NA	NA	NA	NA	0.9 J	NA	1 J	NS
Bromochloromethane	5										
Chlorobenzene	5		NA	NA	NA	NA	NA	5 U	NA	0.7 J	NS
Chloroethane	5	ND	NA	NA	NA	NA	NA	**13 J**	NA	0.6 J	NS
Ethylbenzene	5							5 U		5 U	NS
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	5 U	NA	2 J	NS
Toluene	5	ND	NA	NA	NA	NA	NA	0.4 J	NA	5 U	NS
Trichloroethene	5	ND	NA	NA	NA	NA	NA	0.6 J	NA	5 U	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	11.8 B	NA	938	NS
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	NS
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.6 B	NA	4.0 B	NS
Barium	1,000	118 B	NA	NA	NA	NA	NA	66.1 B	NA	91.1 B	NS
Boron	1,000	312	NA	NA	NA	NA	NA	85.5 B	NA	NA	NS
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	2.2 B	1 U	3.6 B	NS
Calcium		189,000 0	101,000 0	88,900 0	79,600	108,000 0	103,000 0	114,000	159,000	159,000	NS
Chromium	50	2 B	NA	NA	NA	NA	NA	1.4 B	NA	30.5	NS
Cobalt		1.3 B	NA	NA	NA	NA	NA	4.8 B	NA	13.2 B	NS
Copper	200	5.3 B	NA	NA	NA	NA	NA	2.3 B	NA	13.6 B	NS
Iron	300	101 0	**8,050 0**	**15,400 0**	**13,100**	**17,200 0**	**14,100 0**	**22,300**	**42,700**	**33,900**	NS
Lead	25	1.5 U	2.6 B	1.6 U	2 B	1.9 B	3.7 0	2 U	2 U	2.6 B	NS
Magnesium		20,000 0	12,100 0	11,400 0	8,960	10,700 0	9,740 0	9,890	13,800	13,400	NS
Manganese	300	161 0	**1,160 0**	**1,230 0**	**516**	**843 0**	**842 0**	**801**	**1,150**	**1,070**	NS
Nickel	100	16.5 B	NA	NA	NA	NA	NA	20.3 B	NA	474	NS
Potassium		25,100 0	20,400 0	13,800 0	5,130	5,610 E	4,620 B	3,710 JB	4,030 B	4,620 B	NS
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NS
Sodium	20,000	**79,900 0**	**55,200 0**	**97,900 0**	**24,100**	**29,500 E**	**25,000 0**	**23,200**	**30,700**	**32,300**	NS
Thallium	4	2.1 U	NA	NA	NA	NA	NA	6.0 U	NA	3.0 U	NS
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	4.4 B	NS
Zinc		28.7	NA	NA	NA	NA	NA	53.5	NA	25.3	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		516 0	633 0	667 0	339	440 0	368 0	445	539	NA	NS
Ammonia Nitrogen (mg/l)	2	**22 0**	**74.4 0**	**112 0**	**40.8**	**35.5 0**	**28.3 0**	**2.38**	**25.0**	**5.08**	NS
BOD (mg/l)		10.5 0	4.4 U	8.1 0	4.4 U	3.15 0	2.7 0	3.57	5	11.8	NS
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2.0 U	10.4	NS
COD (mg/l)		18.7 0	18 0	29.3 0	3 U	16.2 0	10 U	14.8	18.9	105	NS
Chloride (mg/l)	250	93.1 0	78.4 0	112 0	31.2	42.6 0	41.9 0	47.4	47.9	84.4	NS
Color	15	**40**	NA	NA	NA	NA	NA	**62**	NA	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0810 J	NS
Hardness (mg/l)		555 0	302 0	268.9 0	236	315 0	298 0	325	454	331	NS
Hexavalent Chromium (mg/l)	50	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.500	NS
Nitrate Nitrogen (mg/l)	10	1.53 0	0.25 0	2.53 0	0.1	0.1 U	0.1 U	0.1 U	0.1 U	3.62	NS
Phenols (mg/l)	0.001	0.0035 U	**0.031 0**	**0.032 0**	**0.022**	0.005 U	**0.018 0**	0.012 U	**0.011**	**0.425**	NS
Sulfate (mg/l)	250	46.9 0	5.7 0	4.5 0	8.42	10 U	10.5 0	11.9	10 U	70.3	NS
Total Dissolved Solids (mg/l)		884 0	53 0	793 0	387	404 0	330 0	445 J	520	NA	NS
Total Kjeldahl Nitrogen (mg/l)		28.9 0	104 0	166 0	59.4	38.3 0	29.4 0	27.4	33.2	6.14	NS
Total Organic Carbon (mg/l)		4.25 0	3.06 0	8.77 0	3.39	1.63 0	2.51 0	3.09	6.18	24.9	NS

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MW-3S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	NA	10 U	7 J	NA	NS	NS	NA	10 U	10 U	NA
Benzene	1	NA	1 J	1 J	NA	NS	NS	NA	**2 J**	1 J	NA
Bromochloromethane	5										
Chlorobenzene	5	NA	0.6 U	0.9 J	NA	NS	NS	NA	1 J	1 J	NA
Chloroethane	5	NA	10 U	10 U	NA	NS	NS	NA	5 U	5 U	NA
Ethylbenzene	5	NA	5 U	5 U				5	5		
Methylene Chloride	5	NA	5 U	**6**	NA	NS	NS	NA	5 U	5 U	NA
Toluene	5	NA	5 U	0.1 J	NA	NS	NS	NA	5 U	5 U	NA
Trichloroethene	5	NA	5 U	5 U	NA	NS	NS	NA	5 UJ	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	12.4 B	20.1 U	20.1 U	NS	NS	NA	85.1 B	92 U	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	NS	NS	NA	4.6 U	4.6 U	NA
Arsenic	25	NA	2.8 B	4.9 U	4.9 U	NS	NS	NA	3.5 U	3.5 U	NA
Barium	1,000	NA	91.2 B	71.6 B	71.6 B	NS	NS	NA	73.3	60.7	NA
Boron	1,000	NA	106	72.4 B	72.4 B	NS	NS	NA	78.2	68.9	NA
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	NS	NS	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		176,000	145,000	130,000	154,000	NS	NS	106,000	122,000	116,000	102,000
Chromium	50	NA	1.6 B	0.9 U	0.9 U	NS	NS	NA	2 B	1.3 U	NA
Cobalt		NA	3.6 B	2.5 B	2.5 B	NS	NS	NA	3 B	3.4	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	NS	NS	NA	3.4 B	4.3 U	NA
Iron	300	**5,660**	**21,200**	**20,100**	**67,500**	NS	NS	**16,400**	**18,100**	**13,000**	**11,000**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	NS	NS	**97.3**	**252**	24.4	10.4
Magnesium		13,200	11,600	9,560	10,900	NS	NS	7,740	9,190	7,640	7,220
Manganese	300	**1,110**	**881**	**590**	**723**	NS	NS	**528**	**535**	**555**	**789**
Nickel	100	NA	12.3 B	7.1 B	7.1 B	NS	NS	NA	21	10.7	NA
Potassium		5,200	8,160	5,300	6,480	NS	NS	3,270	4,040	3,800	1,910
Selenium	10	NA	5.0 U	5.4 N	5.4 N	NS	NS	NA	5 U	5 U	NA
Sodium	20,000	**46,500**	**44,200**	**25,400**	**29,600**	NS	NS	**30,400**	**42,400 E**	**27,700**	17,200
Thallium	4	NA	**10.4**	9.9 U	9.9 U	NS	NS	NA	13 UJ	10 U	NA
Vanadium		NA	1.0 U	1.0 U	1.0 U	NS	NS	NA	1 U	1 U	NA
Zinc		NA	5.0 U	4.9 U	4.9 U	NS	NS	NA	11 U	11 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/29/01	12/06/01	10/28/02	12/12/02	09/17/03	11/05/03	05/11/04	10/13/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		595	424	424	484	NS	NS	388	457	423	315
Ammonia Nitrogen (mg/l)	2	**20.4**	**32.8**	**26.6**	**23**	NS	NS	**27**	**29**	**27**	**9.7**
BOD (mg/l)		17	2	2 U	8.2	NS	NS	5.2	4.2	5.2	2.3
Bromide (mg/l)	2		0.1 U	0.1 U	0.051 B	NS	NS	0.1 U	0.065 B	0.043 B	0.029 B
COD (mg/l)		21	19.8	10 U	5.51 B	NS	NS	10 U	13.9	10 U	27.2
Chloride (mg/l)	250	88.9	50.8	45.4	42	NS	NS	46	**293**	33.6	28.2
Color	15	NA	**200**	**300**	**300**	NS	NS	NA	**200**	**150**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	NS	NS	10 U	10 UJ	10 U	NA
Hardness (mg/l)		494	410	364	213	NS	NS	297	342	321	285
Hexavalent Chromium (mg/l)	50	NA	0.01 U	0.01 U	0.01 U	NS	NS	0.01 U	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	NS	NS	0.1 U	0.1 U	0.036 B	0.039 B
Phenols (mg/l)	0.001	0.005 U	**3.42**	0.005 U	0.005 U	NS	NS	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	5.56	8.37	8.42	8.6	NS	NS	7.8	6.13	7.64	10
Total Dissolved Solids (mg/l)		699	430	462	510	NS	NS	410	480	400	320
Total Kjeldahl Nitrogen (mg/l)		26.3	34.3	30	21.8	NS	NS	21.9	27.2	24.5	9.89
Total Organic Carbon (mg/l)		14.8	9.03	3.31	11	NS	NS	4.4	1.7	2.1	1.5

NOTES:
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TABLE 1
MW-3S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/06/07	10/28/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	13	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Benzene	1	0.77 J	NA	**1.3 J**	NA	5 U	NA	5 U	NA	5 U	NA
Bromochloromethane	5										
Chlorobenzene	5	0.68 J	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Chloroethane	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Ethylbenzene	5				NA		NA		NA		NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Toluene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Trichloroethene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		225 B	NA	383	NA	150 J+	NA	4,560 J	NA	487	NA
Antimony	3	**9.5 B**	NA	5.4 U	NA	15.0 U	NA	30 UJ	NA	15 UJ	NA
Arsenic	25	6.2 B	NA	23.2 B	NA	12.9	NA	13.3 J	NA	10 U	NA
Barium	1,000	44.7	NA	94	NA	50.0 U	NA	106 J	NA	59.8	NA
Boron	1,000	33.8 B	NA	61.2 J	NA	500 U	NA	500 UJ	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 UJ	5.00 U	5.00 U	5.00 U
Calcium		106,000	168,000	176,000	141,000	65,700	125,000	189,000 J	156,000	131,000	182,000
Chromium	50	6.3 B	NA	6.2 B	NA	5.48	NA	**658 J**	NA	15.4	NA
Cobalt		1.8 U	NA	9.3 B	NA	20.0 U	NA	103 J	NA	20 U	NA
Copper	200	32.6	NA	91.8	NA	25.5	NA	**268 J**	NA	10.3	NA
Iron	300	**13,900**	**18,700**	**27,700**	**13,700**	**8,210**	**7,180**	**79,900 J**	**22,400**	**14,900 J**	**36,100**
Lead	25	**1,010**	**187**	**428**	**178**	**246 J**	**142**	**2,680 J**	**212**	**150**	**234**
Magnesium		7,880	11,400	11,400	8,610	5,110	8,140	13,700 J	11,400	9,260	12,000
Manganese	300	**368**	**561**	**960**	**566**	274	257	**1,210 J**	**453**	**489**	**531**
Nickel	100	21.2	NA	57.3	NA	59.6	NA	**2,300 J**	NA	39.1	NA
Potassium		1,980	2,980	3,850 J	3,530	3,260	3,590	3,180 J	2,240	2,020 J	5,000 U
Selenium	10	5 U	NA	5 U	NA	7.16 J	NA	5.00 UJ	NA	5 U	NA
Sodium	20,000	19,400 J+	**23,000**	**48,400**	**35,500**	19,800 J	**27,800**	16,100 J	14,500	14,700	14,000
Thallium	4	10 UJ-	10 UJ-	10 UJ-		10 U	NA	10 UJ	NA	10 U	NA
Vanadium		1.8 B	NA	4.7 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		19 B	NA	151	NA	43.0 J	NA	126 J	NA	17.8 J	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/03/05	07/19/06	12/28/06	09/26/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		327	498	560	472	270	470	380	440	360	460
Ammonia Nitrogen (mg/l)	2	**8.5**	**10**	**14**	**20**	**17.3**	**18.1**	**11.5**	**10.7**	**10.1**	**7.52**
BOD (mg/l)		21	23	36	14	14	8	10.0	9.00	7	11
Bromide (mg/l)	2	0.1 U	0.1 U	0.131	0.1 U	0.20 U	1.0 U	200.0 U	2.0 U	20.0 U	20.0 U
COD (mg/l)		38.1	34	89.7	34.5	20 U	52	88	35	39	32
Chloride (mg/l)	250	34.5	32.9	67.5	33.2	22.8	47.7	23.7	19.4	26.7	25.3
Color	15	**150**	NA	**300**	NA	**280**	NA	**20.0**	NA	**50**	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		297	466	486	388	185	347	528	437	366	503
Hexavalent Chromium (mg/l)	50	0.01 U	NA	0.01 U	NA	0.020 U	NA	0.01 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.039 B	0.059 B	0.035 B	0.038 B	0.200 U	0.733	0.990	0.240	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	**0.045**	**0.048**	**0.007**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	8.19	4.47	4.14	6.29	20.0 U	10.0 U	5.0 U	5.00 U	5 U	5.00 U
Total Dissolved Solids (mg/l)		350	520	640	4.5	315	464	350	472	430	1,100
Total Kjeldahl Nitrogen (mg/l)		13.1	10.9	31.1	23.7	22.2	22.4	12.8	13.0	12.5	9.88
Total Organic Carbon (mg/l)		4	5.2	16	4.5	4.6	3.1	5.6	3.0 U	3 U	3.0 U

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TABLE 1
MW-3S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	07/01/10**	11/02/10	11/2/2010**	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)								
Acetone	50	10 UJ	NA	NA	NA	10 U	NA	4.0 J
Benzene	1	5 UJ	NA	NA	NA	5 U	NA	0.95 U
Bromochloromethane	5					5 U		2.5 U
Chlorobenzene	5	5 UJ	NA	NA	NA	5 U	NA	0.99 J
Chloroethane	5	5 UJ	NA	NA	NA	5 U	NA	2.5 U
Ethylbenzene	5	UJ	NA	NA	NA	5 U	NA	2.5 U
Methylene Chloride	5	5 UJ	NA	NA	NA	5 U	NA	2.5 U
Toluene	5	5 UJ	NA	NA	NA	5 U	NA	2.5 U
Trichloroethene	5	5 UJ	NA	NA	NA	5 U	NA	0.5 U

NOTES:

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	07/01/10**	11/02/10	11/2/2010**	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)								
Aluminum		491 J	100 UJ	NA	NA	228	NA	37.0
Antimony	3	5.0 UJ	5.0 UJ	NA	NA	5 U	NA	0.39 J+
Arsenic	25	5.0 UJ	5.0 UJ	NA	NA	5 U	NA	1.29
Barium	1,000	55.8 J	50.0 UJ	NA	NA	66.4	NA	45.31
Boron	1,000	500 UJ	NA	NA	NA	500 U	NA	33.0
Cadmium	5	5.00 UJ	5.00 UJ	5.00 U	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		140,000 J	109,000 J	186,000	166,000	170,000	167,000	160,000
Chromium	50	14.6 J	10.0 UJ	NA	NA	13.8	NA	1.35
Cobalt		20.0 UJ	20.0 UJ	NA	NA	20 U	NA	1.35
Copper	200	10.0 UJ	10.0 UJ	NA	NA	12	NA	4.02
Iron	300	**15,600 J**	60.0 UJ	**26,700**	**3,460**	**11,900**	**8,610**	**10,500**
Lead	25	**54 J**	3.0 UJ	**260**	3.0 U	**78.6**	22.0	**27.5**
Magnesium		10,400 J	8,330 J	13,300	10,600	9,980	8,510	8,400
Manganese	300	**484 J**	285 J	**635**	**538**	**720 J**	**613**	**463.8**
Nickel	100	30.0 UJ	30.0 UJ	NA	NA	46 J	NA	7.08
Potassium		5,000 UJ	5,000 UJ	5,000 U	5,000 U	5,000 UJ	5,000 U	728
Selenium	10	3.0 UJ	3.0 UJ	NA	NA	3 U	NA	5.00 U
Sodium	20,000	18,300 J	16,600 J	13,800	17,600	**23,100 J**	18,400	**20,300**
Thallium	4	3.0 UJ	3.0 UJ	NA	NA	3 U	NA	0.50 U
Vanadium		30.0 UJ	30.0 UJ	NA	NA	30 U	NA	0.40 J
Zinc		74.9 J	24.1 J	NA	NA	18.1 J	NA	16.61

NOTES:

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	07/01/10**	11/02/10	11/2/2010**	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS								
Alkalinity (mg/l)		374 J	NA	390	NA	450 J	450	406
Ammonia Nitrogen (mg/l)	2	**6.86 J**	NA	**4.90**	NA	**9.90**	**7.54**	**4.62**
BOD (mg/l)		13.0 J	NA	16	NA	13	8	6.10
Bromide (mg/l)	2	8.0 UJ	NA	8.0 U	NA	8 U	8 U	0.055
COD (mg/l)		27 J	NA	73	NA	20 U	20 U	12.0
Chloride (mg/l)	250	31.3 J	NA	21.1	NA	40.3	35.2	37.4
Color	15	**75.0 J**	NA	NA	NA	**150**	NA	**82.0**
Cyanide, Total (mg/l)	0.2	0.010 UJ	NA	NA	NA	10 U	NA	0.001 J
Hardness (mg/l)		392 J	NA	519	NA	467	451	440
Hexavalent Chromium (mg/l)	50	0.010 UJ	NA	NA	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.105 J	NA	0.050 U	NA	0.137	0.074	0.048 J
Phenols (mg/l)	0.001	0.005 UJ	NA	0.005 U	NA	0.005 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	5.00 UJ	NA	5.26	NA	5 U	8.2	3.54
Total Dissolved Solids (mg/l)		330 J	NA	490	NA	450	500	470
Total Kjeldahl Nitrogen (mg/l)		12.5 J	NA	9.70	NA	11	9.77	5.90
Total Organic Carbon (mg/l)		3.0 UJ	NA	3.0 U	NA	3.0 U	3.0 U	4.50

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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R = Rejected by data validator

TABLE 1
MW-4M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	2 JB	NS	NA	NS	NS	NA	5 U	NS	1 J	NA
Tetrachloroethene	5							5 U		5 U	
Trichloroethene	5							5 U		5 U	5 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		134 B	NS	NA	NS	NS	NA	19.7 B	NS	80.6 B	NA
Antimony	3	4 B	NS	NA	NS	NS	NA	5 U	NS	3.0 U	NA
Arsenic	25	1.3 U	NS	NA	NS	NS	NA	3.0 U	NS	3.0 U	
Barium	1,000	27 B	NS	NA	NS	NS	NA	36.4 B	NS	26.2 B	NA
Boron	1,000	28.3 B	NS	NA	NS	NS	NA	25.2 B	NS	NA	NA
Cadmium	5	0.4 U	NS	0.5 U	NS	NS	1 U	1.0 U	NS	1.6 B	1 U
Calcium		126,000 0	NS	196,000 0	NS	NS	160,000 0	122,000	NS	116,000	122,000
Chromium	50	5.2 B	NS	NA	NS	NS	NA	1 U	NS	1.0 U	NA
Cobalt		0.8 U	NS	NA	NS	NS	NA	2.0 U	NS	2.0 U	NA
Copper	200	1.3 U	NS	NA	NS	NS	NA	1.4 B	NS	1.3 B	NA
Iron	300	273 0	NS	**1450 0**	NS	NS	73.7 B	**440**	NS	**353**	**303**
Lead	25	1.5 U	NS	1.6 U	NS	NS	1 U	2.3 B	NS	2.0 U	3 U
Magnesium		10,100 0	NS	13,600 0	NS	NS	11,000 0	8,380	NS	8,860	9,430
Manganese	300	128 0	NS	**500 0**	NS	NS	238 0	274	NS	99.5	99.6
Mercury	2	0.2 U	NS	NA	NS	NS	NA	0.10 U	NS	0.10 U	
Nickel	100	4.4 B	NS	NA	NS	NS	NA	8.1 B	NS	3.0 U	NA
Potassium		1,220 B	NS	7,190 0	NS	NS	4,630 B	3,340 JB	NS	1,580 B	1,380 B
Sodium	20,000	2,630 0	NS	4,580 0	NS	NS	5,160 0	3,910 B	NS	3,300 B	3,480 B
Thallium	4	5.7 B	NS	NA	NS	NS	NA	6 U	NS	3.0 U	NA
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 U	NS	2.0 U	NA
Zinc		2.1 U	NS	NA	NS	NS	NA	23.2	NS	13.4 B	NA

NOTES:

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J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Reported data qualified as unusable

N = Spiked sample recovery not within control limits

+/- = Additionally estimated

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		300 0	NS	442 0	NS	NS	372 0	305	NS	395	320
Ammonia Nitrogen (mg/l)	2	0.05 U	NS	0.05 U	NS	NS	0.04 U	0.185	NS	0.0520	.04 U
BOD (mg/l)		3 U	NS	3.8 0	NS	NS	2 U	2 U	NS	2.00 U	2 U
Bromide (mg/l)	2	0.792 0	NS	1.08 0	NS	NS	2 U	2 U	NS	2.00 U	2 U
COD (mg/l)		3 U	NS	7.9 0	NS	NS	10 U	10 U	NS	10.0 U	10 U
Chloride (mg/l)	250	1 U	NS	4.13 0	NS	NS	7.84 0	6.15	NS	3.34	3.48
Color	15	**40**	NS	NA	NS	NS	NA	10	NS	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 J	NA
Hardness (mg/l)		357 0	NS	545 0	NS	NS	444 0	339	NS	326.	343
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 U	
Nitrate Nitrogen (mg/l)	10	1.25 0	NS	2.79 0	NS	NS	0.198 0	0.163	NS	0.100 U	.170
Phenols (mg/l)	0.001	0.0035 U	NS	**0.029 0**	NS	NS	**0.008 0**	0.007 U	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	14.1 0	NS	22.5 0	NS	NS	16.9 0	12.2	NS	14.2	10 U
Total Dissolved Solids (mg/l)		360 0	NS	404 0	NS	NS	387 0	264 J	NS	430	343
Total Kjeldahl Nitrogen (mg/l)		0.25 0	NS	0.44 0	NS	NS	0.134 0	0.114	NS	0.100 U	.100 U
Total Organic Carbon (mg/l)		1 U	NS	5.55 0	NS	NS	1 U	7.61	NS	2.85	2.52

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TABLE 1
MW-4M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	5 U	0.6 J	NA	5 U	NA	NA	5 U	5 U	NA
Tetrachloroethene	5		5 UJ	**14**	NA	5 U	NA	NA	5 U	5 U	NA
Trichloroethene	5		5 UJ	1 J	NA	5 U	NA	NA	5 UJ	5 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	287	245	245	630	NA	NA	708	154	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	5.9 U	5.9 U	4.6 U		
Arsenic	25		2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U	3.9 U	NA
Barium	1,000	NA	49 B	27.6 B	27.6 B	37.3	NA	NA	54.5	33	NA
Boron	1,000	NA	39.6 B	50 U	50 U	50 U	50 U	50 U	27 U		
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		184,000	167,000	124,000	111,000	152,000	211,000	154,000	180,000	140,000	139,000
Chromium	50	NA	1.5 B	1.1 B	1.1 B	4.4 B	NA	NA	5.2 B	1.4	NA
Cobalt		NA	2.6 B	1.2 B	1.2 B	2.1 B	NA	NA	3.5 B	2	NA
Copper	200	NA	2.1 B	1.5 U	1.5 U	1.9 B	NA	NA	3.2 B	4.3 U	NA
Iron	300	**623**	**1,610**	**745**	**503**	**1,860**	**13,800**	**2,910**	**4,870**	**1,570**	**2,320**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		15,000	12,500	7,960	7,210	10,800	13,800	11,000	11,400	8,750	8,360
Manganese	300	209	**407**	145	128	246	**561**	204	**577**	210	188
Mercury	2		0.1 U	0.1 U	0.1 U	0.18 U	0.18 U	0.18 U	0.18 U	2.9	2.9
Nickel	100	NA	5.1 B	2.7 B	2.7 B	4.7 B	NA	NA	5.8 B	2.9	NA
Potassium		1,640 B	4,420 B	2,300 B	2,130	3,450	4,890	1,950	3,670	1,830	1,680
Sodium	20,000	3,700 B	2,930 B	2,600 B	2,510	3,080 J	3,990	3,410	3,350 E	3,760 J	4,300
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	16.1 U	16.1 U	13 UJ		
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.7 B	NA	NA	1.8 B	10 U	NA
Zinc		NA	5.0 U	6.0 B	6.0 B	16.2 U	NA	NA	11 U	11.8	NA

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		524	460	308	298	418	360	484	464	385	388
Ammonia Nitrogen (mg/l)	2	0.04 U	0.088	0.04 U	0.04 U	0.027 B	0.04 U	0.066	0.11	0.051	0.04 U
BOD (mg/l)		2 U	2.0 U	2 U	2 U	1.7 B	2.9	4	0.63 B	1.5	0.24 B
Bromide (mg/l)	2	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.035	0.032 B
COD (mg/l)		10 U	16.8	10 U	10 U	10 U	4.3 B	10 U	10 U	10 U	8.4 B
Chloride (mg/l)	250	2	1.59	4.86	4.9	3.5	3.5	4	5.41	0.171	7.52
Color	15	NA	**20.0**	10	10	**250**	NA	NA	**20**	**20**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		521	468	340	307	424	584	430	496	386	382
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.10 U	0.1 U	0.183	0.18	0.18	0.2	0.047 B	0.1 U	0.171	0.108
Phenols (mg/l)	0.001	0.005 U	**0.006**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.015**	**0.003 B**	**0.006**
Sulfate (mg/l)	250	8.61	11.8	12.2	12	11	9.9	9.4	9.28	10.7	10.5
Total Dissolved Solids (mg/l)		574	508	333	330	400	380	520	500	430	400
Total Kjeldahl Nitrogen (mg/l)		0.14	0.27	0.23	0.1 U	0.1 U	0.396	0.357	0.1 U	0.248	0.1 U
Total Organic Carbon (mg/l)		8.88	7.03	2.34	1.3	0.39 B	1	1.9	5.3	1.5	0.98 B

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TABLE 1
MW-4M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Tetrachloroethene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Trichloroethene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
		07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/29/08	12/09/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		237 B	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	3.9 U	NA	4.2 B	NA	10 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	26.9	NA	31.2	NA	50 U	NA	50.0 U	NA	50 U	NA
Boron	1,000	NS	NS	NS	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		127,000	123,000	135,000	143,000	28,700 U	126,000	36,700 J	33,600	31,100	31,300
Chromium	50	3 B	NA	1.3 U	NA	5 U	NA	5.00 U	NA	5 U	NA
Cobalt		1.8 U	NA	1.8 U	NA	20 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10 U	NA	10.0 U	NA	10 U	NA
Iron	300	**2,180**	**4,370**	74.7 B	**890**	**392**	**4,360**	60.0 U	78.9	60 UJ	71.8
Lead	25	3 U	3 U	3 U	3 U	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		8,590	8,060	10,400	9,280	7,230	7,190	9,500	8,730	8,060	8,540
Manganese	300	108 J-	**445**	14 B	277	25.2	251	10.0 UJ	42.0	10.0 U	28.5
Mercury	2	NS	NS	NS		0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	2.9 B	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,420	1,850	1,920	2,270	1,040	1,780	1,000 U	1,000 U	1,000 UJ	5,000 U
Sodium	20,000	5,930 J+	5,880	5,550 J	2,980	2,710 J	4,420	3,190	2,500	2,590	5,000 U
Thallium	4	10 UJ-	10 UJ-	10 UJ-		10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		1.5 U	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	17.8 J	NA	27.0	NA	10 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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	NYSDEC Class GA Standards	SAMPLING DATE									
		07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/29/08	12/09/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		288	2 U	435	426	110	410	110	120	100	92
Ammonia Nitrogen (mg/l)	2	0.032 B	0.055	0.04 U	0.026 B	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		1.7 B	1.8 B	2.7	4.4	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.20 U	1.0 U	2.0 U	2.0 U	0.2 U	0.2 U
COD (mg/l)		10 U	4.44 B	2.75 B	3.23 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	8.75	7.67	4.56	4.9	2.15	7.29	4.03	3.87	5.01	4.21
Color	15	15	NA	15	NA	11	NA	8.00	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		352	340	380	395	101	344	131	120	111	113
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.38	0.421	0.317	0.044 B	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	10.2	10.5	8.71	9.18	9.63	7.01	10.8	11.7	13.9	16.9
Total Dissolved Solids (mg/l)		340	300	430	3.4	152	368	164	92.5	280	150
Total Kjeldahl Nitrogen (mg/l)		0.274	0.169	0.1 U	0.1 U	0.555	0.500 U	0.500 U	0.500 U	0.500 U	0.005 U
Total Organic Carbon (mg/l)		0.55 B	1.2	4.3	3.4	3 U	53.8	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-4M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 07/01/10	11/02/10	11/09/11	12/28/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)							
Methylene Chloride	5	5 UJ	NA	5 U	NA	NA	NS
Tetrachloroethene	5	5 UJ	NA	5 U	NA	NA	NS
Trichloroethene	5	5 UJ	NA	5 U	NA	NA	NS

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	NYSDEC Class GA Standards	SAMPLING DATE 07/01/10	11/02/10	11/09/11	12/28/11	12/28/2011**	07/23/14
INORGANIC PARAMETERS (µg/L)							
Aluminum		100 UJ	NA	122	NA	NA	NS
Antimony	3	5.0 UJ	NA	5 U	NA	NA	NS
Arsenic	25	5.0 UJ	NA	5 U	NA	NA	NS
Barium	1,000	50.0 UJ	NA	55	NA	NA	NS
Boron	1,000	500 UJ	NA	500	NA	NA	NS
Cadmium	5	5.00 UJ	5.00 U	5.00	5.00 U	5.00 U	NS
Calcium		33,300 J	35,700	182,000 U	216,000	161,000	NS
Chromium	50	10.0 UJ	NA	10	NA	NA	NS
Cobalt		20.0 UJ	NA	20	NA	NA	NS
Copper	200	10.0 UJ	NA	10	NA	NA	NS
Iron	300	60.0 UJ	60.0 U	4940.0 U	**16900.0**	60.0 U	NS
Lead	25	3.0 UJ	3.0 U	3.0	3.0 U	3.0 U	NS
Magnesium		9,060 J	9,770	12,600	13,100	9,970	NS
Manganese	300	11.0 J	10.0 U	**349.0 J**	**519.0**	292.0	NS
Mercury	2	0.200 UJ	NA	0.2 U	NA	NA	NS
Nickel	100	30.0 UJ	NA	30 U	NA	NA	NS
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	5,000 U	NS
Sodium	20,000	5,000 UJ	5,000 U	5,000 UJ	5,000 U	5,000 U	NS
Thallium	4	3.0 UJ	NA	3 U	NA	NA	NS
Vanadium		30.0 UJ	NA	30 U	NA	NA	NS
Zinc		10.0 UJ	NA	10 UJ	NA	NA	NS

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	NYSDEC Class GA Standards	SAMPLING DATE 07/01/10	11/02/10	11/09/11	12/28/11	12/28/2011**	07/23/14
CONVENTIONAL PARAMETERS							
Alkalinity (mg/l)		116 J	100	480 J	440	NA	NS
Ammonia Nitrogen (mg/l)	2	0.500 UJ	0.500 U	0.500 U	0.500 U	NA	NS
BOD (mg/l)		4.0 UJ	4.00 U	4.00 UJ	4.00 U	NA	NS
Bromide (mg/l)	2	0.8 UJ	0.8 U	8.0 UJ	8.0 U	NA	NS
COD (mg/l)		20 UJ	20 U	20 U	20 U	NA	NS
Chloride (mg/l)	250	5.25 J	5.50	3.53	6.56	NA	NS
Color	15	5.00 J	NA	**45**	NA	NA	NS
Cyanide, Total (mg/l)	0.2	0.010 UJ	NA	10 U	NA	NA	NS
Hardness (mg/l)		120 J	129	505	592	NA	NS
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.01 U	NA	NA	NS
Nitrate Nitrogen (mg/l)	10	0.073 J	0.571	0.133	0.087	NA	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NA	NS
Sulfate (mg/l)	250	11.2 J	20.5	8.6	8.8	NA	NS
Total Dissolved Solids (mg/l)		150 J	140	510	640	NA	NS
Total Kjeldahl Nitrogen (mg/l)		0.500 UJ	0.005 U	1.500 J	0.500 U	NA	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	NA	NS

NOTES:

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TABLE 1
MW-4S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/19/99
1,1-Dichloroethane	5							5 U		5 U	
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:
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INORGANIC PARAMETERS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/19/99
Aluminum		112 B	NA	NA	NA	NA	NA	50.6 B	NA	2,620	NA
Antimony	3	68.4	NA	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Arsenic	25	1.8 B	NA	NA	NA	NA	NA	3 U	NA	5.7 B	NA
Barium	1,000	22.8 B	NA	NA	NA	NA	NA	13.7 B	NA	42.6 B	NA
Boron	1,000	22.6 B	NA	NA	NA	NA	NA	15.0 B	NA	NA	NA
Cadmium	5	0.54 B	0.4 U	0.5 U	0.3 U	2 U	1 U	1 U	1 U	1.9 B	1 U
Calcium		13,800 0	204,000 0	195,000 0	135,000	197,000 0	171,000 0	91,800	110,000	219,000	215,000
Chromium	50	11.9	NA	NA	NA	NA	NA	1 U	NA	7.1 B	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2 U	NA	2.2 B	NA
Copper	200	1.5 B	NA	NA	NA	NA	NA	1.6 B	NA	15.0 B	NA
Iron	300	110 0	53.3 B	98.8 B	15.3 U	7 U	12 U	64.8 B	7 U	**6,360**	**2,200**
Lead	25	1.5 U	3 B	1.6 U	1.9 U	1 U	1.7 B	2.1 B	2 U	2.9 B	9.1
Magnesium		10,600 0	12,700 0	11,600 0	7,780	12,200 0	12,200 0	6,170	7,380	17,300	17,100
Manganese	300	5.3 B	90.6 0	**611 0**	232	18 0	25.5 0	2.6 B	3.4 B	178	**421**
Mercury	2	0.53	NA	NA	NA	NA	NA	0.1 U	NA	0.10 U	NA
Nickel	100	2.9 B	NA	NA	NA	NA	NA	5 U	NA	10.8 B	NA
Potassium		1,060 U	2,200 B	917 B	560 B	789 BE	829 B	362 JB	506 B	1,970 B	837 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3 U	NA	R	NA
Sodium	20,000	6,750 0	3,250 B	2,340 B	1,550 B	3,480 BE	3,360 B	2,240 B	2,920 B	2,920 B	3,150 B
Thallium	4	8.9 B	NA	NA	NA	NA	NA	6 U	NA	3.0 U	NA
Vanadium		1 U	NA	NA	NA	NA	NA	1 U	NA	6.5 B	NA
Zinc		2.1 U	NA	NA	NA	NA	NA	26.0	NA	24.0 J	NA

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E = Reported value is estimated because of the presence of interference
R = Rejected- Dataqualified as unusable
N = Spiked sample recovery not within control limits
+/- = Additionally estimated
* = Samples are filtered due to matrix interference

CONVENTIONAL PARAMETERS	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/26/97	06/26/97	10/09/97	02/18/98	05/26/98	08/18/98	11/03/98	05/11/99	10/19/99
Alkalinity (mg/l)		234 0	489 0	457 0	372	528 0	405 0	275	297	642	408
Ammonia Nitrogen (mg/l)	2	0.05 U	0.05 U	0.05 U	0.05 U	0.04 U	0.04 U	0.04 U	0.040 U	0.0410	.04 U
BOD (mg/l)		3 U	4 U	9.4 0	3.7 U	2 U	3.3 0	2 U	5	3.24	2 U
Bromide (mg/l)	2	0.483 0	0.22 0	1.09 0	0.1 U	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		3 U	3 U	12.6 0	3 U	10 U	10 U	10 U	10 U	10.0 U	
Chloride (mg/l)	250	1 U	4.25 0	2.37 0	3.32	4.71 0	5.28 0	3.64	3.6	3.00 U	3 U
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	**20**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 J	NA
Hardness (mg/l)		389 0	562 0	535.1 0	370	559 0	478 0	255	305	618	607
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	NA
Nitrate Nitrogen (mg/l)	10	1.22 0	0.46 0	2.99 0	0.04	0.1 U	0.144 0	0.128	0.20	0.100 U	.1 U
Phenols (mg/l)	0.001	0.0035 U	**0.031 0**	**0.021 0**	**0.019**	**0.007 0**	**0.011 0**	0.009 U	**0.017**	**0.0590**	.05 U
Sulfate (mg/l)	250	10.9 0	15.1 0	17.2 0	11.7	15.2 0	13.5 0	12.1	10 U	16.2	16
Total Dissolved Solids (mg/l)		342 0	511 0	410 0	296	580 0	393 0	304 J	277	609	426
Total Kjeldahl Nitrogen (mg/l)		0.17 0	0.39 0	0.22 0	0.32	0.137 0	0.135 0	0.256	0.40	0.995	1.82
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.48	1 U	1.36 0	3.01	1.82	7.08	1.6

NOTES:
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TABLE 1
MW-4S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
1,1-Dichloroethane	5		5 J	10 U	NA	5 U	NA	NA	5 U	5 U	NA
Acetone	50	NA	10 U	10 U	NA	10 U	NA	NA	4 J	10 U	NA
Methylene Chloride	5	NA	5 U	1 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

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INORGANIC PARAMETERS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
Aluminum		NA	10.0 B	20.1 U	20.1 U	83.3 U	NA	NA	78.3 B	229	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.8 B	9.3	NA
Barium	1,000	NA	35.3 B	28.9 B	28.9 B	30.8	NA	NA	52.1	114	NA
Boron	1,000	NA	22.4 B	50 U	50 U	50 U	NA	NA	27 U		
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		216,000	184,000	126,000	113,000	187,000	221,000	212,000	181,000	210,000	134,000
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U	1.3 U	NA
Cobalt		NA	2.3 B	2.5 B	2.5 B	4.2 B	NA	NA	18	25.1	NA
Copper	200	NA	3.4 B	2.1 B	2.1 B	1.4 U	NA	NA	4.5 B	12.5	NA
Iron	300	30.7 B	**2,420**	**1,440**	258	**406**	**3,910**	**6,620**	**10,000**	**29,700**	**9,440**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		17,000	12,500	8,280	7,300	13,300	15,600	15,600	12,900	11,800	8,030
Manganese	300	80	**426**	**637**	253	**763**	**1,150**	**3,020**	**2,390**	**1,480**	**1,120**
Mercury	2	NA	0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U		
Nickel	100	NA	4.3 B	7.2 B	7.2 B	9.1 B	NA	NA	27	42.2	NA
Potassium		868 B	1,220 B	815 B	786	1,110	1,620	1,020	712	1,430	606
Selenium	10	NA	5.0 UJN	5.1 N	5.1 N	6.9 U	NA	NA	5 U	5 U	NA
Sodium	20,000	2,050 BE	2,210 B	5,630	2,170	2,210 J	2,190	1,740	1,860 E	2,060 J	2,810
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1.5 U	NA
Zinc		NA	5.0 U	7.3 B	7.3 B	16.2 U	NA	NA	11 U	18.9	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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CONVENTIONAL PARAMETERS

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/05/00	10/24/01	12/04/01	10/28/02	12/12/02	09/17/03	11/05/03	05/13/04	10/13/04
Alkalinity (mg/l)		647	449	268	280	502	630	610	491	575	381
Ammonia Nitrogen (mg/l)	2	0.04 U	0.054	0.077	0.04 U	0.04 U	0.11	0.27	0.3	0.33	0.028 B
BOD (mg/l)		2.0 U	3.7	2 U	1.1 B	1.3 B	4.7	4.3	2.4	11	0.24 B
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.048 B	0.05 B	0.1 U	0.1 U	0.05 B	0.028 B
COD (mg/l)			10.0 U	10 U	10 U	10 U	19.5	22	16	34.4	13.2
Chloride (mg/l)	250	1.4	1.13	3.02	3.6	1.6	1.4	2.2	2.84	2.13	4.14
Color	15	NA	**20.0**	15	15	5	NA	NA	**250**	**25**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		609	522	351	312	351	616	593	505	573	368
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	5.78	0.14	0.032 B	0.036 B	0.1 U	0.1 U	0.07 B	0.102
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	**0.003 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	9.04	12.4	59	34	9.1	6.8	7.1	7.88	14.3	11.8
Total Dissolved Solids (mg/l)		666	514	392	350	530	630	650	510	590	380
Total Kjeldahl Nitrogen (mg/l)		0.24	0.17	0.68	0.1 U	0.046 B	1.41	1.3	0.698	2.19	0.525
Total Organic Carbon (mg/l)		7.99	7.54	5.97	1.3	0.24 B	0.47 B	5.8	9.2	4.8	1.3

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TABLE 1
MW-4S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/08/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
1,1-Dichloroethane	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Acetone	50	10 U	NA	10 U	NA	10 U	NA	10 UJ	NA	10 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	**6.3**	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/08/08	7/13/2009*	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		92 U	NA	229 B	NA	100 JJ+	NA	100 U	NA	100 U	NA
Antimony	3					15 U		< 30.0 U	NA	30 UJ	NA
Arsenic	25	3.9 U	NA	5.1 B	NA	10.8	NA	10 U	NA	10 U	NA
Barium	1,000	27.9	NA	76.1	NA	50.0 U	NA	50 U	NA	76.8	NA
Boron	1,000	NS	NS	NS		500 U		< 500 U	NA		NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5 U
Calcium		129,000	201,000	226,000	211,000	112,000	188,000	142,000 J	134,000	199,000	167,000
Chromium	50	1.3 U	NA	3.5 B	NA	5.00 U	NA	5 U	NA	10 U	NA
Cobalt		6.2 B	NA	NA		20.0 U	NA	20 U	NA	22	NA
Copper	200	4.3 U	NA	17.6	NA	10.0 U	NA	10.2	NA	13 J	NA
Iron	300	**6,160**	**32,500**	**15,600**	**6,800**	**1,600**	**68,200**	**3,810 J**	**2,080**	**12,200 J**	**15,300**
Lead	25	3 U	4.1 B	3 U	3 U	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3 U
Magnesium		8,260	15,600	14,000	13,400	6,780	11,000	8,350	8,120	11,200	9,000
Manganese	300	**1,050 J-**	**4,660**	**3,320**	**3,740**	**1,080**	**1,860**	**917 J**	**838**	**2,600**	**1,310**
Mercury	2	NS	NS	NS		0.200 U		0.200 U	NA	0.200 U	NA
Nickel	100	8.7 B	NA	18.6	NA	30.0 U	NA	30 U	NA	30 U	NA
Potassium		667	1,290	1,300	1,280	1,000 U	1,280	1,000 U	1,000 U	1,480 J	5,000 U
Selenium	10	5 U	NA	5 UJ	NA	**13.3 J**	NA	5 U	NA	5 U	NA
Sodium	20,000	3,520 J+	4,750	1,540 J	2,040	1,900 J	2,970	3,170	2,390	3,100	5,000 U
Thallium	4	10 UJ-	10 UJ-	10 UJ-		10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		1.5 U	NA	3.4 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	22.1 B	NA	10.0 UJ	NA	10.0 U	NA	56 J	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/07/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/08/08	07/13/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		331	450	615	544	350	400	360	400	470	420
Ammonia Nitrogen (mg/l)	2	0.1	0.093	0.18	0.13	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		2.9	1.9 B	8.5	3.4	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.022 B	0.1 U	0.20 U	1.0 U	0.2 U	2.0 U	20.0 U	2.0 U
COD (mg/l)		10 U	5.41 B	31.9	13.7	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	4.87	2.88	2.1	1 U	2.54	6.96	2.93	2.37	2.63	1.82
Color	15	**20**	NA	**50**	NA	**90**	NA	10.0	NA	7	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		356	566	622	582	306	516	390	369	488	454
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.020 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.259	0.091 B	0.04 B	0.032 B	0.200 U	0.200 U	0.266	0.200 U	0.380	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	13.7	11.8	11	9	8.64	20 U	17.6	8.19	15.6	17.7
Total Dissolved Solids (mg/l)		360	450	640	4.2	390	472	395	428	570	450
Total Kjeldahl Nitrogen (mg/l)		0.54	0.694	1.34	0.67	0.500 U	0.664	0.500 U	0.500 U	0.572	0.500 U
Total Organic Carbon (mg/l)		0.89 B	1.8	11	4.2	3.0 U	10.1	3.0 U	3.0 U	3.0 U	3.0 U

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TABLE 1
MW-4S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/03/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
1,1-Dichloroethane	5	5 U	NA	5 U	NA	NS
Acetone	50	10 U	NA	10 U	NA	NS
Methylene Chloride	5	5 U	NA	5 U	NA	NS

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/03/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NA	191	NA	NS
Antimony	3	5.0 UJ	NA	5 U	NA	NS
Arsenic	25	5.0 UJ	NA	5 U	NA	NS
Barium	1,000	50.0 U	NA	56.3	NA	NS
Boron	1,000	500 U	NA	500 U	NA	NS
Cadmium	5	5.00 U	5.00 U	5.00 U	5.00 U	NS
Calcium		161,000	165,000	231,000	202,000	NS
Chromium	50	10.0 U	NA	10 U	NA	NS
Cobalt		20.0 U	NA	20 U	NA	NS
Copper	200	10.0 U	NA	10 U	NA	NS
Iron	300	**1,250**	**1,120**	**1,440**	**1,200**	NS
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	NS
Magnesium		8,970	10,400	13,000	9,680	NS
Manganese	300	**615**	**616**	**1,250**	**1,470**	NS
Mercury	2	0.200 U	NA	0 U	NA	NS
Nickel	100	30.0 U	NA	30 U	NA	NS
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.0 U	NA	3 U	NA	NS
Sodium	20,000	5,000 U	5,000 U	5,000 UJ	5,000 U	NS
Thallium	4	3.0 U	NA	3 U	NA	NS
Vanadium		30.0 U	NA	30 U	NA	NS
Zinc		19.2 J	NA	10 UJ	NA	NS

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/03/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		366	370	560 J	500	NS
Ammonia Nitrogen (mg/l)	2	0.500 U	0.500 U	1 U	0.500 U	NS
BOD (mg/l)		4.0 U	4.0 U	4.0 UJ	4.0 U	NS
Bromide (mg/l)	2	0.8 U	4.0 U	8.0 UJ	8.0 U	NS
COD (mg/l)		20 U	20 U	20 U	28	NS
Chloride (mg/l)	250	3.09	2.29	19.8	3.33	NS
Color	15	7.00	NA	12	NA	NS
Cyanide, Total (mg/l)	0.2	0.010 U	NA	10 U	NA	NS
Hardness (mg/l)		439	454	630	544	NS
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.462	0.619	0.050 U	0.058	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	15.0	19.1	8.7	10.2	NS
Total Dissolved Solids (mg/l)		430	440	910	540	NS
Total Kjeldahl Nitrogen (mg/l)		0.500 U	0.541	0.847	0.5 U	NS
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.0 U	3.0 U	NS

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TABLE 1
MW-6M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	2 JB	NS	NA	NS	NS	NA	5 U	NS	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		85.5 B	NS	NA	NS	NS	NA	14.3 B	NS	22.0 U	NA
Antimony	3	3.9 U	NS	NA	NS	NS	NA	5.0 U	NS	3.0 U	
Arsenic	25	1.6 U	NS	NA	NS	NS	NA	3.0 U	NS	3.0 U	
Barium	1,000	96.3 B	NS	NA	NS	NS	NA	60.1 B	NS	70.2 B	NA
Beryllium	3	0.1 B	NS	NA	NS	NS	NA	1 U	NS	1.0 U	NA
Boron	1,000	74.6 B	NS	NA	NS	NS	NA	36.0 B	NS	NA	NA
Cadmium	5	0.9 B	NS	0.5 U	NS	NS	1 U	2.8 B	NS	2.3 B	1 U
Calcium		108,000 0	NS	134,000 0	NS	NS	103,000	179,000	NS	122,000	147,000
Chromium	50	1.4 B	NS	NA	NS	NS	NA	1 U	NS	1.0 U	NA
Cobalt		0.8 U	NS	NA	NS	NS	NA	2 U	NS	2.0 U	NA
Copper	200	1.5 B	NS	NA	NS	NS	NA	1 U	NS	1.0 U	NA
Iron	300	**19,500 0**	NS	**20,200 0**	NS	NS	**12,200**	**21,600**	NS	**17,800**	**18,600**
Lead	25	1.5 U	NS	1.6 U	NS	NS	1.7 B	2.0 U	NS	2.0 U	3 U
Magnesium		6,200 0	NS	9,690 0	NS	NS	5,780	9,060	NS	6,570	7,730
Manganese	300	**880 0**	NS	**1,400 0**	NS	NS	**931**	**1,830**	NS	**992**	**1430**
Mercury	2	0.2 U	NS	NA	NS	NS	NA	0.10 U	NS	0.10 U	
Nickel	100	4.6 B	NS	NA	NS	NS	NA	7.0 B	NS	3.6 B	NA
Potassium		5,850 0	NS	2,150 B	NS	NS	1,850 BE	1,380 JB	NS	3,280 B	1,760 B
Selenium	10	3 U	NS	NA	NS	NS	NA	3.0 U	NS	R	NA
Sodium	20,000	**59,900 0**	NS	17,500 0	NS	NS	18,200	17,700	NS	**26,700**	**22,600**
Thallium	4	7.8 B	NS	NA	NS	NS	NA	6 U	NS	3.0 U	NA
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 U	NS	2.0 U	
Zinc		2.1 U	NS	NA	NS	NS	NA	62.9	NS	5.0 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		424 0	NS	NA	NS	NS	230	402	NS	425	448.
Ammonia Nitrogen (mg/l)	2	**39.1 0**	NS	NA	NS	NS	**6.62**	**3.21**	NS	**18.4**	**3.29**
BOD (mg/l)		3 U	NS	NA	NS	NS	2 U	5.97	NS	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	NS	NA	NS	NS	2 U	2.00 U	NS	2.00 U	
COD (mg/l)		10.6 0	NS	NA	NS	NS	10 U	10 U	NS	10.0 U	10 U
Chloride (mg/l)	250	71.4 0	NS	NA	NS	NS	41	20.2	NS	34.4	24.3
Color	15	**150**	NS	NA	NS	NS	NA	**40**	NS	**60**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS	NA	NS	NS		0.0100 U	NS	0.0100 J	NA
Hardness (mg/l)		296 0	NS	NA	NS	NS	281	484	NS	332	399
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NS	NS		0.0100 U	NS	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.035 0	NS	NA	NS	NS	0.1 U	0.1 U	NS	0.100 U	.100 U
Phenols (mg/l)	0.001	0.0035 U	NS	NA	NS	NS	**0.024**	0.007 U	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	48.4 0	NS	NA	NS	NS	12.8	17.4	NS	10.3	10 U
Total Dissolved Solids (mg/l)		451 0	NS	NA	NS	NS	296	466 J	NS	433	502
Total Kjeldahl Nitrogen (mg/l)		36.7 0	NS	NA	NS	NS	8.17	3.77	NS	19.6	3.53
Total Organic Carbon (mg/l)		1 U	NS	NA	NS	NS	4.48	2.02	NS	2.08	5.52

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TABLE 1
MW-6M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	5 U	0.4 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	35.4 B	780	NA	428 B	NA	NA	60 U	92 U	NA
Antimony	3	NA	5.0 U	4.6 U	NA	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	NA	7 U	NA	NA	3.5 U		NA
Barium	1,000	NA	85.5 B	60.4 B	NA	72.9	NA	NA	58.6	70.3	NA
Beryllium	3	NA	0.5 U	0.5 U	NA	1 U	NA	NA	0.64 U		
Boron	1,000	NA	40.6 B	50 U	NA	50 U	NA	NA	30.3 B	35.5	NA
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	3.3 B	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		109,000	196,000	152,000	138,000	171,000	134,000	123,000	131,000	147,000	141,000
Chromium	50	NA	1.6 B	4.3 B	NA	2.6 B	NA	NA	1.4 U	1.3 U	NA
Cobalt		NA	1.0 U	2.1 B	NA	3 B	NA	NA	1.7 B	2.2	NA
Copper	200	NA	1.3 B	14.1 B	NA	5.9 B	NA	NA	2.6 U	4.3 U	NA
Iron	300	**18,100**	**25,500**	**19,200**	**17,000**	**23,100**	**19,600**	**18,000**	**18,900**	**20,100**	**17,300**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	12.3	3.6 U	3.6 U	3 U	3 U
Magnesium		6,350	10,000	7,520	6,600	9,440	7,370	6,180	6,450	7,460	7,150
Manganese	300	**914**	**1,900**	**1,520**	**1,380**	**1,720**	**1,310**	**1,260**	**1,280**	**1,560**	**1,520**
Mercury	2		0.1 U	0.1 U	NA	0.18 U	NA	NA	0.18 U	4.2	4.2
Nickel	100	NA	4.3 B	6.8 B	NA	5.5 B	NA	NA	3.1 B	4.2	NA
Potassium		3,230 B	4,500 B	2,530 B	1,860	3,580	4,020	2,040	1,710	2,320	1,470
Selenium	10	NA	5.0 JN	4.6 UN	NA	6.9 U	NA	NA	5 U		
Sodium	20,000	**26,300 E**	**24,500**	18,200	14,700	17,300 J	17,900	12,600	13,100 E	**21,900 J**	11,600
Thallium	4	NA	6.0 U	9.9 U	NA	16.1 U	NA	NA	13 UJ		
Vanadium			1.0 U	2.2 B	NA	1.8 B	NA	NA	1 U	1.5 U	NA
Zinc		NA	28.8	31	31	16.2 U	16.2 U	16.2 U	11 U	11 U	NA

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CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		402	442	402	389	452	406	372	367	429	415
Ammonia Nitrogen (mg/l)	2	**19.5**	**5.63**	**3.26**	**2.2**	**5.7**	**8.3**	**6.3**	**4.2**	**6.8**	**2.5**
BOD (mg/l)		2 U	2.0 U	2 U	1.4 B	3.4	7.7	2.6	5	1.6 B	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.029 B	0.1 U	0.1 U	0.1 U	0.1 U	0.042 B	0.1 U
COD (mg/l)		12.5	10.0 U	17.9	10 U	10 U	14.7	10 U	10 U	10 U	12.9
Chloride (mg/l)	250	27.3	19.0	17.5	21	15	20	14	14.6	28.6	13.4
Color	15	NA	**150**	**100**	NA	**100**	NA	NA	**250**	**150**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	NA	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		298	531	411	372	466	365	333	354	398	382
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.001 B	0.012	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.193	0.1 U	0.073 B	0.19	0.1 U	0.1 U	0.066 B	0.037 B
Phenols (mg/l)	0.001	**0.006**	0.005 U	0.005 U	0.005 U	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	12	12.3	10.5	10	11	12	11	9.2	8.34	9.46
Total Dissolved Solids (mg/l)		407	526	445	470	500	430	410	420	490	450
Total Kjeldahl Nitrogen (mg/l)		20.3	6.1	3.7	2.1	5.31	9.07	6.42	4.35	6.43	2.99
Total Organic Carbon (mg/l)		9.95	5.7	9.38	3.4	0.31 B	1.4	1.3	2.2	1.7	1.2

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TABLE 1
MW-6M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

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		07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		166 B	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25		NA		NA	11.8	NA	10.0 U	NA	10 U	NA
Barium	1,000	59.1	NA	52.5	NA	50.0 U	NA	71.0	NA	51.9	NA
Beryllium	3	NS	NS	NS		3.00 U	NA	3.00 U	NA	3 U	NA
Boron	1,000	27.5 B	NA	27 U	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.5 B	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		170,000	126,000	132,000	132,000	109,000	97,800	169,000 J	119,000	121,000	139,000
Chromium	50	1.3 U	NA	1.3 U	NA	11.1 J	NA	5.00 U	NA	5 U	NA
Cobalt		2.3 B	NA	2.9 B	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**19,300**	**10,400**	**17,000**	**15,400**	**11,700**	**6,690**	**17,300 J**	**12,200**	**11,800 J**	**13,600**
Lead	25	3 U	7.5 BN	3 U	3 U	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		8,720	6,140	6,540	6,160	5,400	4,820	8,230	5,840	5,840	7,120
Manganese	300	**1,840 J-**	**965**	**1,340**	**1,480**	**1,290**	**672**	**1,950 J**	**1,320**	**1,420**	**1,600**
Mercury	2					0.200 U	NA	0.200 U	NA	0 U	NA
Nickel	100	4.8 B	NA	4.4 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,560	1,530 N	1,190	1,450	1490	1,530	1,930	1,360	1,200 J	5,000 U
Selenium	10	NS	NS	NS		9.12 J	NA	5.00 U	NA	5 U	NA
Sodium	20,000	17,400 J+	12,000	14,000 J	13,500	8,000 J	8,970	11,500	6,700	11,800	11,400
Thallium	4	10 UJ-	10 UJ-	10 UJ-		10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		1.5 U	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	10 U	NA

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		07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		405	365	380	385	300	300	210	350	340	400
Ammonia Nitrogen (mg/l)	2	**2.1**	1.8	2	1.9	1.36	1.62	1.40	1.30	1.45	1.07
BOD (mg/l)		8.3	12	3.7	5.6	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.017 B	0.1 U	2.0 U	1.0 U	2.0 U	2.0 U	20.0 U	2.0 U
COD (mg/l)		10 U	21.2	2.43 B	4.46 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	18.2	18.2	8.64	9.66	3.67	8.03	9.03	8.86	20.8	13.9
Color	15	**200**	NA	**50**	NA	**180**	NA	**25**	NA	**16**	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		460	340	357	355	295	264	457	321	326	375
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.063 B	0.368	0.1 U	0.04 B	0.200 UJ	0.218	0.200 U	0.200 U	0.2 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	10.1	11.4	8.63	9.23	5.00 U	7.20	5.00 U	11.5	8.29	10.2
Total Dissolved Solids (mg/l)		450	380	400	2.4	400	328	542	392	450	560
Total Kjeldahl Nitrogen (mg/l)		2.27	2.17	2.62	2.04	1.71	1.75	1.62	1.55	1.79	0.925
Total Organic Carbon (mg/l)		0.93 B	1.8	5.6	2.4	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3 U

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TABLE 1
MW-6M Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	5 UJ	NA	5 U	NA	2.5 U

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	NYSDEC Class GA Standards	SAMPLING DATE				
		06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NA	100 U	NA	86.2
Antimony	3	5.0 UJ	NA	5 U	NA	0.14 J
Arsenic	25	5.0 UJ	NA	5 U	NA	1.67
Barium	1,000	50.0 UJ	NA	54.5	NA	35.72
Beryllium	3	3.00 UJ	NA	3 U	NA	0.50 U
Boron	1,000	500 UJ	NA	500 U	NA	9.00 J
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		128,000 J	135,000	132,000	130,000	100,000
Chromium	50	10.0 UJ	NA	10 U	NA	1.31
Cobalt		20.0 UJ	NA	20 U	NA	2.96
Copper	200	10.0 UJ	NA	10 U	NA	2.51
Iron	300	**12,100 J**	**13,600**	**12,800**	**13,000**	**10,200**
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	0.7 J
Magnesium		6,500 J	7,100	6,450	6,140	5,200
Manganese	300	**1,470 J**	**1,470**	**1,530 J**	**1,440**	**1,279**
Mercury	2	0.212 J	NA	0 U	NA	0.20 U
Nickel	100	30.0 UJ	NA	30 U	NA	4.15
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	1,050
Selenium	10	3.0 UJ	NA	3 U	NA	0.57 J
Sodium	20,000	16,200 J	15,600	17,000 J	13,000	19,800
Thallium	4	3.0 UJ	NA	3 U	NA	0.50 U
Vanadium		30.0 UJ	NA	30 U	NA	0.37 J
Zinc		10.0 UJ	NA	10 UJ	NA	5.95 J

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		06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		343 J	320	370 J	330	281
Ammonia Nitrogen (mg/l)	2	0.942 J	1.10	1.58	1.12	1.49
BOD (mg/l)		4.0 UJ	5.0	4.0 UJ	4.0 U	2.00 U
Bromide (mg/l)	2	8.0 UJ	8.0 U	8.0 UJ	8.0 U	0.05 U
COD (mg/l)		20 UJ	20 U	20 U	20 U	5.00 J
Chloride (mg/l)	250	25.1 J	16.0	17.0	25.3	47.4
Color	15	**30.0 J**	NA	**110**	NA	**110**
Cyanide, Total (mg/l)	0.2	0.010 UJ	NA	10 U	NA	0.002 J
Hardness (mg/l)		346 J	367	357	349	280
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.063 J	0.050 U	0.050 U	0.101	0.085 J
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	8.88 J	6.50	9.90	10.90	61.4
Total Dissolved Solids (mg/l)		420 J	400	540	370	390
Total Kjeldahl Nitrogen (mg/l)		1.33 J	1.25	2.32	0.937	1.60
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	1.96

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TABLE 1
MW-6S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/28/98	08/19/98	11/04/98	05/11/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
2-Butanone	50	ND	NA	NA	NA	NA	NA	1 J	NA	10 U	NA
2-Hexanone	50	ND	NA	NA	NA	NA	NA	0.5 U	NA	10 U	NA
Acetone	50	4 J	NA	NA	NA	NA	NA	1 U	NA	10 U	NA
cis-1,2-Dichloroethylene	5	ND	NA	NA	NA	NA	NA	0.5 J	NA	5 U	NA
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	0.5 U	NA	5 U	NA
Trichloroethene	5							5 U		5 U	5 U

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INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	7.4 B	NA	22.0 U	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.0 U	NA	3.0 U	NA
Barium	1,000	5.2 U	NA	NA	NA	NA	NA	43.6 B	NA	49.3 B	NA
Boron	1,000	90.9 B	NA	NA	NA	NA	NA	27.7 B	NA	NA	NA
Cadmium	5	0.7 B	0.4 U	0.5 U	0.3 U	2 U	1 U	1.5 B	1 U	1.6 B	1 U
Calcium		146 U	156,000 0	211,000 0	171,000	150,000 0	139,000	161,000	164,000	96,500	178,000
Chromium	50	0.6 U	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	
Cobalt		1.2 B	NA	NA	NA	NA	NA	2 U	NA	2.0 U	NA
Copper	200	1.3 U	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	NA
Iron	300	28 B	**12,100 0**	**7,600 0**	**2,380**	**3,270 0**	**5,960**	**3,890**	**2,840**	**2,930**	**10,400**
Lead	25	2 B	1.8 U	1.6 U	1.9 U	1 U	1 U	2.6 B	2 U	2.0 U	3 U
Magnesium		139 U	10,400 0	14,900 0	11,300	7,860 0	7,960	9,010	8,890	5,170	10,000
Manganese	300	0.5 U	**1,360 0**	**881 0**	**686**	**1,070 0**	**1,300**	**1,060**	**1,110**	**927**	**1,760**
Nickel		1.8 B	NA	NA	NA	NA	NA	10.0 B	NA	3.3 B	NA
Potassium		10,200 0	4920 B	2390 B	1330 B	3870 BE	2560 BE	1510 JB	1790 B	4,260 B	2,850 B
Selenium	10	3.2 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NA
Silver	50	2.3 B	NA	NA	NA	NA	NA	1 U	NA	2.0 U	NA
Sodium	20,000	511 U	**41,300 0**	**39,500 0**	**21,100**	**40,500 0**	**25,700**	**21,400**	17,600	19,900	18,900
Thallium	4	9 B	NA	NA	NA	NA	NA	6 U	NA	3.0 U	NA
Vanadium		2.5 B	NA	NA	NA	NA	NA	1 U	NA	2.0 U	NA
Zinc		2.1 U	NA	NA	NA	NA	NA	20.2	NA	6.2 B	NA

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CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		614 0	452 0	520 0	427	483 0	371	492	230	378	461
Ammonia Nitrogen (mg/l)	2	**65.4 0**	**6.36 0**	1.8 0	0.53	**16.2 0**	**7.36**	**2.68**	**3.44**	**19.2**	**3.79**
BOD (mg/l)		3 U	3.1 0	4 U	3.7 U	2 U	2.67	3.87	4	2.00 U	4.14
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	1.08	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		12.6 0	3 U	3 U	3 U	10 U	10 U	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	100 0	56.3 0	54.3 0	22	46.6 0	29.5	31.6	13.7	28.7	26.5
Color	15	**200**	NA	NA	NA	NA	NA	**40**	NA	**100**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.001 U	NA	0.0100 J	NA
Hardness (mg/l)		326 0	433 0	587.6 0	475	401 0	380	439	414	262.	486
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.22 0	0.11 0	2.92 0	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.100 U	.100 U
Phenols (mg/l)	0.001	0.0035 U	**0.025 0**	0.005 U	0.005 U	**0.007 0**	**0.008**	0.007 U	**0.012**	0.0500 U	.05 U
Sulfate (mg/l)	250	10.7 0	13.7 0	18.2 0	18.6	10 U	16.5	20.1	10 U	13.0	20.5
Total Dissolved Solids (mg/l)		497 0	612 0	543 0	446	539 0	414	536 J	214	374	171
Total Kjeldahl Nitrogen (mg/l)		53.8 0	6.69 0	3.03 0	1.44	16.1 0	10.4	3.55	3.42	22.9	4.17
Total Organic Carbon (mg/l)		1.0 U	1.0 U	1.61 0	1.75	2.09 0	4.61	1.50	3.33	2.17	2.35

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-6S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
2-Butanone	50	NA		10 U	NA	10 U	NA	NA	10 U	10 U	NA
2-Hexanone	50	NA	10 UJ	10 U	NA	10 U	NA	NA	10 U	10 U	NA
Acetone	50	NA	10 U	10 U	10 U	10 U	10 U	10 U	5 J	10 U	NA
cis-1,2-Dichloroethylene	5	NA	0.5 UJ	5 U	NA	5 U	NA	NA	5 U	5 U	NA
Methylene Chloride	5	NA	5 U	0.8 J	NA	5 U	NA	NA	5 U	5 U	NA
Trichloroethene	5	NA	5 UJ	1 J	NA	5 U	NA	NA	5 UJ	5 U	NA

NOTES:

Concentrations highlighted exceed the
corresponding NYSDEC Class GA Standard

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J = Concentration is an estimated value

NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
Aluminum		NA	30.3 B	20.1 U	20.1 U	83.3 U	NA	NA	60 U	60 U	60 U
Antimony	3		5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U	4.6 U	4.6 U
Arsenic	25	NA	7.4 B	4.9 U	4.9 U	7 U	NA	NA	3.5 U	3.5 U	NA
Barium	1,000	NA	108 B	49.2 B	49.2 B	60.2	NA	NA	65	75	NA
Boron	1,000	NA	54.8 B	50 U	50 U	50 U	NA	NA	27 U	27 U	NA
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		107,000	287,000	161,000	145,000	156,000	174,000	205,000	195,000	219,000	185,000
Chromium	50		1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U		
Cobalt		NA	13.5 B	9.8 B	9.8 B	5.7 B	NA	NA	26.3	31.8	NA
Copper	200	NA	18.6 B	1.5 U	1.5 U	1.4 U	NA	NA	2.6 U	4.3 U	NA
Iron	300	**5,900**	**38,100**	**9,910**	**7,380**	**7,360**	**13,500**	**24,000**	**26,800**	**35,000**	**29,000**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		7,430	20000	8,120	7,180	8,330	9,890	17,200	15,300	17,100	13,000
Manganese	300	**1,300**	**2,660**	**1,720**	**1,460**	**1,830**	**1,770**	**3,810**	**3,010**	**3,560**	**2,160**
Nickel		NA	14.0 B	14.6 B	14.6 B	8.3 B	NA	NA	30.6	43.8	NA
Potassium		4,870 B	5,690	2,190 B	2,250	3,660	6,560	3,240	2,770	3,500	2,750
Selenium	10	NA	5.0 UJN	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		
Silver	50	NA	1.0 U	1.0 U	1.0 U	1.4 U	NA	NA	0.93 U		
Sodium	20,000	**29,400 E**	**46,900**	**26,100**	18,900	17,000 J	**27,100**	**52,300**	**42,900 E**	**63,300 J**	**34,100**
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Vanadium		NA	1.1 B	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1.5 U	NA
Zinc		NA	23.2	5.1 B	5.1 B	16.2 U	NA	NA	11 U	11 U	NA

NOTES:

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CONVENTIONAL PARAMETERS

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
Alkalinity (mg/l)		483	638	446	393	446	492	643	579	660	530
Ammonia Nitrogen (mg/l)	2	**34.3**	**4.83**	**2.62**	**2.3**	**5.9**	**11**	**4.4**	**3.8**	NA	**3**
BOD (mg/l)		2 U	23.0	2 U	1.4 B	2.4	2.2	8.6	7.7	4	1.3 B
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.036 B	0.1 U	0.1 U	0.11	0.1 U	0.071 B	0.053 B
COD (mg/l)		17.7	56.2	10 U	4.96 B	10 U	8.86 B	24.4	13.9	NA	17.5
Chloride (mg/l)	250	28.6	56.1	19.3	19	16	44	73	54.6	92.3	43.1
Color	15	NA	**280**	**70**	**70**	**150**	NA	NA	**250**	**200**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		298	799	435	392	424	475	583	550	617	515
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01	.01 U	NA	NA	0.009 B	0.01	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.021 B	0.025 B	0.029 B	0.098 B	0.1 U	0.1 U	0.035 B
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.014**	**0.003 B**	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	10.8	9.25	10.3	10	11	11	3	3.94	4.49	7.64
Total Dissolved Solids (mg/l)		439	745	506	470	490	570	760	680	800	600
Total Kjeldahl Nitrogen (mg/l)		35.6	6.3	0.1 U	2.31	5.73	13.9	5.69	0.1 U	2.78	3.87
Total Organic Carbon (mg/l)		5.46	24.5	11.5	3.2	0.43 B	0.26 B	7.7	14	3.6	2.6

NOTES:

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TABLE 1
MW-6S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	08/05/09	10/26/09
2-Butanone	50	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	NA
2-Hexanone	50	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	NA
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
cis-1,2-Dichloroethylene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Trichloroethene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
Aluminum		60 U	60 U	60 U		100 U	NA	100 U	NA	100 U	NA
Antimony	3	4.6 U	4.6 U	4.6 U		15 U	NA	30 U	NA	15 UJ	NA
Arsenic	25	7.8 B	NA	3.9 U	NA	15.9	NA	10.0 U	NA	10 U	NA
Barium	1,000	68	NA	76.1	NA	50.0 U	NA	66.4	NA	56	NA
Boron	1,000	29.7 B	NA	27 U	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		222,000	166,000	229,000	218,000	157,000	166,000	196,000 J	120,000	167,000	157,000
Chromium	50	NS	NS	NS	NA	5.00 U	NA	5.00 U	NA	5 U	NA
Cobalt		41.5	NA	31.4	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.8 B	NA	13.2	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**23,200**	**12,200**	**12,500**	**18,400**	**15,400**	**12,800**	**16,500 J**	**9,990**	**13,200 J**	**13,200**
Lead	25	3 U	3 U	3 U	3 U	3.00 UJ	3.00 U	3.00 U	5.01	3.00 U	3.00 U
Magnesium		14,700	8,410	20,400	18,600	11,500	12,700	11,600	6,000	9,650	8,570
Manganese	300	**2,870 J-**	**1,890**	**3,780**	**3,700**	**2,490**	**2,500**	**2,740 J**	**1,970**	**2,260**	**2,410**
Nickel		82.2	NA	53.2	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		2,850	2,300 N	3,080	2,660	1,880	1,810	2,050	1,530	1,580 J	5,000 U
Selenium	10	NS	NS	NS		**16.5 J**	NA	5.00 U	NA	5 U	NA
Silver	50	1.1 UJ-	1.1 UJ-	1.1 UJ-		10 U	NA	10.0 U	NA	10 UJ	NA
Sodium	20,000	**52,300 J+**	16,000	**79,600 J**	**49,900**	19,000 J	**21,000**	17,500	10,400	**22,000**	16,600
Thallium	4	10 UJ-	10 UJ-	10 UJ-		10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		1.5 U	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	10 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
CONVENTIONAL PARAMETERS	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	9/25/2007	12/6/2007	10/28/2008	12/9/2008	7/14/2009	10/26/2009
Alkalinity (mg/l)		561	432	654	643	450	400	500	350	460	410
Ammonia Nitrogen (mg/l)	2	**2.6**	**3.6**	1.2	1.1	1.54	1.59	1.58	1.86	1.81	1.55
BOD (mg/l)		8.9	10	5.2	6.2	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.227	0.021 B	2.0 U	1.0 U	20.0 U	0.20 U	20.00 U	2.00 U
COD (mg/l)		11	13.1	23.9	4.15 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	55.9	22.6	105	68.8	21.1	20.0	27.8	15.7	44	26.5
Color	15	**250**	NA	75	NA	**220**	NA	**125**	NA	14	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	1.9 B	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		615	449	656	621	440	467	537	323	456	428
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.020 U	NA	0.01 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.039 B	0.1 U	0.1 U	0.034 B	0.200 UJ	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	**0.005 B**	**0.02**	**0.005 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	8.32	19.7	4.4	2.12	10 U	10 U	5.00 U	15.80	7.6	8.36
Total Dissolved Solids (mg/l)		630	490	810	5.4	478	508	540	412	820	680
Total Kjeldahl Nitrogen (mg/l)		3.29	3.64	2.92	1.64	1.57	2.01	2.02	2.38	2.06	1.8
Total Organic Carbon (mg/l)		2	1.3	8.1	5.4	3.0 U	3.0 U	3.0 U	3 U	3.0 U	3.0 U

NOTES:

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TABLE 1
MW-6S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
VOLATILE COMPOUNDS (µg/L)						
2-Butanone	50	10 UJ	NA	10 U	NA	5.0 U
2-Hexanone	50	10 UJ	NA	10 U	NA	5.0 U
Acetone	50	10 UJ	NA	10 U	NA	5.0 U
cis-1,2-Dichloroethylene	5	5 UJ	NA	5 U	NA	0.5 U
Methylene Chloride	5	5 UJ	NA	5 U	NA	2.5 U
Trichloroethene	5	5 UJ	NA	5 U	NA	0.5 U

NOTES:

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NA	100 U	NA	3.41 J
Antimony	3	5.0 UJ	NA	5 U	NA	0.16 J
Arsenic	25	5.0 UJ	NA	5 U	NA	2.16
Barium	1,000	54.9 J	NA	59.9	NA	55.62
Boron	1,000	500 UJ	NA	500 U	NA	14.9 J
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		163,000 J	146,000	171,000	159,000	170,000
Chromium	50	10.0 UJ	NA	10 U	NA	0.95 J
Cobalt		20.0 UJ	NA	20 U	NA	3.69
Copper	200	10.0 UJ	NA	10 U	NA	0.80 J
Iron	300	**12,900 J**	**11,800**	**11,400**	**10,800**	**7,570**
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	1.00 U
Magnesium		8,710 J	7,580	11,800	10,900	11,000
Manganese	300	**2,440 J**	**2,420**	**2,360 J**	**2,220**	**2,998**
Nickel		30.0 UJ	NA	30 U	NA	6.36
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	2,190
Selenium	10	3.0 UJ	NA	3 U	NA	0.70 J
Silver	50	10.0 JJR	NA	16.8 J	NA	0.40 U
Sodium	20,000	**25,100 J**	18,100	40,100 **J**	**30,800**	**61,600**
Thallium	4	3.0 UJ	NA	3 U	NA	0.50 U
Vanadium		30.0 UJ	NA	30 U	NA	0.13 J
Zinc		10.0 UJ	NA	12.8 J	NA	5.47 J

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	06/30/10	11/02/10	11/09/11	12/28/11	07/21/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		426 J	350	460 J	430	448
Ammonia Nitrogen (mg/l)	2	**2.08 J**	1.44	**2.17**	1.79	**2.81**
BOD (mg/l)		4.0 UJ	4.0 U	4.0 UJ	4.0 U	2.20
Bromide (mg/l)	2	8.0 UJ	8.0 U	8.0 UJ	8.0 U	0.026 J
COD (mg/l)		20 UJ	20 U	20 U	20 U	30.0
Chloride (mg/l)	250	38.4 J	19.8	57.5	62.7	111
Color	15	**50.0 J**	NA	**250**	NA	52.0
Cyanide, Total (mg/l)	0.2	0.010 UJ	NA	10 U	NA	0.002 J
Hardness (mg/l)		444 J	397	476	441	480
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.067 J	0.068	0.050 U	0.050 U	0.051 J
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	9.21 J	5.44	5.8	6	12.5
Total Dissolved Solids (mg/l)		470 J	440	610	510	580
Total Kjeldahl Nitrogen (mg/l)		1.92 J	1.63	2.29	2.32	3.5
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	3.2

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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TABLE 1
MW-7D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
1,1,2,2-Tetrachloroethane	5							5 U		5 U	
Acetone	50	10 U	NS	NA	NA	NA	NA	10 U	NA	10 U	NA
Bromoform	50							5 U		5 U	
Methylene Chloride	5	3 JB	NS	NA	NA	NA	NA	0.7 U	NA	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		151 B	NS	NA	NA	NA	NA	18.6 B	NA	27.8 B	NA
Antimony	3	3.9 U	NS	NA	NA	NA	NA	5.0 U	NA	3.0 U	
Arsenic	25	2.8 B	NS	NA	NA	NA	NA	3 U	NA	4.6 B	NA
Barium	1,000	510	NS	NA	NA	NA	NA	458	NA	438	NA
Beryllium	3	0.29 B	NS	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Boron	1,000	697	NS	NA	NA	NA	NA	619	NA	NA	NA
Cadmium	5	1.2 B	NS	2.5 B	0.3 U	2 U	1.7 B	2.1 B	1.7 B	1.0 U	1 U
Calcium		25,200 0	NS	22,800 0	20,400	21,200 0	19,700	14,600	164,000	14,700	16,600
Chromium	50	2.7 B	NS	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.88 B	NS	NA	NA	NA	NA	2 U	NA	2.0 U	NA
Copper	200	3.8 B	NS	NA	NA	NA	NA	1.7 B	NA	1.0 U	NA
Iron	300	**920 0**	NS	**517 0**	**444**	**740 0**	**413**	**382**	**511**	**627 ***	**503**
Lead	25	2 B	NS	1.7 B	1.9 U	1.6 B	1 U	2.4 B	2 U	2.0 U	3 U
Magnesium		19,500 0	NS	18,400 0	17,500	17,700 0	17,300	12,000	14,200	12,700	14,900
Manganese	300	**435 0**	NS	**327 0**	294	292 0	235	177	208	180	221
Mercury	2	0.2	NS	NA	NA	NA	NA	0.1 U	NA	0.10 U	NA
Nickel	100	2.3 B	NS	NA	NA	NA	NA	5 U	NA	3.0 U	NA
Potassium		2,150 B	NS	2,170 B	1,700 B	2,280 BE	2,450 BE	1,500 JB	1,770 B	1,680 B	2,230 B
Silver	50	1 U	NS	NA	NA	NA	NA	1.0 U	NA	2.0 U	
Sodium	20,000	**65,100 0**	NS	**64,800 0**	**57,300**	**55,200 E**	**56,700**	**41,100**	**47,900**	**41,700**	**48,700**
Thallium	4	8.9 B	NS	NA	NA	NA	NA	6 U	NA	**8.4 B**	NA
Vanadium		1 U	NS	NA	NA	NA	NA	1.0 U	NA	2.0 U	
Zinc		6.7 B	NS	NA	NA	NA	NA	48.1	NA	32.1	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		25.5 0	NS	234 0	234	238 0	210	222	213	215	219
Ammonia Nitrogen (mg/l)	2	**2.43 0**	NS	**2.72 0**	1.82	**5.32 0**	**2.49**	**3.68**	**4.3**	**3.61**	**4.31**
BOD (mg/l)		4.1 0	NS	12.1 0	10.5	5.25 0	14.7	15.1	16	2.00 J	2 U
Bromide (mg/l)	2	0.1 U	NS	0.1 U	0.11	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		3 U	NS	23.1 0	3 U	10 U	10 U	10 U	22.1	10.0 U	10 U
Chloride (mg/l)	250	5.64 0	NS	10.2 0	10.8	11.8 0	13.5	12.5	10.6	12.2	11.8
Color	15	**60**	NS	NA	NA	NA	NA	15	NA	15	NA
Cyanide, Total (mg/l)		0.01 U	NS	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Hardness (mg/l)		143 0	NS	132.2 0	123	123 0	120	85.9	99.4	89.0	103
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.033 0	NS	2.66 0	0.04 U	0.1 U	0.1 U	0.1 U	0.1 U	0.100 U	.1 U
Phenols (mg/l)	0.001	0.0035 U	NS	**0.018 0**	**0.022**	0.005 U	**0.014**	0.009 U	**0.028**	0.0500 U	.05 U
Sulfate (mg/l)	250	1.5 0	NS	4.5 0	4.77	10 U	10.2	12.6	10 U	10.0 U	10 U
Total Dissolved Solids (mg/l)		266 0	NS	440 0	225	257 0	233	294 J	168	239	225
Total Kjeldahl Nitrogen (mg/l)		3.8 0	NS	1.59 0	2.03	4.35 0	5.25	4.33	3.01	4.65	4.35
Total Organic Carbon (mg/l)		1 U	NS	1 U	1.16	1 U	1.9	1.48	2.73	1.00 U	1 U

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TABLE 1
MW-7D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
VOLATILE COMPOUNDS (µg/L)											
1,1,2,2-Tetrachloroethane	5		5 UJ	0.9 J	NA	5 U	NA	NA	5 U	5 U	NA
Acetone	50	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	50		5 U	0.4 J	NA	5 U	NA	NA	5 U	5 U	NA
Methylene Chloride	5	NA	5 U	0.4 J	NA	5 U	NA	NA	5 U	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	22.4 B	26.7 B	26.7 B	83.3 U	NA	NA	60 U	95.7	NA
Antimony	3		5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U		
Barium	1,000	NA	749	562	562	647	NA	NA	666	666	NA
Beryllium	3	NA	0.5 U	0.5 U	0.5 U	1 U	NA	NA	0.64 U		
Boron	1,000	NA	870	723	723	726	NA	NA	717	719	NA
Cadmium	5	1.0 B	0.5 U	0.8 U	1.2 U	1.3 U	**17.7**	0.94 U	0.94 U	2	1.3 B
Calcium		15,400	20,100	17,100	17,000	17,700	41,800	17,400	15,700	17,200	17,100
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U		
Cobalt		NA	1.0 U	1.2 U	1.2 U	1.5 U	NA	NA	1.7 U		
Copper	200	NA	14.8 B	1.8 B	1.8 B	2.5 B	NA	NA	2.6 U	6.4	NA
Iron	300	**604**	**495**	**679**	**309**	**887**	**4,210**	**555**	**489**	**1,240**	**1,070**
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	**50.4**	3.6 U	3.6 U	3 U	3 U
Magnesium		13,700	18,600	14,400	13,300	16,000	6,130	14,900	14,400	15,200	15,000
Manganese	300	182	238	187	155	214	130	186	140	208	192
Mercury	2	NA	0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U		
Nickel	100	NA	1.5 U	1.3 U	1.3 U	1.9 U	NA	NA	1.8 U	1.9 U	NA
Potassium		1,870 B	3,460 B	2,480 B	2,810	2,800	7,250	2,100	2,190	2,030	2,080
Silver	50		1.0 U	1.0 U	1.0 U	1.4 U	NA	NA	0.93 U		
Sodium	20,000	**46,000 E**	**61,600**	**47,000**	**44,300**	**51,700 J**	15,300	**48,000**	**48,900 E**	**48,400 J**	**47,600**
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Vanadium			1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U		
Zinc		NA	18.7 B	35	35	89.6	NA	NA	36.2 B	95.2	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		220	216	202	210	206	162	223	220	241	229
Ammonia Nitrogen (mg/l)	2	**3.45**	**3.95**	**4.09**	**3.9**	**4.2**	1	**4.3**	**4.1**	**4.2**	**4.8**
BOD (mg/l)		5.1	11.5	6.4	8.9	8.2	10	16	16	14	7
Bromide (mg/l)	2	0.301	0.332	0.272	0.27	0.3	0.099 B	0.28	0.308	0.272	0.281
COD (mg/l)		10 U	10.0 U	10 U	5.67 B	10 U	50.4	10 U	10 U	8.91 B	8.7 B
Chloride (mg/l)	250	9.54	9.27	9.5	9.2	9.6	5.6	9.7	9.64	8.98	9.47
Color	15	NA	5.0	15	15	15	NA	NA	10	15	NA
Cyanide, Total (mg/l)			0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		94.9	127	102	97.2	110	130	105	98.5	106	104
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.063 B	0.1 U	0.1 U	0.1 U	0.1 U
Phenols (mg/l)	0.001	**0.01**	0.005 U	0.005 U	0.005 U	**0.002 B**	**0.005 B**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	4.53	4.39	3.98	4.9	4.4	6.8	4	1.88	1.87	1.79
Total Dissolved Solids (mg/l)		202	208	203	220	240	190	190	230	220	200
Total Kjeldahl Nitrogen (mg/l)		4.6	4.2	4.3	3.96	3.99	2.86	3.97	4.71	4.38	3.94
Total Organic Carbon (mg/l)		2.93	4.63	6.35	2.3	0.68 B	4.4	1.7	6.7	0.61 B	0.66 B

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TABLE 1
MW-7D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
1,1,2,2-Tetrachloroethane	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Acetone	50	10 U	10 U	10 U							
Bromoform	50	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		92 U	NA	92 U	NA	100 JJ+	NA	398	NA	1390	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25					10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	749	NA	717	NA	220	NA	729	NA	1150	NA
Beryllium	3	NS	NS	NS		3.00 U	NA	3.00 U	NA	3 U	NA
Boron	1,000	733	NA	636	NA	500 U	NA	664	NA	916	NA
Cadmium	5	1.1 U	**8.6 B**	3 B	0.76 U	5.00 U	5.00 U	5.00 U	**5.26**	5 U	5 U
Calcium		19,200	37,600	19,900	17,800	25,400 U	66,500	19,900 J	28,300	24,500	22,000
Chromium	50	NS	NS	NS		5.00 U	NA	5.00 U	NA	6.07	NA
Cobalt		NS	NS	NS		20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	24.1	NA	10.0 U	NA	45.8	NA	71.5	NA
Iron	300	**782**	**6,880**	**1,390**	**787**	**362**	**1,070**	**1,700 J**	**4,020**	**2,540 J**	**1,750**
Lead	25	3 U	**60.4 N**	4 B	3 U	3.00 UJ	3.00 U	12.4	18.5	12.1	9.78
Magnesium		16,900	3,930	15,500	15,700	6080	7,210	14,400	17,300	20,000	14,900
Manganese	300	197 J-	**377**	199	187	149	83.4	208 J	243	255	**328**
Mercury	2	NS	NS	NS		0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	1.9 U	NA	3.2 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		2,340	3,840 N	2,210	2,130	4,090	2,580	2,660	2,920	3,230 J	5,000 U
Silver	50	1.1 UJ-	1.1 UJ-	1.1 JJ-		10.0 U	NA	10.0 UJ	NA	10 UJ	NA
Sodium	20,000	**49,800 J+**	5,720	**44,600 J**	**45,900**	16,400 J	4,410	**44,700**	**50,700**	**61,400**	**50,200**
Thallium	4	10 UJ-	10 UJ-	10 JJ-		10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium						30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		13.2 B	NA	136	NA	34.2 J	NA	228	NA	150 J	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/21/05	11/08/05	07/25/06	12/27/06	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		219	119	231	227	140	120	430	240	220	230
Ammonia Nitrogen (mg/l)	2	**3.9**	0.32	**3.9**	**4.8**	1.01	0.500 U	**3.79**	**4.62**	**4.50**	**4.18**
BOD (mg/l)		8.3	7.1	11	10	5	4 U	9.00	26.0	27.0	15
Bromide (mg/l)	2	0.248	0.1 U	0.219	0.23	0.200 U	1.0 U	0.20 U	2.0 U	2.0 U	2.0 U
COD (mg/l)		10 U	57.5	8.51 B	4.15 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	8.55	2.28	9.38	8.9	3.41	7.01	15.5	8.52	10.7	10
Color	15	**20**	NA	**20**	NA	**21.0**	NA	**19.0**	NA	7	NA
Cyanide, Total (mg/l)		10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		118	110	114	109	88.4	196	109	142	143	116
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.554	0.1 U	0.1 U	0.201 J	2.17	0.200 U	0.200 U	0.682	0.200 U
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	1.59	1.86	1	1.35	5.00 U	18.2	5.00 U	6.13	9.99	6.1
Total Dissolved Solids (mg/l)		200	110	200	1.4	162	260	195	197	190	250
Total Kjeldahl Nitrogen (mg/l)		3.7	1.98	4.26	4.73	1.43	0.700	4.07	5.18	4.99	4.94
Total Organic Carbon (mg/l)		0.68 B	4.1	1.6	1.4	3.4	3.8	3.0 U	3.0 U	3.0 U	3.0 U

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TABLE 1
MW-7D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	**SAMPLING DATE**			
	GA Standards	06/30/10	11/02/10	11/09/11	07/23/14
VOLATILE COMPOUNDS (µg/L)					
1,1,2,2-Tetrachloroethane	5	5 UJ	NA	5 U	0.5 U
Acetone	50			10 U	1.8 J
Bromoform	50	5 UJ	NA	5 U	2.0 U
Methylene Chloride	5	5 UJ	NA	5 U	2.5 U

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	NYSDEC Class	**SAMPLING DATE**			
	GA Standards	06/30/10	11/02/10	11/09/11	07/23/14
INORGANIC PARAMETERS (µg/L)					
Aluminum		139 J	NA	372	1,040
Antimony	3	5.0 UJ	NA	5 U	**4.04**
Arsenic	25	5.0 UJ	NA	5 U	2.06
Barium	1,000	650 J	NA	752	83.4 J+
Beryllium	3	3.00 UJ	NA	3 U	0.50 U
Boron	1,000	519 J	NA	590	43.0
Cadmium	5	5.00 UJ	5.00 U	5.00 U	0.91
Calcium		27,000 J	21,100	20,600	51,000
Chromium	50	10.0 UJ	NA	10 U	2.97
Cobalt		20.0 UJ	NA	20 U	2.37
Copper	200	11.1 J	NA	10 U	72.07
Iron	300	**534 J**	**724**	**866**	**2,680**
Lead	25	3.2 J	3.0	3.0 U	15.8
Magnesium		12,700 J	17,200	13,800	3,900
Manganese	300	**309 J**	261	244 J	**703.2 J+**
Mercury	2	0.200 UJ	NA	0.2 U	0.20 U
Nickel	100	30.0 UJ	NA	30 U	5.63
Potassium		5,670 J	5,000 U	5,000 UJ	7,660
Silver	50	10.0 JJR	NA	10 UJ	1.07
Sodium	20,000	**46,500 J**	**61,300**	**50,900 J**	9,650 J
Thallium	4	3.0 UJ	NA	3 U	0.50 U
Vanadium		30.0 UJ	NA	30 U	1.48 J
Zinc		59.9 J	NA	60.1 J	575.4

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	NYSDEC Class	**SAMPLING DATE**			
	GA Standards	06/30/10	11/02/10	11/09/11	07/23/14
CONVENTIONAL PARAMETERS					
Alkalinity (mg/l)		219 J	230	190 J	148
Ammonia Nitrogen (mg/l)	2	**4.02 J**	**4.40**	**2.43**	0.128
BOD (mg/l)		17.0 J	13	15 J	12.0
Bromide (mg/l)	2	1.6 UJ	4.0 U	8.0 UJ	0.038 J
COD (mg/l)		24 J	20 U	20 U	84.0
Chloride (mg/l)	250	10.6 J	10.8	12.4	10.5
Color	15	**50.0 J**	NA	**21**	**98**
Cyanide, Total (mg/l)		0.010 J	NA	10 U	0.002 J
Hardness (mg/l)		120 J	123	108	140
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.01 U	0.01 U
Nitrate Nitrogen (mg/l)	10	0.711 J	0.130	0.303	1.40
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.03 U
Sulfate (mg/l)	250	5.00 UJ	5.00 U	5.00 U	7.38
Total Dissolved Solids (mg/l)		210 J	220	330	200
Total Kjeldahl Nitrogen (mg/l)		6.36 J	4.83	5.04 J	2.30
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	10.1

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TABLE 1
MW-7S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
Acetone	50	10 U	NS	NS	NS	NS	NA	10 U		10 U	
Chloroform	7	ND	NS	NS	NS	NS	NA	**8**	NA	5 U	NS
Methylene Chloride	5	6 JB	NS	NS	NS	NS	NA	5 U	NA	5 U	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		05/22/96	03/37/97	0626/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
Aluminum		4,460	NS	NS	NS	NS	NA	733	NA	2,950	NS
Antimony	3	3.9 U	NS	NS	NS	NS	NA	5.0 U	NA	3.0 U	
Arsenic	25	1.8 B	NS	NS	NS	NS	NA	3 U	NA	9.7 B	NS
Barium	1,000	37.1 B	NS	NS	NS	NS	NA	21.0 B	NA	23.4 B	NS
Beryllium	3	0.16 B	NS	NS	NS	NS	NA	1 U	NA	1.0 U	NS
Boron	1,000	30.3 B	NS	NS	NS	NS	NA	16.5 B	NA	NA	NS
Cadmium	5	0.4 U	NS	NS	NS	NS	1 U	1.5 B	1.3 B	1.7 B	NS
Calcium		25,400 0	NS	NS	NS	NS	114,000	61,200	44,300	35,700	NS
Chromium	50	9.6 B	NS	NS	NS	NS	NA	1 U	NA	5.0 B	NS
Cobalt		4.3 B	NS	NS	NS	NS	NA	2 U	NA	2.0 U	NS
Copper	200	57.3	NS	NS	NS	NS	NA	6.5 B	NA	9.6 B	NS
Iron	300	**10,400 0**	NS	NS	NS	NS	**60,600**	**1,070**	**6,800**	**5,880 ***	NS
Lead	25	5.4 0	NS	NS	NS	NS	22.3	4.6	2 U	4.5	NS
Magnesium		5,110 0	NS	NS	NS	NS	14,500	5,810	6,230	4,010 B	NS
Manganese	300	**469 0**	NS	NS	NS	NS	**1,210**	114	162	84.4	NS
Nickel	100	9.3 B	NS	NS	NS	NS	NA	6.3 B	NA	7.3 B	NS
Potassium		1,850 B	NS	NS	NS	NS	7,260 E	991 JB	1400 B	817 B	NS
Selenium	10	3 U	NS	NS	NS	NS	NA	3.0 U	NA	4.0 U	NS
Sodium	20,000	1,580 B	NS	NS	NS	NS	6,390	6,480	8,920	2,050 B	NS
Vanadium		9.6 B	NS	NS	NS	NS	NA	2.2 B	NA	7.2 B	NS
Zinc		36	NS	NS	NS	NS	NA	38.0	NA	20.8	NS

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		05/22/96	03/37/97	0626/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/13/99	10/19/99
Alkalinity (mg/l)		72 0	NS	NS	NS	NS	170	170	NA	100	NS
Ammonia Nitrogen (mg/l)	2	0.06 0	NS	NS	NS	NS	0.06	0.0570	NA	0.0400 U	NS
BOD (mg/l)		3 U	NS	NS	NS	NS	5.4	7.59	NA	2.00 J	NS
Bromide (mg/l)		0.686 0	NS	NS	NS	NS	2 U	2 U	NA	2.00 U	NS
COD (mg/l)		3 U	NS	NS	NS	NS	10 U	12.9	NA	10.0 U	NS
Chloride (mg/l)	250	1 U	NS	NS	NS	NS	3 U	4.01	NA	3.00 U	NS
Color	15	**300**	NS	NS	NS	NS	NA	**40**	NA	**20**	NS
Cyanide, Total	0.2	0.01 U	NS	NS	NS	NS	NA	0.01 U	NA	0.0100 U	NS
Hardness (mg/l)		84.6 0	NS	NS	NS	NS	344	176	136	106	NS
Hexavalent Chromium		0.01 U	NS	NS	NS	NS	NA	0.01 U	NA	0.0100 U	NS
Nitrate Nitrogen (mg/l)	10	0.04 U	NS	NS	NS	NS	0.1 U	0.332	NA	0.100 U	NS
Phenols (mg/l)	0.001	**0.012 0**	NS	NS	NS	NS	**0.054**	0.007 U	NA	0.005 U	NS
Sulfate (mg/l)	250	58 0	NS	NS	NS	NS	17	13.9	NA	10.8	NS
Total Dissolved Solids (mg/l)		100 0	NS	NS	NS	NS	163	195 J	NA	147	NS
Total Kjeldahl Nitrogen (mg/l)		0.19 0	NS	NS	NS	NS	1.39	1.61	NA	0.834	NS
Total Organic Carbon (mg/l)		1 U	NS	NS	NS	NS	6.04	1.03	NA	1.00 U	NS

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TABLE 1
MW-7S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)	GA Standards	05/19/00	10/09/00	10/29/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
Acetone	50		10 U	10 U	10 U	10 U	10 U	10 U	10 U		
Chloroform	7	NA	5 U	5 U	NS	5 U	NA	NA	5 U	5 U	NS
Methylene Chloride	5	NA	5 U	5 U	NS	5 U	NA	NA	5 U	5 U	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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	NYSDEC Class	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)	GA Standards	05/19/00	10/09/00	10/29/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
Aluminum		NA	1,870	1,660	NS	2,790	NA	NA	503	2,570	NS
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	NS	7 U	NA	NA	3.5 U		
Barium	1,000	NA	22.9 B	23.8 B	NS	31.9	NA	NA	15.5	23.7	NS
Beryllium	3	NA	0.5 U	0.5 U	NS	1 U	NA	NA	0.64 U		
Boron	1,000	NA	22.6 B	50 U	NS	50 U	NA	NA	27 U		
Cadmium	5	0.37 B	0.5 U	0.8 U	NS	**8.4 B**	2.4 B	3.4 B	1 B	1.3	NS
Calcium		25,400	57,000	49,900	NS	48,600	49,700	55,800	60,400	45,200	NS
Chromium	50	NA	3.4 B	1.8 B	NS	3.2 B	NA	NA	1.4 U	4.2	NS
Cobalt		NA	1.0 U	2.2 B	NS	2.6 B	NA	NA	1.7 U	1.9	NS
Copper	200	NA	6.7 B	2.7 B	NS	28.5	NA	NA	6.2 B	9	NS
Iron	300	**3,670**	**3,040**	**2,240**	NS	**4,230**	**5,870**	**34,100**	**813**	**4,890**	NS
Lead	25	2.1 B	2.0 UJ	2.3 U	NS	8.9 B	4.8 B	12.6	3.6 U	3 U	NS
Magnesium		2,820 B	5,790	6,300	NS	7,000	5,210	7,570	5,450	4,210	NS
Manganese	300	70.4	106	**418**	NS	**308**	162	**1,160**	38.8	149	NS
Nickel	100	NA	2.8 B	4.5 B	NS	8.2 B	NA	NA	2 B	4.8	NS
Potassium		519 B	1,480 B	1,410 B	NS	2,110	1,550	3,320	578	760	NS
Selenium	10		5.0 JN	5.1 N	NS	6.9 U	NA	NA	5 U		
Sodium	20,000	1,380 BE	4,890 BE	8,640	NS	10,200 J	2,850	3,570	3,630 E	1,810 J	NS
Vanadium		NA	5.6 B	3.9 B	NS	6.6	NA	NA	1.1 B	6.3	NS
Zinc		NA	33.5	16.1 B	NS	53.8	NA	NA	11.7 B	17.4	NS

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	NYSDEC Class	SAMPLING DATE									
CONVENTIONAL PARAMETERS	GA Standards	05/19/00	10/09/00	10/29/01	12/04/01	10/28/02	12/09/02	09/16/03	11/04/03	05/11/04	10/26/04
Alkalinity (mg/l)		69.5	146	141	NS	148	124	143	138	108	NS
Ammonia Nitrogen (mg/l)	2	0.04 U	0.19		NS	0.083	0.04 U	0.056	0.044	0.097	NS
BOD (mg/l)		2 U	2.0 U	2.2	NS	4.8	2 B	6.6	1.4 B	4	NS
Bromide (mg/l)		0.1 U	0.1 U	0.1 U	NS	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NS
COD (mg/l)		38.5	39.5		NS	10 U	10 U	6.45 B	10 U	10 U	NS
Chloride (mg/l)	250	0.825	0.5 U	1 U	NS	0.91 B	1.21	0.93 B	1 U	0.935 B	NS
Color	15	NA	**160**	**150**	NS	**250**	NA	NA	**100**	15	NS
Cyanide, Total	0.2	NA	0.01 U	10 U	NS	NA	NA	NA	10 UJ	10 U	NS
Hardness (mg/l)		75	166	151	NS	150	146	170	173	130	NS
Hexavalent Chromium			0.01 U	0.01 U	NS	0.01 U	NA	NA	0.01 U	0.01 U	NS
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	NS	0.067 B	0.03 B	0.033 B	0.1 U	0.04 B	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U		NS	NA	**0.005 B**	**0.018**	**0.004 B**	0.005 U	NS
Sulfate (mg/l)	250	11.2	19.2	12	NS	12	19	14	14.4	9.22	NS
Total Dissolved Solids (mg/l)		103	233	206	NS	210	180	190	220	150	NS
Total Kjeldahl Nitrogen (mg/l)		1.0	0.15		NS	0.836	0.592	1.37	0.215	1.14	NS
Total Organic Carbon (mg/l)		2.0	1.33	2.71	NS	0.54 B	1.5	0.45 B	0.78 B	1.3	NS

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TABLE 1
MW-7S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		07/21/05	11/08/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/09/08	08/05/09	10/26/09
Acetone	50										
Chloroform	7	5 U	NS	5 U	NA	NS	NS	NS	NS	5 U	NS
Methylene Chloride	5	5 U	NS	5 U	NA	NS	NS	NS	NS	5 U	NS

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	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		07/21/05	11/08/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
Aluminum		3,790	NS	417 B	NA	NS	NS	NS	NS	NS	NS
Antimony	3					NS	NS	NS	NS	NS	NS
Arsenic	25					NS	NS	NS	NS	NS	NS
Barium	1,000	44.2	NS	12.1	NA	NS	NS	NS	NS	NS	NS
Beryllium	3	NS	NS	NS		NS	NS	NS	NS	NS	NS
Boron	1,000	NS	NS	NS		NS	NS	NS	NS	NS	NS
Cadmium	5	2.9 B	NS	1.4 B	0.76 U	NS	NS	NS	NS	NS	NS
Calcium		56,100	NS	43,200	50,800	NS	NS	NS	NS	NS	NS
Chromium	50	5.4 B	NS	2 B	NA	NS	NS	NS	NS	NS	NS
Cobalt		6.6 B	NS	1.8 U	NA	NS	NS	NS	NS	NS	NS
Copper	200	12.6	NS	6.6 B	NA	NS	NS	NS	NS	NS	NS
Iron	300	**6,530**	NS	**1,040**	**717**	NS	NS	NS	NS	NS	NS
Lead	25	3 U	NS	3 U	3 U	NS	NS	NS	NS	NS	NS
Magnesium		6,870	NS	4,230	4,660	NS	NS	NS	NS	NS	NS
Manganese	300	**464 J-**	NS	59	77.4	NS	NS	NS	NS	NS	NS
Nickel	100	10.4	NS	2.7 B	NA	NS	NS	NS	NS	NS	NS
Potassium		1,660	NS	281 B	448	NS	NS	NS	NS	NS	NS
Selenium	10	NS	NS	NS		NS	NS	NS	NS	NS	NS
Sodium	20,000	9,730 J+	NS	1,860 J	2,130	NS	NS	NS	NS	NS	NS
Vanadium		8.8	NS	1.5 U	NA	NS	NS	NS	NS	NS	NS
Zinc		35.4 B	NS	11.3 B	NA	NS	NS	NS	NS	NS	NS

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		07/21/05	11/08/05	07/25/06	12/27/06	09/26/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
Alkalinity (mg/l)		155	NS	115	125	NS	NS	NS	NS	NS	NS
Ammonia Nitrogen (mg/l)	2	0.073	NS	0.04 U	0.04 U	NS	NS	NS	NS	NS	NS
BOD (mg/l)		0.48 B	NS	1 B	3.2	NS	NS	NS	NS	NS	NS
Bromide (mg/l)		0.1 U	NS	0.1 U	0.1 U	NS	NS	NS	NS	NS	NS
COD (mg/l)		12.9	NS	7.55 B	6.61 B	NS	NS	NS	NS	NS	NS
Chloride (mg/l)	250	0.931 B	NS	0.652 B	1.17	NS	NS	NS	NS	NS	NS
Color	15	**200**	NS	10	NA	NS	NS	NS	NS	NS	NS
Cyanide, Total	0.2	10 U	NS	10 U	NA	NS	NS	NS	NS	NS	NS
Hardness (mg/l)		168	NS	125	146	NS	NS	NS	NS	NS	NS
Hexavalent Chromium		0.01 U	NS	0.01 U	NA	NS	NS	NS	NS	NS	NS
Nitrate Nitrogen (mg/l)	10	0.042 B	NS	0.1 U	0.037 B	NS	NS	NS	NS	NS	NS
Phenols (mg/l)	0.001	0.005 U	NS	**0.007**	0.005 U	NS	NS	NS	NS	NS	NS
Sulfate (mg/l)	250	12.3	NS	12	9.76	NS	NS	NS	NS	NS	NS
Total Dissolved Solids (mg/l)		160	NS	140	1.3	NS	NS	NS	NS	NS	NS
Total Kjeldahl Nitrogen (mg/l)		3.34	NS	0.0803 B	0.214	NS	NS	NS	NS	NS	NS
Total Organic Carbon (mg/l)		0.5 B	NS	1.4	1.3	NS	NS	NS	NS	NS	NS

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TABLE 1
MW-7S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	7/01/10**	11/02/10	11/09/11	12/28/11	07/23/14
Acetone	50				10 U	NA	2.3 J
Chloroform	7	5 UJ	NA	NS	5 U	NA	2.5 U
Methylene Chloride	5	5 UJ	NA	NS	5 U	NA	2.5 U

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INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	7/01/10**	11/02/10	11/09/11	12/28/11	07/23/14
Aluminum		1,390 J	100 J	NS	3,320	NA	414
Antimony	3	5.0 UJ	5.0 UJ	NS	5 U	NA	0.35 J
Arsenic	25	5.0 UJ	5.0 UJ	NS	5 U	NA	0.49 J
Barium	1,000	50.0 UJ	50.0 UJ	NS	50 U	NA	14.12
Beryllium	3	3.00 UJ	3.00 UJ	NS	3 U	NA	0.50 U
Boron	1,000	500 UJ	NA	NS	500 U	NA	30.0 U
Cadmium	5	5.00 UJ	5.00 UJ	NS	5 U	5 U	0.28
Calcium		34,800 J	31,200 J	NS	46,600	42,800	43,000
Chromium	50	10.0 UJ	10.0 UJ	NS	10 U	NA	1.69
Cobalt		20.0 UJ	20.0 UJ	NS	20 U	NA	0.74
Copper	200	12.2 J	10.0 UJ	NS	10 U	NA	4.73
Iron	300	**1,820 J**	60.0 UJ	NS	**4,790**	183	**1,240**
Lead	25	3.0 UJ	3.0 UJ	NS	3 U	3 U	1.79
Magnesium		5,000 UJ	5,000 UJ	NS	5,290	5,000 U	4,200
Manganese	300	105 J	10.0 UJ	NS	91.5 J	12.3	37.65
Nickel	100	30.0 UJ	30.0 UJ	NS	30 U	NA	1.79
Potassium		5,000 UJ	5,000 UJ	NS	5,000 UJ	5,000 U	367
Selenium	10	3.0 UJ	3.0 UJ	NS	3 U	NA	0.42 J
Sodium	20,000	5,000 UJ	5,000 UJ	NS	5,000 UJ	5,000 U	738
Vanadium		30.0 UJ	30.0 UJ	NS	30 U	NA	1.81 J
Zinc		21.7 J	18.2 J	NS	20.6 J	NA	19.14

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	7/01/10**	11/02/10	11/09/11	12/28/11	07/23/14
Alkalinity (mg/l)		132	NA	NS	130 J	150	114
Ammonia Nitrogen (mg/l)	2	0.500 U	NA	NS	0.5 U	0.5 U	0.113
BOD (mg/l)		4.0 U	NA	NS	4 UJ	4 U	22.0
Bromide (mg/l)		8.0 U	NA	NS	8 UJ	8 U	0.05 U
COD (mg/l)		41	NA	NS	130	20 U	84.0
Chloride (mg/l)	250	3.14	NA	NS	1.39	1.65	0.50
Color	15	**60.0**	NA	NS	**100**	NA	**50**
Cyanide, Total	0.2	0.010 U	NA	NS	10 U	NA	0.001 J
Hardness (mg/l)		87	NA	NS	138	107	120
Hexavalent Chromium		0.010 U	NA	NS	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.104	NA	NS	0.109	0.073	0.078 J
Phenols (mg/l)	0.001	0.005 U	NA	NS	0.05 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	6.07	NA	NS	11	16.3	11.2
Total Dissolved Solids (mg/l)		180	NA	NS	270	290	130
Total Kjeldahl Nitrogen (mg/l)		1.35	NA	NS	2.05	0.735	0.35
Total Organic Carbon (mg/l)		3.0 U	NA	NS	3 U	3 U	2.35

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R = Rejected by data validator

TABLE 1
MW-8D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	3 JB	NS	NA	NS	NS	NA	5 U	NS	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
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NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NS	NA	NS	NS	NA	14.8 B	NS	22.0 U	NA
Arsenic	25	1.6 U	NS	NA	NS	NS	NA	3.0 U	NS	3.0 U	NA
Barium	1,000	33.5 B	NS	NA	NS	NS	NA	34.0 B	NS	28.8 B	NA
Boron	1,000	52	NS	NA	NS	NS	NA	51.2 B	NS	NA	NA
Cadmium	5	0.4 U	NS	0.5 U	NS	NS	1 U	2.1 JB	NS	1.4 B	1 U
Calcium		116,000 0	NS	106,000 0	NS	NS	112,000 0	94,000	NS	94,200	108,000
Chromium	50	0.6 U	NS	NA	NS	NS	NA	1.4 B	NS	1.0 U	NA
Cobalt		0.8 U	NS	NA	NS	NS	NA	2.0 U	NS	2.0 U	NA
Copper	200	13.6 B	NS	NA	NS	NS	NA	1.6 B	NS	1.4 B	NA
Iron	300	10.8 U	NS	34 U	NS	NS	12 U	62.3 B	NS	30.0 U	35 U
Lead	25	1.5 U	NS	1.6 U	NS	NS	3.5 0	3.8	NS	2.0 U	3 U
Magnesium		10,800 0	NS	9,510 0	NS	NS	10,400 0	8,720	NS	9,070	10,200
Manganese	300	154 0	NS	78.8 0	NS	NS	63.4 0	69.7	NS	108	132
Mercury	2	0.2 U	NS	NA	NS	NS	NA	0.10 U	NS	0.10 B	NA
Nickel		2.5 B	NS	NA	NS	NS	NA	6.1 B	NS	3.1 B	NA
Potassium		1,070 U	NS	1,740 B	NS	NS	2,100 B	1,760 B	NS	1,150 B	1,040 B
Selenium	10	3 U	NS	NA	NS	NS	NA	3.0 U	NS	R	NA
Sodium	20,000	7,270 0	NS	19,600 0	NS	NS	6,090 0	4,230 B	NS	3360 B	3,570 B
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 U	NS	2.0 U	NA
Zinc		20.7	NS	NA	NS	NS	NA	50.6	NS	15.0 B	NA

NOTES:
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		254 0	NS	296 0	NS	NS	294 0	288	NS	312	303
Ammonia Nitrogen (mg/l)	2	1.562 0	NS	**5.03 0**	NS	NS	**6.59 0**	**6.82 J**	NS	**3.23**	**2.28**
BOD (mg/l)		3 U	NS	4 U	NS	NS	5.1 0	3.87	NS	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	NS	0.1 U	NS	NS	2 U	2.00 U	NS	2.00 U	
COD (mg/l)		3.2 0	NS	3 U	NS	NS	10 U	10.0 U	NS	10.0 U	10 U
Chloride (mg/l)	250	6.17 0	NS	19.6 0	NS	NS	6.3 0	10.3	NS	8.72	10
Color	15	**40**	NS	NA	NS	NS	NA	5 U	NS	5. U	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 J	NA
Hardness (mg/l)		3 0	NS	304 0	NS	NS	324 0	271	NS	273	312
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 U	
Nitrate Nitrogen (mg/l)	10	3.5 0	NS	2.79 0	NS	NS	0.283 0	0.361	NS	1.13	.908
Phenols (mg/l)	0.001	**0.012 0**	NS	**0.011 0**	NS	NS	**0.008 0**	**0.007**	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	28.6 0	NS	11.9 0	NS	NS	19.2 0	13.8	NS	15.1	16.8
Total Dissolved Solids (mg/l)		374 0	NS	305 0	NS	NS	278 0	264	NS	344	343
Total Kjeldahl Nitrogen (mg/l)		2.41 0	NS	8.5 0	NS	NS	7.31 0	7.42 J	NS	3.71	2.65
Total Organic Carbon (mg/l)		1 U	NS	2.08 0	NS	NS	2.73 0	1.00 U	NS	1.00 U	5.52

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TABLE 1
MW-8D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	5 U	0.8 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	10.0 U	20.1 U	20.1 U	83.3 U	NA	NA	60 U	60 U	NA
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U	3.9 U	NA
Barium	1,000	NA	32.1 B	27.3 B	27.3 B	32.4	NA	NA	30.1	26.8	NA
Boron	1,000	NA	31 B	50 U	50 U	50 U	NA	NA	27 U		
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		99,500	130,000	108,000	103,000	114,000	115,000	111,000	115,000	113,000	104,000
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U	1.4 U	NA
Cobalt		NA	1.0 U	1.3 B	1.3 B	1.7 B	NA	NA	1.7 U	1.8 U	NA
Copper	200	NA	1.6 B	1.5 U	1.5 U	1.4 U	NA	NA	2.6 U	4.3 U	NA
Iron	300	76.9 B	21.8 B	16.4 U	63.5 U	85.3 U	85.3 U	53 U	53 U	**524**	54 U
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		9,340	11,600	8,820	8,390	10,100	10,200	9,640	9,890	10,600	8,290
Manganese	300	136	145	207	246	**375**	**345**	191	202	180	209
Mercury	2	NA	0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U		
Nickel		NA	3.7 B	3.6 B	3.6 B	3.7 B	NA	NA	3.7 B	3	NA
Potassium		648 B	1,070 B	1,190 B	1,270	1,450	1,360	685	664	884	1,300
Selenium	10	NA	5.0 JJN	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		
Sodium	20,000	3,300 B	6,400	9,660	7,310	4,630 J	4,710	5,660	10,100 E	5,760	5,780
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1 U	NA
Zinc		NA	5.0 U	7.3 B	7.3 B	16.2 U	NA	NA	11 U	11 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		313	320	292	292	306	312	320	322	298	301
Ammonia Nitrogen (mg/l)	2	1.19	0.7	0.95	1.2	1.6	1.5	0.53	0.57	0.61	1.9
BOD (mg/l)		2 U	2.0 U	2 U	2.2	1.6 B	0.68 B	0.66 B	2 U	0.54 B	0.36 B
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	26.3
Chloride (mg/l)	250	4.55	7.87	10.3	11	7.2	11	10	13.9	8.24	11.1
Color	15	NA	5.0 U	5	5	5	NA	NA	5 U	5 U	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		287	372	306	292	326	329	316	328	326	293
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	1.72	0.119	0.1 U	0.042 B	0.1	0.11	0.11	0.1 U	0.138	0.144
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.007**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	15.9	15.9	13.2	13	13	15	13	11	12	12.7
Total Dissolved Solids (mg/l)		352	386	356	330	350	360	370	380	320	320
Total Kjeldahl Nitrogen (mg/l)		1.6	0.82	1.3	1.18	1.64	1.76	0.712	0.484	0.7	1.88
Total Organic Carbon (mg/l)		3.39	3.97	3.31	0.48 B	0.36 B	0.59 B	0.81 B	1.8	0.83 B	0.85 B

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TABLE 1
MW-8D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/09/08	07/15/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		639	NA	92 U	NA	100 UJ+	NA	100 U	NA	100 U	NA
Arsenic	25	3.9 U	NA	4.1 B	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	35.9	NA	26.8	NA	50.0 U	NA	50.0 U	NA	50 U	NA
Boron	1,000					500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		139,000	100,000	103,000	117,000	77,600 U	92,900	98,200 J	92,400	108,000	94,800
Chromium	50	2.4 B	NA	1.3 U	NA	5.00 UJ	NA	5.00 U	NA	5 U	NA
Cobalt		2.4 B	NA	1.8 U	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**2,360**	54 U	54 U	275	60.0 U	84	60.0 UJ	60.0 U	60.0 U	73
Lead	25	3 U	3 U	3 U	3.3 B	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		15,500	8,550	9,140	10,200	6,580	7,600	8,460	8,090	10,000	8,750
Manganese	300	**359**	**340**	193	223	90.8	192	110 J	109	97.9	**311**
Mercury	2					0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel		6.2 B	NA	2.7 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		1,260	960	655 J	861	1,280	1,170	1,820	1,880	1,240 J	5,000 U
Selenium	10					**13.1 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	6,940 J+	6,240 N	4,370	8,890	13,000 J	7,880	5,180	7,880	5,860	5,000 U
Vanadium		2.6 B	NA	1.5 U	NA	30.0 U	NA	30 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10 UJ	NA	10.0 U	NA	37.1 J	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/09/08	07/15/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		295	287	307	311	280	300	280	280	270	280
Ammonia Nitrogen (mg/l)	2	1.5	1.4	0.54	0.46	0.675	0.500 U	**3.70**	**3.55**	1.30	0.50 U
BOD (mg/l)		3.1	6.6	2.6	0.94 B	4 U	4 U	4.0 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	1.0 U	0.20 U	0.20 U	2.00 U	0.20 U
COD (mg/l)		10 U	4.12 B	10 U	2.16 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	7.52	12.2	6.82	11.3	7.48	13.4	10.3	9.87	5.13	7.54
Color	15	5	NA	5	NA	8.00	NA	8.00	NA	**20.00**	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		411	285	295	334	221	263	280	264	311	273
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.13	0.197	0.215	0.085 B	0.355 J	1.22	0.803	0.654	0.459	0.52
Phenols (mg/l)	0.001	0.005 U	**0.011**	**0.005 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	11.2	11.8	10.8	11.5	7.90	8.7	13.7	9.73	11.1	12.7
Total Dissolved Solids (mg/l)		310	340	320	330	312	328	325	260	300	310
Total Kjeldahl Nitrogen (mg/l)		1.5	1.31	0.636	0.545	0.769	0.500 U	3.93	4.17	1.630	0.545
Total Organic Carbon (mg/l)		0.67 B	1.8	4.9	1.4	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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R = Rejected by data validator

TABLE 1
MW-8D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	5 U	NA	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

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NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NA	100 U	NA	NS
Arsenic	25	5.0 UJ	NA	5 U	NA	NS
Barium	1,000	50.0 U	NA	50 U	NA	NS
Boron	1,000	500 U	NA	500 U	NA	NS
Cadmium	5	5.00 U	5.00 U	5.00 U	5.00 U	NS
Calcium		96,900	104,000	104,000	104,000	NS
Chromium	50	10.0 U	NA	10 U	NA	NS
Cobalt		20.0 U	NA	20 U	NA	NS
Copper	200	10.0 U	NA	10 U	NA	NS
Iron	300	60.0 U	60.0 U	130.0	60.0 U	NS
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	NS
Magnesium		9,650	9,750	10,100	8,940	NS
Manganese	300	101	129	66.3	49.6	NS
Mercury	2	0.200 U	NA	0.2 U	NA	NS
Nickel		30.0 U	NA	30 U	NA	NS
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.0 U	NA	3 U	NA	NS
Sodium	20,000	5,920	5,270	5,320 J	5,000 U	NS
Vanadium		30.0 U	NA	30 U	NA	NS
Zinc		10.0 UJ	NA	10 UJ	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		280	260	310 J	310	NS
Ammonia Nitrogen (mg/l)	2	0.700	**3.86**	0.50 U	0.50 U	NS
BOD (mg/l)		4.0 U	4.0 U	4.0 U	4.0 U	NS
Bromide (mg/l)	2	0.8 U	0.8 U	0.8 U	0.8 U	NS
COD (mg/l)		20 U	20 U	20 U	20 U	NS
Chloride (mg/l)	250	5.60	9.17	9.56	7.07	NS
Color	15	7.00	NA	6	NA	NS
Cyanide, Total (mg/l)	0.2	0.010 U	NA	10 U	NA	NS
Hardness (mg/l)		282	300	302	298	NS
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.346	0.221	0.167	0.17	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	11.6	18.8	11.3	10.1	NS
Total Dissolved Solids (mg/l)		300	280	340	290	NS
Total Kjeldahl Nitrogen (mg/l)		1.03	1.04	0.5 U	0.5 U	NS
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.0 U	3.0 U	NS

NOTES:

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TABLE 1
MW-8S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
Acetone	50	10 U	NS	NA	NS	NS	NS	10 U	NS	10 U	NA
Methylene Chloride	5	3 JB	NS	NA	NS	NS	NS	0.6 U	NS	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/11/99	10/19/99
Aluminum		22.9 U	NS	NA	NS	NS	NA	6.0 U	NS	22.0 U	NA
Arsenic	25	1.6 U	NS	NA		NS	NA	3.0 U	NS	3.0 U	
Barium	1,000	33.6 B	NS	NA	NS	NS	NA	46.5 B	NS	33.2 B	NA
Boron	1,000	44.6 B	NS	NA	NS	NS	NA	71.9 B	NS	NA	NA
Cadmium	5	0.4 U	NS	0.5 U	NS	NS	1 U	1.9 JB	NS	1.5 B	1 U
Calcium		110,000 0	NS	117,000 0	NS	NS	118,000 0	109,000	NS	102,000	121,000
Chromium	50	0.85 B	NS	NA	NS	NS	NA	1 U	NS	1.0 U	NA
Cobalt		0.8 U	NS	NA	NS	NS	NA	2.0 U	NS	2.0 U	NA
Copper	200	56.3	NS	NA	NS	NS	NA	1 U	NS	1.4 B	NA
Iron	300	153 0	NS	34 U	NS	NS	27.7 B	12.0 B	NS	62.8 B	**927**
Lead	25	1.5 U	NS	1.6 U	NS	NS	2.9 B	2 U	NS	2.0 U	3 U
Magnesium		9,880 0	NS	10,300 0	NS	NS	10,600 0	9,950	NS	9,540	12,100
Manganese	300	149 0	NS	268 0	NS	NS	164 0	161	NS	93.6	**1,770**
Mercury	2	0.2 U	NS	NA	NS	NS	NA	0.10 U	NS	0.10 U	
Nickel	100	2 B	NS	NA	NS	NS	NA	5.2 B	NS	3.4 B	NA
Potassium		1,200 B	NS	2,570 B	NS	NS	2,960 B	2,340 B	NS	1,380 B	1,220 B
Selenium	10	3 U	NS	NA	NS	NS	NA	3.0 U	NS	R	NA
Sodium	20,000	8,250 0	NS	**27,100 0**	NS	NS	7,820 0	5,440	NS	3,570 B	4,470 B
Thallium	4	2.1 U	NS	NA	NS	NS	NA	6.0 UN	NS	3.0 U	
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 U	NS	2.0 U	NA
Zinc		22.9	NS	NA	NS	NS	NA	19.5 B	NS	5.0 U	NA

NOTES:

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CONVENTIONAL PARAMETERS

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/19/99
Alkalinity (mg/l)		244 0	NS	339 0	NS	NS	324 0	318	NS	322	289
Ammonia Nitrogen (mg/l)	2	1.52 0	NS	**8.65 0**	NS	NS	**11.1 0**	**10.0 J**	NS	**3.81**	**2.74**
BOD (mg/l)		3 U	NS	4 U	NS	NS	3 0	4.77	NS	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	NS	0.1 U	NS	NS	2 U	2.00 U	NS	2.00 U	
COD (mg/l)		3 U	NS	3 U	NS	NS	10 U	10.0 U	NS	10.0 U	NA
Chloride (mg/l)	250	6.81 0	NS	26.6 0	NS	NS	7.76 0	12.5	NS	9.48	11.1
Color	15	**40**	NS	NA	NS	NS	NA	5 U	NS	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 J	NA
Hardness (mg/l)		316 0	NS	334 0	NS	NS	338 0	313	NS	294	352
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 U	NA
Nitrate Nitrogen (mg/l)	10	3.5 0	NS	2.97 0	NS	NS	2.19 0	0.688	NS	1.72	4.22
Phenols (mg/l)	0.001	**0.02 0**	NS	**0.009 0**	NS	NS	**0.019 0**	**0.007**	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	25.7 0	NS	15.1 0	NS	NS	16.3 0	13.8	NS	14.6	17.3
Total Dissolved Solids (mg/l)		387 0	NS	355 0	NS	NS	309 0	335	NS	361	366
Total Kjeldahl Nitrogen (mg/l)		2.06 0	NS	9.35 0	NS	NS	11.5 0	9.72 J	NS	4.32	3.37
Total Organic Carbon (mg/l)		1 U	NS	1.17 0	NS	NS	3.2 0	6.83	NS	1.04	1 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

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R = Rejected by data validator

TABLE 1
MW-8S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	NA	5 U	0.6 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
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NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	10.0 U	20.1 U	20.1 U	83.3 U	NA	NA	137 B	146	NA
Arsenic	25		2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U		
Barium	1,000	NA	34.3 B	27.4 B	27.4 B	31.1	NA	NA	31.3	25.8	NA
Boron	1,000	NA	37.3 B	50 U	50 U	50 U	NA	NA	27 U		
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		180,000	136,000	114,000	110,000	107,000	107,000	120,000	113,000	110,000	105,000
Chromium	50	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U	1.4 U	NA
Cobalt		NA	1.0 U	1.2 U	1.2 U	1.5 B	NA	NA	1.7 U	1.8 U	NA
Copper	200	NA	3.1 B	1.5 U	1.5 U	1.4 U	NA	NA	2.6 U	2.6 U	NA
Iron	300	44.7 B	39.2 B	**394**	**304**	**469**	**2,170**	**853**	**970**	**331**	54 U
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		9,860	12,400	9,330	8,760	9,010	9,240	10,900	9,890	9,150	8,040
Manganese	300	74	153	**318**	**337**	**502**	**2,330**	**581**	**595**	**378**	**426**
Mercury	2		0.1 U	0.10 U	0.10 U	0.18 U	NA	NA	0.18 U	2.5	2.5
Nickel	100	NA	3.4 B	3.9 B	3.9 B	3.8 B	NA	NA	4 B	2.5	NA
Potassium		715 B	1,310 B	1,180 B	1,260	1,580	1,490	829	630	811	1,260
Selenium	10	NA	5.0 UJN	5.5 N	5.5 N	6.9 U	NA	NA	5 U	5 U	NA
Sodium	20,000	3,780 B	7,380	10,700	8,660	4,960 J	4,910	7,350	10,900 E	7,140	6,490
Thallium	4		6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1 U	NA
Zinc		NA	5.0 U	4.9 B	4.9 B	16.2 U	NA	NA	11 U	11 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/05/00	10/25/01	12/06/01	10/28/02	12/09/02	09/16/03	11/06/03	05/04/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		295	321	304	304	280	286	332	320	305	314
Ammonia Nitrogen (mg/l)	2	0.775	0.66	0.807	1	1.4	1.6	0.84	0.82	0.68	**2.1**
BOD (mg/l)		3.4	2.0 U	2 U	1.5 B	7.8	6.7	3.4	3.5	1.1 B	0.36 B
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	10.0 U	10 U	10 U	10 U	10 U	8.17 B	10 U	10 U	5.07 B
Chloride (mg/l)	250	4.71	9.83	13.4	14	7	9.5	13	17.9	9.49	12.9
Color	15	NA	5.0 U	5	5	**20**	NA	NA	10	5	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		309	391	323	311	304	305	344	323	312	295
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	1.57	0.205	0.1 U	0.03 B	0.13	0.2	0.11	0.225	0.274	0.572
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	13.4	15.1	12.5	14	11	11	12	10.7	11.6	12.2
Total Dissolved Solids (mg/l)		331	407	367	350	320	330	370	390	330	340
Total Kjeldahl Nitrogen (mg/l)		1.2	0.82	1.3	1.12	1.67	1.78	1.01	0.475	1.11	1.94
Total Organic Carbon (mg/l)		3.54	5.03	3.24	2.4	0.76 B	1.1	0.43 B	1.7	1.2	0.88 B

NOTES:

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TABLE 1
MW-8S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/04/07	10/28/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	3.1 J	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/04/07	10/28/08	12/09/08	07/15/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		2,650	NA	92 U	NA	100 JJ+	NA	100 U	NA	100 U	NA
Arsenic	25					11.9	NA	10.0 U	NA	10 U	NA
Barium	1,000	70.7	NA	30.7	NA	50 U	NA	50.0 U	NA	50 U	NA
Boron	1,000					500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5 U	5.00 U	5.00 U	5.00 U
Calcium		160,000	101,000	110,000	121,000	89,600	102,000	113,000 J	98,100	92,600	104,000
Chromium	50	6.8 B	NA	1.3 U	NA	5 UJ	NA	5.00 U	NA	5 U	NA
Cobalt		12.2	NA	1.9 B	NA	20 U	NA	20.0 U	NA	20 U	NA
Copper	200	13.9	NA	4.3 U	NA	10 U	NA	10.0 U	NA	10 U	NA
Iron	300	**7,090**	85.9 B	63.4 B	255	148	**987**	183 J	**357**	104 J	**1,060**
Lead	25	3 U	3 U	3 U	3.5 B	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		23,200	8,140	9,460	10,200	6,960	8,050	9,160	8,020	9,030	10,200
Manganese	300	**3,610**	278	**610**	**681**	264	**1,590**	**321 J**	**395**	**347**	**329**
Mercury	2					0.2 U	NA	0.2 U	NA	0.2 U	NA
Nickel	100	12.2	NA	2.7 B	NA	30 U	NA	30.0 U	NA	30 U	NA
Potassium		1,950	1,290	1,110 J	1,470	1,200	2,600	2,500	2,120	3,470 J	5,000 U
Selenium	10	5 U	NA	5 UJ	NA	**17.0 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	7,060 J+	6,500 N	5,170	11,200	16,600 J	15,800	7,250	5,950	5,460	5,800
Thallium	4	10 UJ-	10 UJ-	10 UJ-	10 JJ-	**10.8**	NA	10.0 U	NA	10 U	NA
Vanadium		9.1	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		12.3 B	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	10 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/04/07	10/28/08	12/09/08	07/15/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		296	276	310	328	280	290	280	290	260	220
Ammonia Nitrogen (mg/l)	2	1.1	0.81	0.92	0.62	0.500 U	0.500 U	**2.67**	**2.74**	1.81	1.16
BOD (mg/l)		9.1	2.2	2.5	1.5 B	4 U	4 U	5.00	5.00 U	9	7
Bromide (mg/l)	2	0.1 U	0.1 U	0.028 B	0.1 U	0.20 U	1.0 U	0.2 U	2.0 U	0.2 U	2.0 U
COD (mg/l)		14.3	4.44 B	10 U	1.85 B	20 U	20 U	20 U	20 U	20 U	29
Chloride (mg/l)	250	9.81	12.1	9.52	14.4	12.0	13.6	11.1	11.4	8.18	13
Color	15	**50**	NA	10	NA	8.0	NA	5 U	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		495	286	314	344	252	287	319	278	268	301
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	1.03	1.07	0.843	1.02	0.611 J	5.45	2.69	2.99	4.32	5.11
Phenols (mg/l)	0.001	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	10.8	10.7	10.5	11.1	7.65	10.0 U	10.4	13.1	12.2	12
Total Dissolved Solids (mg/l)		330	340	330	360	370	352	355	338	360	390
Total Kjeldahl Nitrogen (mg/l)		2.67	1.04	1.04	0.79	0.587	0.500 U	2.91	3.29	1.930	2.25
Total Organic Carbon (mg/l)		1.2	1.9	7.6	2.5	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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TABLE 1
MW-8S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Acetone	50	10 U	NA	10 U	NA	NS
Methylene Chloride	5	5 U	NA	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NA	100 U	NA	NS
Arsenic	25	5.0 UJ	NA	5 U	NA	NS
Barium	1,000	50.0 U	NA	50 U	NA	NS
Boron	1,000	500 U	NA	500 U	NA	NS
Cadmium	5	5.00 U	5.00 U	5.00 U	5.00 U	NS
Calcium		98,100	109,000	103,000	97,100	NS
Chromium	50	10.0 U	NA	10 U	NA	NS
Cobalt		20.0 U	NA	20 U	NA	NS
Copper	200	10.0 U	NA	10 U	NA	NS
Iron	300	60.0 U	60.0 U	**644.0**	87.8	NS
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	NS
Magnesium		9,840	9,950	11,300	8,930	NS
Manganese	300	112	163	149 J	95.9	NS
Mercury	2	0.257 J	NA	0.2 U	NA	NS
Nickel	100	30.0 U	NA	30 U	NA	NS
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.0 U	NA	3 U	NA	NS
Sodium	20,000	6,970	6,890	5,910 J	5,140	NS
Thallium	4	3.0 U	NA	3 U	NA	NS
Vanadium		30.0 U	NA	30 U	NA	NS
Zinc		11 J	NA	10 UJ	NA	NS

NOTES:

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		290	270	310 J	310	NS
Ammonia Nitrogen (mg/l)	2	1.50	1.51	0.5 U	0.5 U	NS
BOD (mg/l)		4.0 U	4.0 U	4.0 U	4.0 U	NS
Bromide (mg/l)	2	0.8 U	0.8 U	0.8 U	0.8 U	NS
COD (mg/l)		20 U	20 U	20 U	20 U	NS
Chloride (mg/l)	250	8.38	10.7	20.4	9.65	NS
Color	15	5.00 U	NA	**50**	NA	NS
Cyanide, Total (mg/l)	0.2	0.010 U	NA	10 U	NA	NS
Hardness (mg/l)		285	312	303	279	NS
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.01 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.795	0.562	0.317	0.396	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	11.3	5.75	10.8	11.2	NS
Total Dissolved Solids (mg/l)		320	340	1100	520	NS
Total Kjeldahl Nitrogen (mg/l)		1.48	0.750	0.5 U	0.5 U	NS
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.0 U	3.0 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Rejected by data validator

TABLE 1
MW-9D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U	NA	10 U	NA
Benzene	1	10 U	NA	NA	NA	NA	NA	0.8 J	NA	1 J	NA
Bromochloromethane	5										
Chlorobenzene	5		NA	NA	NA	NA	NA	5 U	NA	.5 J	NA
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		30.4 B	NA	NA	NA	NA	NA	11.9 B	NA	22.0 U	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	3.0 U	
Arsenic	25	2.2 B	NA	NA	NA	NA	NA	4.6 B	NA	7.0 B	NA
Barium	1,000	117 B	NA	NA	NA	NA	NA	85.7 B	NA	84.8 B	NA
Boron	1,000	123	NA	NA	NA	NA	NA	142	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.5 B	1 U	1.5 B	1 U
Calcium		136,000 0	127,000 0	145,000 0	93,500	103,000 0	114,000	99,400	96,100	116,000	131,000
Chromium	50	2.9 B	NA	NA	NA	NA	NA	1.5 B	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2 U	NA	2.0 U	
Copper	200	9.9 B	NA	NA	NA	NA	NA	1.4 B	NA	1.0 B	NA
Iron	300	**19,000 0**	**16,600 0**	**17,900 0**	**11,000**	**11,600 0**	**13,100**	**11,200**	**12,000**	**14,600**	**17900**
Lead	25	1.5 U	1.8 U	1.6 U	1.9 U	1.6 B	3.2	2 U	2 U	2.0 U	3 U
Magnesium		14,900 0	14,000 0	15,400 0	9,490	10,600 0	12,400	10,200	9,970	12200	13,400
Manganese	300	**582 0**	**558 0**	**621 0**	**403**	**405 0**	**460**	**445**	**417**	**491**	**643**
Mercury	2	0.2 U	NA	NA	NA	NA	NA	0.1 U	NA	0.10 U	
Nickel	100	4.7 B	NA	NA	NA	NA	NA	6.4 B	NA	3.0 U	NA
Potassium		7,220 0	21,200 0	13,700 0	11,700	10,200 E	9,140 E	6,950 J	6,190	4,860 B	4,900 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3 U	NA	R	NA
Sodium	20,000	**56,100 0**	**60,400 0**	**88,400 0**	**61,300**	**38,200 E**	**35,000**	**29,300**	**25,800**	19,100	**21,200**
Vanadium		1 U	NA	NA	NA	NA	NA	1 U	NA	2.0 U	NA
Zinc		26.5	NA	NA	NA	NA	NA	38.9	NA	38.0	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		538 0	579 0	622 0	567	524 0	495	488	437	468	479
Ammonia Nitrogen (mg/l)	2	**41.4 0**	**61.8 0**	**66.4 0**	1.52	**58.8 0**	**48.5**	**49.1**	**55.9**	**34.3**	**29.5**
BOD (mg/l)		3 U	5.9 0	6.7 0	6.9	2 U	2 U	2.37	4	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2 U	2.00 U	
COD (mg/l)		15.4 0	14.1 0	20.4 0	3 U	13.6 0	10 U	14.8	12.7	10.0 U	10 U
Chloride (mg/l)	250	72.1 0	71.3 0	108 0	60.1	36.2 0	74.1	44.2	38.5	28.6	31.4
Color	15	**60**	NA	NA	NA	NA	NA	**88**	NA	**90**	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 J	NA
Hardness (mg/l)		401 0	375 0	426.1 0	273	300 0	334	290	281	340.	382
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.08 0	0.04 U	2.33 0	0.04 U	0.1 U	0.1 U	0.1 U	0.1 U	2.20	.1 U
Phenols (mg/l)	0.001	0.0035 U	**0.041 0**	0.005 U	0.005 U	**0.007 0**	**0.013**	0.007 U	0.01 U	0.0500 U	.05 U
Sulfate (mg/l)	250	50.8 0	3 U	3 U	8.02	10 U	11.6	10 U	10 U	10.0 U	10 U
Total Dissolved Solids (mg/l)		647 0	516 0	717 0	624	390 0	416	533 J	333	419	475
Total Kjeldahl Nitrogen (mg/l)		43.8 0	126 0	69.3 0	108	61.9 0	63.2	50.5	67.0	36.0	26.7
Total Organic Carbon (mg/l)		1 U	1 U	9.68 0	5.89	1 U	10.3	5.07	6.47	2.58	5.2

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TABLE 1
MW-9D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
Acetone	50	NA	10 U	10 U	NA	11	NA	NA	10 U	10 U	NA
Benzene	1	NA	0.8 U	1 J	NA	0.9 J	NA	NA	5 U	0.9 J	NA
Bromochloromethane	5										
Chlorobenzene	5	NA	5 U	5 U	NA	0.5 J	NA	NA	5 U	5 U	NA
Methylene Chloride	5	NA	5 U	**7**	NA	5 U	NA	NA	5 U	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
Aluminum		NA	13.6 B	20.1 U	20.1 U	83.3 U	NA	NA	60 U	92 U	NA
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	3.9 B	4.9 U	4.9 U	7 U	NA	NA	3.5 U	5.4 U	NA
Barium	1,000	NA	115 B	80.2 B	80.2 B	85.8	NA	NA	95.1	3.9 U	NA
Boron	1,000	NA	107	84.6 B	84.6 B	70.2	NA	NA	69.9	63.4	NA
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		139,000	167,000	115,000	106,000	125,000	191,000	171,000	139,000	130,000	129,000
Chromium	50	NA	2.1 B	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U	1.3 U	NA
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	NA	NA	1.7 U	1.8 U	1.8 U
Copper	200	NA	1.0 U	1.5 U	1.5 U	2.3 B	NA	NA	2.6 U	4.3 U	NA
Iron	300	**19,700**	**22,900**	**13,700**	**12,500**	**16,200**	**20,100**	**20,100**	**18,300**	**15,700**	**12,600**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		13,300	14,600	9,210	8,320	10,900	14,100	12,700	10,600	9,610	9,230
Manganese	300	**692**	**879**	**532**	**473**	**634**	**868**	**901**	**716**	**626**	**654**
Mercury	2		0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	1.9 U	1.9 U
Nickel	100	NA	4.8 B	3.1 B	3.1 B	1.9 U	NA	NA	3.6 B	1.9 U	NA
Potassium		3,200 B	6,190	5,210	6,110	7,980	6,750	5,050	3,180	3,610	3,620
Selenium	10	NA	5.0 U	5.4 N	5.4 N	6.9 U	NA	NA	5 U		
Sodium	20,000	18,500	**44,500**	**31,200**	**24,300**	19,700 J	19,400	**34,800**	**35,200 E**	**27,100**	**21,600**
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1 U	
Zinc		NA	5.0 U	5.8 B	5.8 B	16.2 U	NA	NA	11 U	11 U	NA

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	NYSDEC Class	SAMPLING DATE									
CONVENTIONAL PARAMETERS	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
Alkalinity (mg/l)		520	496	406	389	410	496	505	455	462	386
Ammonia Nitrogen (mg/l)	2	**21.4**	**19.8**	**23.7**	**25**	**17**	**19**	**15**	**17**	**20**	**17**
BOD (mg/l)		2.2	2.0 U	2 U	3.9	4.2	5.4	6.8	2 U	2.9	2 U
Bromide (mg/l)	2		0.114	0.1 U	0.042 B	0.1 U	0.1 U	0.1 U	0.068 B	0.045 B	0.036 B
COD (mg/l)		21	17.7	10 U	4.83 B	10 U	4.68 B	12	5.26 JB	10 U	8.4 B
Chloride (mg/l)	250	46.4	54.9	46.7	38	31	30	48	50.4	29.1	33.3
Color	15	NA	**240**	**500**	**500**	**200**	NA	NA	**120**	**150**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		402	477	325	299	357	535	480	391	364	359
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.004 B	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	0.28	0.23	0.34	0.1 U	0.035 B	0.15
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	**0.003 B**	**0.075**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	4.41	1.78	2.53	3.4	2	0.82 B	0.5 B	0.861 B	1.88	2.34
Total Dissolved Solids (mg/l)		520	226	430	390	430	450	560	520	440	370
Total Kjeldahl Nitrogen (mg/l)		22	22.2	29.9	25.1	17.4	20.9	14.1	16.9	23.2	17
Total Organic Carbon (mg/l)		13.6	9.63	5.76	7.1	0.68 B	1.9	3.6	5.5	1.8	1.5

NOTES:

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TABLE 1
MW-9D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 UJ	NA
Benzene	1	0.83 J	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Bromochloromethane	5										
Chlorobenzene	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		690	NA	110 B	NA	100 UJ+	NA	100 U	NA	425	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	3.9 U	NA	3.9 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	75.7	NA	74.8	NA	63.5	NA	79.9	NA	76	NA
Boron	1,000	51.7 B	NA	47.6 JB	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		155,000	146,000	140,000	139,000	86,600	99,400	108,000 J	94,200	127,000	101,000
Chromium	50	4.2 B	NA	1.3 U	NA	5.00 UJ	NA	5.00 U	NA	5 U	NA
Cobalt					1.8 U	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	6.2 B	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**14,500**	**13,400**	**16,800**	**5,380**	**10,400**	**1,220**	**12,300 J**	**10,900**	**13,700 J**	**10,900**
Lead	25	3 U	3 U	3 U	4.2 B	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		11,200	11,300	11,100	10,000	6,090	6,990	8,370	7,630	10,400	7,740
Manganese	300	**745**	**623**	**664**	**735**	**396**	161	**460 J**	**390**	**494**	**630**
Mercury	2				1.9 U	0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	5.5 B	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		3,230	2,360	1,830 J	3,710	2,670	4,960	2,590	2,070	2,340 J	5,000 U
Selenium	10					**11.2 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	19,300 J+	18,700	17,700	17,000	**30,500 J**	17,600	17,100	13,200	14,400	13,100
Vanadium		2.3 B	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		13.2 B	NA	12 B	NA	10.0 UJ	NA	10.0 U	NA	16.8 J	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		398	382	448	425	390	350	330	350	360	310
Ammonia Nitrogen (mg/l)	2	**12**	**11**	**8.6**	**7.4**	**16.6**	**4.66**	**13.4**	**12.9**	**10.6**	**8.78**
BOD (mg/l)		7	2.8	7.1	7.4	4	9	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.046 B	0.017 B	2.0 U	1.0 U	20 U	20 U	20 U	20 U
COD (mg/l)		10 U	10 U	10 U	2.16 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	33.7	31.6	33.8	36.9	39.4	28.4	23.6	20.3	22.3	22.8
Color	15	**120**	NA	**200**	NA	**210**	NA	**50.0**	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		433	411	395	388	241	277	304	267	359	285
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.005 B	NA	0.01 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.055 B	0.152 B	0.332	0.072 B	0.200 UJ	3.27	0.200 U	0.200 U	0.2 U	0.200 U
Phenols (mg/l)	0.001	**0.006**	**0.007**	**0.007**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	0.804 B	0.668 B	0.45 B	0.468 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Total Dissolved Solids (mg/l)		400	390	470	450	425	312	315	322	400	370
Total Kjeldahl Nitrogen (mg/l)		10.8	8.37	9.13	9.53	19.1	5.05	12.8	13.4	11.6	10.5
Total Organic Carbon (mg/l)		1.4	2.1	3.7	3.5	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

NOTES:

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TABLE 1
MW-9D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/22/14
VOLATILE COMPOUNDS (µg/L)						
Acetone	50	10 U	NA	10 U	NA	7.2
Benzene	1	5 U	NA	5 U	NA	0.19 J
Bromochloromethane	5			5 U	NA	0.5 U
Chlorobenzene	5	5 U	NA	5 U	NA	2.5 U
Methylene Chloride	5	5 U	NA	5 U	NA	2.5 U

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	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/22/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NA	100 U	NA	11.2
Antimony	3	5.0 UJ	NA	5 U	NA	0.12 J
Arsenic	25	5.0 UJ	NA	5 U	NA	0.41 J
Barium	1,000	66.7	NA	63.9	NA	48.98
Boron	1,000	500 U	NA	500 U	NA	31.0
Cadmium	5	5.00 U	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		126,000	127,000	133,000	125,000	110,000
Chromium	50	10.0 U	NA	10 U	NA	1.15
Cobalt		20.0 U	NA	20 U	NA	0.17 J
Copper	200	10.0 U	NA	10 U	NA	2.03
Iron	300	**13,300**	**12,500**	**13,600**	**12,400**	**11,400**
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	0.25 J
Magnesium		10,100	10,300	10,800	9,370	8,600
Manganese	300	**497**	**502**	**472 J**	**436**	**361.7**
Mercury	2	0.239 J	NA	0.2 U	NA	0.20 U
Nickel	100	30.0 U	NA	30 U	NA	1.59
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	1,260
Selenium	10	3.0 U	NA	3 U	NA	0.55 J
Sodium	20,000	16,600	17,200	17,600 J	18,000	15,300
Vanadium		30.0 U	NA	30 U	NA	0.39 J
Zinc		10.0 UJ	NA	10 UJ	NA	4.20 J

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	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/22/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		360	310	390 J	360	372
Ammonia Nitrogen (mg/l)	2	**6.49**	**6.63**	**5.49**	**5.71**	**4.32**
BOD (mg/l)		4.0 U	4.0 U	4.0 U	4.0 U	2.00 U
Bromide (mg/l)	2	8.0 U	8.0 U	8.0 U	8.0 U	0.024 J
COD (mg/l)		20 U	20 U	20 U	20 U	9.50 J
Chloride (mg/l)	250	25.8	22.3	31.3	33.8	30.9
Color	15	**120**	NA	**200**	NA	**230**
Cyanide, Total (mg/l)	0.2	0.010 U	NA	10 U	NA	0.001 J
Hardness (mg/l)		355	359	375	351	310
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.069	0.050 U	0.094	0.050 U	0.031 J
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	**0.12**
Sulfate (mg/l)	250	5.00 U	5.00 U	5.00 U	5.00 U	3.15
Total Dissolved Solids (mg/l)		320	360	420	410	400
Total Kjeldahl Nitrogen (mg/l)		9.25	6.39	5.64	6	4.90
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.6	3.0 U	2.44

NOTES:

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TABLE 1
MW-9S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
1,1,2-Trichloroethane	1	10 U	NA	NA	NA	NA	NA	0.4 J	NA	5 U	NA
Benzene	1	10 U	NA	NA	NA	NA	NA	0.5 J	NA	1 J	NA
Chlorobenzene	5	5 U	NA	NA	NA	NA	NA	5 U	NA	1 J	NA
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	0.6 U	NA	5 U	NA
Trichloroethene	5	10 U	NA	NA	NA	NA	NA	0.4 J	NA	5 U	NA

NOTES:

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		32.1 B	NA	NA	NA	NA	NA	16.8 B	NA	420	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	**4.0 B**	NA
Arsenic	25	2.2 B	NA	NA	NA	NA	NA	4.0 B	NA	**45.4**	NA
Barium	1,000	83.7 B	NA	NA	NA	NA	NA	80.7 B	NA	105 B	NA
Boron	1,000	160	NA	NA	NA	NA	NA	136	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.9 B	1 U	1.0 U	1 U
Calcium		109,000 0	196,000 0	146,000 0	196,000	131,000 0	74,200	131,000	142,000	109,000	136,000
Chromium	50	1.4 B	NA	NA	NA	NA	NA	1.7 B	NA	27.3	NA
Cobalt		4.3 B	NA	NA	NA	NA	NA	4.2 B	NA	7.2 B	NA
Copper	200	3.6 B	NA	NA	NA	NA	NA	1.5 B	NA	7.3 B	NA
Iron	300	**16,500 0**	**20,000 0**	**8,190 0**	**8,480**	**6,780 0**	**2,020**	**9,920**	**17,800**	**54,500 ***	**27900**
Lead	25	1.5 U	1.8 B	1.6 U	1.9 U	1.7 B	1 U	2 U	2 U	2.0 U	3.9
Magnesium		11,500 0	18,100 0	12,500 0	16,100	11,800 0	6,840	12,600	12,100	9740	13,700
Manganese	300	**484 0**	**1,130 0**	**797 0**	**1,390**	**805 0**	**396**	**986**	**1,400**	**1,700**	**1220**
Nickel	100	9.1 B	NA	NA	NA	NA	NA	11.9 B	NA	21.1 B	NA
Potassium		8,140 0	16,500 0	9,770 0	17,800	19,900 E	8,210 E	7,390 J	8,810	7,140	3,890 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3 U	NA	4.0 U	NA
Sodium	20,000	**49,800 0**	**49,900 0**	**33,500 0**	**92,700**	**62,900 E**	**23,500**	**34,500**	**41,400**	17,400	**20,900**
Thallium	4	2.8 B	NA	NA	NA	NA	NA	6.0 U	NA	3.0 U	NA
Vanadium		1 U	NA	NA	NA	NA	NA	1.0 U	NA	6.8 B	NA
Zinc		12.9 B	NA	NA	NA	NA	NA	44.1	NA	17.0 B	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/26/97	06/26/97	10/08/97	02/18/98	05/28/98	08/18/98	11/04/98	05/12/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		455 0	533 0	418 0	516	715 0	330	500	642	448	506
Ammonia Nitrogen (mg/l)	2	**35.8 0**	**26 0**	**18.2 0**	**47.8**	**74.6 0**	**29.1**	**42.8**	**99.4**	0.259	**27.4**
BOD (mg/l)		3 U	4 U	3.6 0	4.4 U	2 U	2.67	2.07	4	13.3 J	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2 U	2 U	2.00 U	
COD (mg/l)		14.4 0	19.4 0	7.9 0	18.1	13.6 0	10 U	14.8	15.8	10.0 U	17.3
Chloride (mg/l)	250	63.3 0	82.2 0	63.3 0	185	57.4 0	17.7	54.2	64.4	22.4	30.9
Color	15	**100**	NA	NA	NA	NA	NA	**75**	NA	**90**	NA
Cyanide, Total	0.2	0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Hardness (mg/l)		319 0	564 0	415.1 0	555	398 0	NA	379	404	312.	396
Hexavalent Chromium		0.01 U	NA	NA	NA	NA	NA	0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.69 0	0.75 0	3.05 0	0.38	9.34 0	4.56	2.19	0.48	0.973	.189
Phenols (mg/l)	0.001	0.0035 U	0.005 U	**0.006 0**	0.005 U	**0.01 0**	**0.014**	0.012 U	0.01 U	0.0500 U	.05 U
Sulfate (mg/l)	250	46 0	5.7 0	4.5 0	4.37	10 U	10 U	10 U	10 U	11.1	12.6
Total Dissolved Solids (mg/l)		550 0	584 0	476 0	790	585 0	271	10 U	499	NA*	509
Total Kjeldahl Nitrogen (mg/l)		36.9 0	23.4 0	16.9 0	58.1	85.8 0	50	42.3	98.8	5.78	24.9
Total Organic Carbon (mg/l)		1 U	1 U	3.12 0	6.78	1 U	7.12	5.55	4.28	NA	5.4

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TABLE 1
MW-9S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
1,1,2-Trichloroethane	1	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NS
Benzene	1	NA	0.4 U	5 U	NA	5 U	NA	NA	5 U	5 U	NS
Chlorobenzene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NS
Methylene Chloride	5	NA	0.4 U	5 U	NA	5 U	NA	NA	5 U	5 U	NS
Trichloroethene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 UJ	5 U	NS

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
Aluminum		NA	94.7 B	20.1 U	20.1 U	83.3 U	NA	NA	60 U	92 U	NS
Antimony	3	NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	3.4 B	4.9 U	4.9 U	7 U	NA	NA	3.5 U	3.9 U	NS
Barium	1,000	NA	43.1 B	66.4 B	66.4 B	63	NA	NA	36.3	39.8	NS
Boron	1,000	NA	97.9 B	88.4 B	88.4 B	95.1	NA	NA	65.6	48.5	NS
Cadmium	5	0.21 B	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	NS
Calcium		95,600	180,000	158,000	153,000	136,000	145,000	179,000	133,000	167,000	NS
Chromium	50	NA	7.8 B	1.6 B	1.6 B	1.9 B	NA	NA	1.4 U	1.3 U	NS
Cobalt		NA	2.1 B	3.9 B	3.9 B	3.6 B	NA	NA	2.3 B	1.9	NS
Copper	200	NA	6.6 B	1.5 U	1.5 U	1.4 U	NA	NA	2.6 U	4.3 U	NS
Iron	300	**1,690**	**16,000**	**6,390**	**7,400**	**9,970**	**10,600**	**8,600**	**2,680**	**4,890**	NS
Lead	25	1.3 U	2.0 UJ	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	NS
Magnesium		7,740	12500	11,800	11,000	10,200	10,500	12,100	8,640	11,500	NS
Manganese	300	**887**	**1,850**	**1,090**	**1,010**	**1,380**	**1,440**	**2,540**	**1,700**	**1,580**	NS
Nickel	100	NA	8.0 B	9.7 B	9.7 B	5.5 B	NA	NA	6.4 B	4.5	NS
Potassium		3,210 B	4,040 B	9,450	11,200	5,560	4,970	2,610	2,330	2,500	NS
Selenium	10	NA	5.0 UJN	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		
Sodium	20,000	9,940	**24,400**	**48,900**	**47,900**	17,900 J	**20,200**	**42,200**	**29,100 E**	**31,800**	NS
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Vanadium		NA	3.7 B	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1.5 U	NS
Zinc		NA	7.8 B	4.9 U	4.9 U	16.2 U	NA	NA	11 U	11 U	NS

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		05/18/00	10/05/00	10/29/01	12/06/01	10/28/02	12/10/02	09/17/03	11/06/03	05/04/04	10/12/04
Alkalinity (mg/l)		311	488	509	5,170	414	434	533	431	504	NS
Ammonia Nitrogen (mg/l)	2	**12.9**	**2.62**	**15.4**	**20**	**15**	**14**	**5.7**	**5**	**6.1**	NS
BOD (mg/l)		17.2	4.0	2 U	8.1	3.5	3	7.4	2 U	1.1 B	NS
Bromide (mg/l)	2		0.1 U	0.1 U	0.078 B	0.1 U	0.1 U	0.1 U	0.1 U	0.049 B	NS
COD (mg/l)		18.5	70.0	13.8	7.54 B	10 U	10 U	10 U	28	10 U	NS
Chloride (mg/l)	250	11	52.2	72.4	62	28	31	63	37.4	35.5	NS
Color	15	NA	15.0	**150**	**150**	**100**	NA	NA	**30**	**75**	NS
Cyanide, Total	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NS
Hardness (mg/l)		271	501	443	427	382	405	497	368	464	NS
Hexavalent Chromium			0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NS
Nitrate Nitrogen (mg/l)	10	2.44	0.353	0.909	0.59	0.95	0.62	0.35	0.286	0.876	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.002 B**	**0.003 B**	0.005 U	0.005 U	NS
Sulfate (mg/l)	250	15.2	5.14	4.27	5.3	5.5	5.5	4.5	3.80	5.14	NS
Total Dissolved Solids (mg/l)		23	626	607	590	440	480	660	490	560	NS
Total Kjeldahl Nitrogen (mg/l)		12.9	3.5	18	17.5	13.9	15.2	5.48	3.82	6.48	NS
Total Organic Carbon (mg/l)		5.69	10.5	7.14	10	0.17 B	1.4	4.5	4.9	2.1	NS

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TABLE 1
MW-9S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/26/07	12/05/07	10/29/08	12/09/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
1,1,2-Trichloroethane	1	NS	NS	5 U	NA	5 U	NA	NS	NS	NS	NS
Benzene	1	NS	NS	5 U	NA	5 U	NA	NS	NS	NS	NS
Chlorobenzene	5	NS	NS	5 U	NA	5 U	NA	NS	NS	NS	NS
Methylene Chloride	5	NS	NS	5 U	NA	5 U	NA	NS	NS	NS	NS
Trichloroethene	5	NS	NS	5 U	NA	5 U	NA	NS	NS	NS	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/26/07	12/05/07	10/29/08	12/09/08	07/14/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		NS	NS	416 B	NA	593 J+	NA	NS	NS	NS	NS
Antimony	3				NA	15.0 U	NA			NS	NS
Arsenic	25	NS	NS	3.9 U	NA	12.2	NA	NS	NS	NS	NS
Barium	1,000	NS	NS	22.3	NA	50.0 U	NA	NS	NS	NS	NS
Boron	1,000	NS	NS	38.5 JB	NA	500 U	NA	NS	NS	NS	NS
Cadmium	5	NS	NS	1.1 U	0.76 U	5.00 U	5.00 U	NS	NS	NS	NS
Calcium		NS	NS	86,500	165,000	140,000	149,000	NS	NS	NS	NS
Chromium	50	NS	NS	1.5 B	NA	5.00 UJ	NA	NS	NS	NS	NS
Cobalt		NS	NS	1.8 U	NA	20.0 U	NA	NS	NS	NS	NS
Copper	200	NS	NS	4.3 U	NA	10.0 U	NA	NS	NS	NS	NS
Iron	300	NS	NS	**4,680**	**3,670**	**1,600**	**26,800**	NS	NS	NS	NS
Lead	25	NS	NS	3 U	3 U	3.00 UJ	4.23	NS	NS	NS	NS
Magnesium		NS	NS	5,360	9,610	8,790	10,700	NS	NS	NS	NS
Manganese	300	NS	NS	**509**	**967**	**423**	**1,190**	NS	NS	NS	NS
Nickel	100	NS	NS	2.8 B	NA	30.0 U	NA	NS	NS	NS	NS
Potassium		NS	NS	1,020 J	1,390	5,610	6,540	NS	NS	NS	NS
Selenium	10	NS	NS	NS	NA	**15.3 J**	NA	NS	NS	NS	NS
Sodium	20,000	NS	NS	5,870	**24,600**	**35,900 J**	**57,400**	NS	NS	NS	NS
Thallium	4	NS	NS	NS	NA	**11.0**	NA	NS	NS	NS	NS
Vanadium		NS	NS	1.5 U	NA	30.0 U	NA	NS	NS	NS	NS
Zinc		NS	NS	11 U	NA	13.2 UJ	NA	NS	NS	NS	NS

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	11/02/05	07/20/06	01/03/07	09/26/07	12/05/07	10/29/08	12/09/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		NS	NS	257	462	430	490	NS	NS	NS	NS
Ammonia Nitrogen (mg/l)	2	NS	NS	**2.1**	1.2	**5.86**	**9.78**	NS	NS	NS	NS
BOD (mg/l)		NS	NS	8.2	2.8	22	10	NS	NS	NS	NS
Bromide (mg/l)	2	NS	NS	0.024 B	0.026 B	2.0 U	1.0 U	NS	NS	NS	NS
COD (mg/l)		NS	NS	3.91 B	2.8 B	20 U	20 U	NS	NS	NS	NS
Chloride (mg/l)	250	NS	NS	11.3	47.4	78.7	50.2	NS	NS	NS	NS
Color	15	NS	NS	**50**	NA	**1050**	NA	NS	NS	NS	NS
Cyanide, Total	0.2	NS	NS	10 U	NA	10.0 UJ	NA	NS	NS	NS	NS
Hardness (mg/l)		NS	NS	238	452	385	416	NS	NS	NS	NS
Hexavalent Chromium		NS	NS	0.01 U	NA	0.010 U	NA	NS	NS	NS	NS
Nitrate Nitrogen (mg/l)	10	NS	NS	0.684	0.079 B	0.471	2.16	NS	NS	NS	NS
Phenols (mg/l)	0.001	NS	NS	**0.005 B**	0.005 U	0.005 U	0.005 U	NS	NS	NS	NS
Sulfate (mg/l)	250	NS	NS	3.32	4.14	20.0 U	20.0 U	NS	NS	NS	NS
Total Dissolved Solids (mg/l)		NS	NS	260	520	587	640	NS	NS	NS	NS
Total Kjeldahl Nitrogen (mg/l)		NS	NS	2.87	1.43	8.17	10.4	NS	NS	NS	NS
Total Organic Carbon (mg/l)		NS	NS	2	2.8	3.0 U	3.0 U	NS	NS	NS	NS

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MW-9S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	11/01/10	11/09/11	11/9/2011**	12/30/11	12/30/2011**	07/22/14
VOLATILE COMPOUNDS (µg/L)								
1,1,2-Trichloroethane	1	NS	NS	5 U	NA	NA	NA	1.5 U
Benzene	1	NS	NS	5 U	NA	NA	NA	2.5 U
Chlorobenzene	5	NS	NS	5 U	NA	NA	NA	2.5 U
Methylene Chloride	5	NS	NS	5 U	NA	NA	NA	2.5 U
Trichloroethene	5	NS	NS	5 U	NA	NA	NA	0.5 U

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	11/01/10	11/09/11	11/9/2011**	12/30/11	12/30/2011**	07/22/14
INORGANIC PARAMETERS (µg/L)								
Aluminum		NS	NS	7890	100 RU	NA	NA	967
Antimony	3	NS	NS	5 U	5 RU	NA	NA	0.13 J
Arsenic	25	NS	NS	5 U	5 RU	NA	NA	0.26 J
Barium	1,000	NS	NS	52.6	50 RU	NA	NA	11.36
Boron	1,000	NS	NS	500 U		NA	NA	16.0 J
Cadmium	5	NS	NS	5 U	5 RU	5 U	5 U	0.20 U
Calcium		NS	NS	17,700	37900 R	90300	120000	58,000
Chromium	50	NS	NS	18.3	10 RU	NA	NA	2.28
Cobalt		NS	NS	20 U	20 RU	NA	NA	0.54
Copper	200	NS	NS	10.8	10 RU	NA	NA	1.53
Iron	300	NS	NS	**11,000**	60 RU	**3390**	60 U	**1,240**
Lead	25	NS	NS	3 U	3 RU	3 U	3 U	0.52 J
Magnesium		NS	NS	5000 U	5000 RU	5730	7190	3,300
Manganese	300	NS	NS	**316 J**	12.5 R	**346**	**496**	32.38
Nickel	100	NS	NS	30 U	30 RU	NA	NA	2.22
Potassium		NS	NS	5000 UJ	5000 RU	5000 U	5000 U	1,180
Selenium	10	NS	NS	3 U	3 RU	NA	NA	0.48 J
Sodium	20,000	NS	NS	5000 UJ	5000 **RU**	6630	10200	5,160
Thallium	4	NS	NS	3 U	3 RU	NA	NA	0.50 U
Vanadium		NS	NS	30 U	30 RU	NA	NA	1.34 J
Zinc		NS	NS	12.6 UJ	34.8 R	NA	NA	5.62 J

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	NYSDEC Class	SAMPLING DATE						
	GA Standards	07/01/10	11/01/10	11/09/11	11/9/2011**	12/30/11	12/30/2011**	07/22/14
CONVENTIONAL PARAMETERS								
Alkalinity (mg/l)		NS	NS	270 J	NA	320	NA	240
Ammonia Nitrogen (mg/l)	2	NS	NS	0.5 U	NA	0.563	NA	0.358
BOD (mg/l)		NS	NS	4 U	NA	4 U	NA	2.00 U
Bromide (mg/l)	2	NS	NS	8 U	NA	8 U	NA	0.021 J
COD (mg/l)		NS	NS	20 U	NA	20 U	NA	19.0
Chloride (mg/l)	250	NS	NS	12.1	NA	18.8	NA	16.2
Color	15	NS	NS	**220**	NA	NA	NA	12.0
Cyanide, Total	0.2	NS	NS	10 U	NA	NA	NA	0.003 J
Hardness (mg/l)		NS	NS	44.1	NA	249	NA	160 U
Hexavalent Chromium		NS	NS	0.01 U	NA	NA	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	NS	NS	0.305	NA	0.437	NA	0.43
Phenols (mg/l)	0.001	NS	NS	0.005 RU	NA	0.005 U	NA	**0.01 J**
Sulfate (mg/l)	250	NS	NS	5 U	NA	5 U	NA	5.97
Total Dissolved Solids (mg/l)		NS	NS	210	NA	370	NA	310
Total Kjeldahl Nitrogen (mg/l)		NS	NS	3.84	NA	2.09	NA	0.42
Total Organic Carbon (mg/l)		NS	NS	3 U	NA	3 U	NA	2.74

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J = Concentration is an estimated value

NA = Parameter not analyzed

NA* = Results not available due to lab scheduling error

** Filtered sample

R = Rejected by data validator

TABLE 1
MW-10D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
Acetone	50	10 U	NS	NA	NS	NS	NA	10 U	NS	10 U	NA
Chloromethane	5							10 U		10 U	
Methylene Chloride	5	3 JB	NS	NA	NS	NS	NA	5 U	NS	5 U	NA

NOTES:

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

N = Spiked sample recovery not within control limits

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
Barium	1,000	19.7 B	NS	NA	NS	NS	NA	14.3 B	NS	23.9 B	NA
Boron	1,000	74.3	NS	NA	NS	NS	NA	27.8 B	NS	NA	NA
Cadmium	5	0.4 U	NS	0.5 U	NS	NS	1 U	1.9 JB	NS	1.2 B	1 U
Calcium		104,000 0	NS	90,000 0	NS	NS	56,700	87,400	NS	89,400	114,000
Copper	200	35.7	NS	NA	NS	NS	NA	1 U	NS	1.1 B	NA
Iron	300	269 0	NS	34 U	NS	NS	12 U	10.7 B	NS	30.0 U	52.2 B
Lead	25	1.5 U	NS	2 B	NS	NS	1 U	2 U	NS	2.1 B	3 U
Magnesium		8,890 0	NS	7,950 0	NS	NS	21,300	7,490	NS	7,530	9,710
Manganese	300	11.5 B	NS	7.9 B	NS	NS	56.8	4.5 B	NS	23.3	18
Potassium		1,070 U	NS	835 B	NS	NS	2,020 BE	758 B	NS	993 B	793 B
Selenium	10	3.2 U	NS	NA	NS	NS	NA	3.0 U	NS	R	NA
Sodium	20,000	5,950 0	NS	6,060 0	NS	NS	11,400	3,440 B	NS	2,890 B	2,780 B
Thallium	4	2.1 U	NS	NA	NS	NS	NA	6.0 UN	NS	3.0 U	NA
Zinc		24	NS	NA	NS	NS	NA	10.2 B	NS	5.0 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Concentration is less than the CRQL and greater than the IDL

J or E = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

E = Reported value is estimated because of the presence of interference

R = Rejected- Data qualified as unusable

+/- = Additionally estimated

CONVENTIONAL PARAMETERS

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
Alkalinity (mg/l)		268 0	NS	214 0	NS	NS	220	227	NS	275	286
Ammonia Nitrogen (mg/l)	2	0.05 U	NS	0.05 U	NS	NS	0.04 U	0.0840 J	NS	0.629	0.29
BOD (mg/l)		3 U	NS	4 U	NS	NS	2 U	2.67	NS	2.00 U	2 U
Bromide (mg/l)	2	0.1 U	NS	0.43 0	NS	NS	2 U	2 U	NS	2.00 U	2 U
COD (mg/l)		3 U	NS	3 U	NS	NS	10 U	10.0 U	NS	10.0 U	
Chloride (mg/l)	250	1 U	NS	6.01 0	NS	NS	3 U	3.18	NS	3.65	3 U
Color	15	**40**	NS	NA	NS	NS	NA	5 U	NS	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS	NA	NS	NS	NA	0.0100 J	NS	0.0100 J	NA
Hardness (mg/l)		297 0	NS	257 0	NS	NS	229	249	NS	254	325
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS	NA	NS	NS	NA	0.0100 U	NS	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.04 U	NS	3.26 0	NS	NS	0.983	1.37	NS	1.09	4.82
Phenols (mg/l)	0.001	**0.02 0**	NS	**0.03 0**	NS	NS	**0.021**	**0.0150**	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	22.2 0	NS	12.9 0	NS	NS	11.1	13.2	NS	14.6	21.6
Total Dissolved Solids (mg/l)		319 0	NS	219 0	NS	NS	264	255	NS	302	350
Total Kjeldahl Nitrogen (mg/l)		0.2 0	NS	0.6 0	NS	NS	0.177	0.321 J	NS	0.809	.603
Total Organic Carbon (mg/l)		1 U	NS	3.23 0	NS	NS	1.86	1.12	NS	1.00 U	3.27

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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TABLE 1
MW-10D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		05/19/00	10/03/00	10/29/01	12/05/01	10/28/02	12/10/02	09/17/03	11/05/03	05/04/04	10/13/04
Acetone	50	NA	5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Chloromethane	5		2 J	10 U	NA	5 U	NA	NA	5 U	5 U	NA
Methylene Chloride	5	NA	2 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

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NA = Parameter not analyzed

NS = Monitoring well not sampled

N = Spiked sample recovery not within control limits

	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		05/19/00	10/03/00	10/29/01	12/05/01	10/28/02	12/10/02	09/17/03	11/05/03	05/04/04	10/13/04
Barium	1,000	NA	20.6 B	22 B	22 B	26.8	NA	NA	18.9	17	NA
Boron	1,000	NA	26.8 B	50 U	50 U	50 U	NA	NA	27 U		
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		90,300	108,000	110,000	98,300	112,000	130,000	110,000	104,000	98,100	48,500
Copper	200	NA	1.0 U	1.5 U	1.5 U	2.7 B	NA	NA	2.6 U	4.3 U	NA
Iron	300	7.2 U	10.0 U	16.4 U	63.5 U	85.3 U	**4,640**	286	53 U	62.1	261
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	4.5 B	3.6 U	3.6 U	3 U	5.1 B
Magnesium		7,950	9,400	9,250	8,350	9,910	11,900	9,310	9,270	8,350	17,900
Manganese	300	6.3 B	5.2 B	6.0 B	6.9 B	4.1 B	**417**	109	22.6	6.9 U	257
Potassium		837 B	1,050 B	1,040 B	1,040	918	2,940	762	643	778	1290
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		
Sodium	20,000	3,120 BE	3,090 B	4,320 B	3,870	3,420 J	4,260	3,170	3,340 E	4,190	9,160
Thallium	4	NA	6.0 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ		
Zinc		NA	5.2 B	4.9 U	4.9 U	16.2 U	NA	NA	11 U	28.3	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		05/19/00	10/05/00	10/29/01	12/05/01	10/28/02	12/10/02	09/17/03	11/05/03	05/04/04	10/13/04
Alkalinity (mg/l)		264	272	290	293	309	300	296	288	277	198
Ammonia Nitrogen (mg/l)	2	0.04 U	0.04 U	0.044	0.069	0.087	0.04 U	0.036 B	0.08	0.04 U	0.46
BOD (mg/l)		2 U	2.0 U	2 U	2 U	1.5 B	3	0.69 B	2 U	0.24 B	0.24 B
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.029 B
COD (mg/l)			10 U	10 U	10 U	10 U	5.96 B	10 U	10 U	10 U	27.2
Chloride (mg/l)	250	3.67	1.56	3.82	4.9	2.1	4.3	4	5.29	6.27	5.23
Color	15	NA	5.0 U	5 U	5 U	5 U	NA	NA	5 U	5 U	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		258	308	313	280	320	374	313	298	279	195
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	1.19	0.694	0.391	0.49	0.48	0.47	0.33	0.265	0.215	0.524
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	**0.002 B**	**0.013**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	17.1	15.0	11.3	11	12	12	12	10.6	11	11
Total Dissolved Solids (mg/l)		313	307	329	320	340	330	330	330	300	200
Total Kjeldahl Nitrogen (mg/l)		0.15	0.11	0.2	0.069	0.1 U	0.569	0.171	0.103	0.318	0.547
Total Organic Carbon (mg/l)		4.45	1.0 U	4.08	3.5	0.58 B	2.4	2.6	0.46 B	0.63 B	1.1

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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R = Rejected by data validator

TABLE 1
MW-10D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Chloromethane	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

N = Spiked sample recovery not within control limits

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	07/14/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Barium	1,000	15.9	NA	16	NA	50.0 U	NA	50.0 U	NA	50.0 U	NA
Boron	1,000				NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		94,100	104,000	90,800	103,000	77,500	79,700	99,700 J	88,500	106,000	85,300
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10.00 U	NA
Iron	300	54 U	**358**	54 U	77.4 B	60.0 U	130	68 J	63.5	280 J	71.4
Lead	25	3 U	3 U	3 U	3 U	3.00 UJ	3 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		8,390	8,410	7,560	8,740	6,940	6,770	8,930	8,010	9,570	7,720
Manganese	300	6.9 U	78.2	6.9 U	4.2 B	12.3	22.8	43.1 UJ	17.2	64.7	10.0 U
Potassium		705	4,220	769 J	750	1,000 U	1,060	1,120	1,000 U	1,010 J	5,000 U
Selenium	10					**18.1 J**	NA	5.00 U	NA	5.00 U	NA
Sodium	20,000	3,910 J+	5,630	2,710	5,000	7,100 J	5,650	3,140	1,890	4,460	5,000 U
Thallium	4	10 UJ-	10 UJ-	10 UJ-		**11.3**	NA	10.0 U	NA	10.0 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	16.6 J	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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R = Rejected- Data qualified as unusable

+/- = Additionally estimated

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/09/08	07/14/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		263	253	245	282	270	270	260	260	230	250
Ammonia Nitrogen (mg/l)	2	0.04 U	0.6	0.04 U	0.022 B	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		2 U	6.7	2 U	0.64 B	4 U	4 U	4.0 U	4.0 U	4.0 U	4.0 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.024 B	0.1 U	0.2 U	1 U	2.0 U	0.20 U	0.20 U	2.00 U
COD (mg/l)		10 U	6.05 B	10 U	3.75 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	7.52	8.93	3.49	7.62	4.24	7.64	4.91	4.94	2.8	2.93
Color	15	5 U	NA	5	NA	8.00	NA	5.00 U	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		270	294	258	293	222	227	286	254	305	245
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.13	0.625	0.275	0.268	0.647 J	0.685	2.13	2.24	1.75	1.98
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.003 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	11.2	12.3	10.3	10.7	8.15	8.11	10.8	6.76	9.19	10.6
Total Dissolved Solids (mg/l)		280	300	260	310	257	322	302	240	290	260
Total Kjeldahl Nitrogen (mg/l)		0.175	4.67	0.0734 B	0.1 U	0.5 U	0.5 U	0.500 U	0.500 U	0.500 U	0.500 U
Total Organic Carbon (mg/l)		0.61 B	7.2	1.4	2.2	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Rejected by data validator

TABLE 1
MW-10D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Acetone	50	10 U	NA	10 U	NA	NS
Chloromethane	5	5 U	NA	5 U	NA	NS
Methylene Chloride	5	5 U	NA	5 U	NA	NS

NOTES:
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
N = Spiked sample recovery not within control limits

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Barium	1,000	50.0 U	NA	50.0 U	NA	NS
Boron	1,000	500 U	NA	500 U	NA	NS
Cadmium	5	5.00 U	5.00 U	5.00 U	5.00 U	NS
Calcium		94,000	88,500	82,000	88,300	NS
Copper	200	10.0 U	NA	10.0 U	NA	NS
Iron	300	60.0 U	60.0 U	71.5	60.0 U	NS
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	NS
Magnesium		8,620	7,680	7,230	7,310	NS
Manganese	300	42.6 U	10.0 U	16.8 J	39.9	NS
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	NS
Selenium	10	3.00 U	NA	3.00 U	NA	NS
Sodium	20,000	5,000 U	5,000 U	5,000 UJ	5000.00 U	NS
Thallium	4	3.0 U	NA	3.0 U	NA	NS
Zinc		12.3 J	NA	10 UJ	NA	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
B = Concentration is less than the CRQL and greater than the IDL
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NA = Parameter not analyzed
NS = Monitoring well not sampled
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R = Rejected- Data qualified as unusable
+/- = Additionally estimated

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		250	210	240 J	270	NS
Ammonia Nitrogen (mg/l)	2	0.500 U	0.500 U	0.500 U	0.500 U	NS
BOD (mg/l)		4.0 U	4.0 U	4.0 UJ	4.0 U	NS
Bromide (mg/l)	2	0.8 UJ	0.8 U	0.8 UJ	0.8 U	NS
COD (mg/l)		20 U	20 U	20 U	20 U	NS
Chloride (mg/l)	250	2.58	3.61	5.34	4.67	NS
Color	15	5.00 U	NA	11.00	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 U	NA	10 U	NA	NS
Hardness (mg/l)		270	253	235	250	NS
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.010 U	NA	NS
Nitrate Nitrogen (mg/l)	10	1.36	2.91	0.487	0.485	NS
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	9.28	5.13	10.9	8.7	NS
Total Dissolved Solids (mg/l)		240	270	480	300	NS
Total Kjeldahl Nitrogen (mg/l)		0.500 U	0.500 U	1.010 J	0.500 U	NS
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.0 U	3.0 U	NS

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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TABLE 1
MW-11D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	NA	NA	NA	NA	10 U		10 U	
Acrylonitrile	5							35 U		35 U	
Chloroform	7							5 U		5 U	
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	6.0 U	NA	64.2 B	NA
Antimony	3	3.9 U						5.0 U	NA	4.4 B	
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.0 U	NA	3.6 B	NA
Barium	1,000	18.4 B	NA	NA	NA	NA	NA	19.4 B	NA	16.9 B	NA
Boron	1,000	74.3	NA	NA	NA	NA	NA	28.6 B	NA	NA	
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	1.6 JB	1.0 U	1.0 U	1 U
Calcium		108,000 0	106,000 0	96,600 0	84,600	92,500 0	106,000 0	100,000	93,500	83,300	108,000
Chromium	50	2.1 B	NA	NA	NA	NA	NA	1.7 B	NA	2.8 B	NA
Cobalt		0.8 U						2.0 U	NA	2.0 U	
Copper	200	30.3	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	NA
Iron	300	74.3 B	69 B	71 B	15.3 U	7 U	14.9 B	12.7 B	**723**	275 *	88.4 B
Lead	25	1.5 U	2.3 B	1.6 U	1.9 U	1 U	1 U	2.0 U	2 U	2.0 U	3 U
Magnesium		10,800 0	12,800 0	11,700 0	9,970	10,300 0	12,400 0	11,700	10,100	8,860	11,300
Manganese	300	4.5 B	5.3 B	5.4 B	0.6 U	7 U	1 U	1 U	4.1 B	5.7 B	9 B
Mercury	2	0.2 U						0.10 U	NA	0.10 U	
Nickel	100	1.2 U	NA	NA	NA	NA	NA	5.0 U	NA	3.2 B	NA
Potassium		1,070 U	2,380 B	1,020 B	836 B	961 BE	1,050 B	981 B	855 B	832 B	1,200 B
Selenium	10	3.2 U						3.0 U	NA	4.0 U	
Sodium	20,000	6,400 0	5,700 0	4,970 B	3,680 B	5,010 E	4,770 B	3,840 B	3,190 B	2,590 B	2,920 B
Vanadium		1 U						1.0 U	NA	2.0 U	
Zinc		25	NA	NA	NA	NA	NA	38.8	NA	23.7	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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J = Concentration is an estimated value

NA = Parameter not analyzed

* Duplicate analysis not within control limits

N = Spiked sample recovery not within control limits

+/- = Additionally estimated

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		217 0	239 0	226 0	226	239 0	240 0	232	234	255	263
Ammonia Nitrogen (mg/l)	2	0.073 0	0.05 U	0.05 U	0.05 U	0.04 U	0.041 0	0.04 U	0.04 U	0.0400 U	.064
BOD (mg/l)		3 U	4 U	4 U	3.7 U	2 U	2.7 0	2 U	4	2.00 J	2 U
Bromide (mg/l)	2	0.538 0	0.52 0	0.58 0	0.36	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		3 U	13.2 0	3 U	3 U	10 U	10 U	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	1 U	4.66 0	2.19 0	3 U	3.6 0	3 U	3 U	3 U	3.02	3 U
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U						0.01 U	NA	0.0100 U	
Hardness (mg/l)		315 0	317 0	334 0	252	276 0	316 0	298	275	244	316
Hexavalent Chromium (mg/l)	0.05	0.01 U						0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	3.4 0	1.69 0	3.21 0	1.3	1.31 0	1.93 0	1.97	2.35	0.100 U	3.32
Phenols (mg/l)	0.001	**0.02 0**	**0.025 0**	**0.02 0**	0.005 U	**0.02 0**	**0.019 0**	**0.0130**	0.01 U	0.0500 U	.05 U
Sulfate (mg/l)	250	64.3 0	47.8 0	81.6 0	28.3	21.4 0	54.2 0	43.3	31.5	25.2	36
Total Dissolved Solids (mg/l)		316 0	316 0	250 0	230	302 0	292 0	295	281	NA*	340
Total Kjeldahl Nitrogen (mg/l)		0.21 0	0.18 0	0.65 0	1.22	0.128 0	0.112 0	0.182 J	0.32	1.90	.214
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.3	1 U	2.38 0	1.36	2.19	NA	4.22

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling error.

R = Rejected by data validator

TABLE 1
MW-11D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Acetone	50		10 U	15	NA	10 U	NA	NA	10 U	10 U	NA
Acrylonitrile	5		35 U	35 U	NA	10 U	NA	NA	5 U	10 U	NA
Chloroform	7		5 U	5 U	5 U	5 U	5 U	5 U	5 U		
Methylene Chloride	5	NA	5 U	0.7 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	36.4 B	32.5 B	32.5 B	234 B	NA	NA	1,120	518	NA
Antimony	3		5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U	3.9 U	NA
Barium	1,000	NA	23.0 B	20.2 B	20.2 B	24.3	NA	NA	30.5	22.6	NA
Boron	1,000		22.2 U	50 U	50 U	50 U	NA	NA	27 U		
Cadmium	5	0.21 B	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		98,500	112,000	99,000	98,600	102,000	105,000	92,900	115,000	95,200	102,000
Chromium	50	NA	2.8 B	0.9 U	0.9 U	2 B	NA	NA	3.8 B	1.4	NA
Cobalt			1.0 U	1.2 U	1.2 U	1.5 U	NA	NA	2 B	1.8 U	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	3.4 B	NA	NA	4 B	4.3 U	NA
Iron	300	96.7 B	146	84.5 B	**524**	**475**	**929**	**1,270**	**2,800**	**693**	247
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		10,300	13,900	11,300	10,700	12,400	12,200	11,600	14,100 NJ	11,700	11,600
Manganese	300	2.5 B	5.5 B	4.8 B	15.7 B	14.7 B	31.6	26	85.8	**2,750**	30.1
Mercury	2		0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	1.9	1.9
Nickel	100	NA	1.9 B	1.4 B	1.4 B	1.9 U	NA	NA	3.8 B	1.9 U	NA
Potassium		606 B	1,240 B	1,170 B	1,420	1,620	1,830	1,150	1,290 NJ	1,140	1,200
Selenium	10		5.0 U	6.1 N	6.1 N	6.9 U	NA	NA	5 U		
Sodium	20,000	2,720 B	3,110 B	3,280 B	3,500	3,420 J	3,380	2,590	2,930 NJ	3,210	3,130
Vanadium			1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	3.8 B	1.5 U	NA
Zinc		NA	7.4 B	6.8 B	6.8 B	16.2 U	NA	NA	11 U	11 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J = Concentration is an estimated value

NA = Parameter not analyzed

* Duplicate analysis not within control limits

N = Spiked sample recovery not within control limits

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	NYSDEC Class GA Standards	SAMPLING DATE 05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		256	245	260	274	272	290	254	258	305	256
Ammonia Nitrogen (mg/l)	2	0.04 U	0.04 U	0.04 U	0.061	0.049	0.043	0.088	0.039 B	0.036 B	0.1
BOD (mg/l)		2 U	2.0 U	2 U	2 U	2 U	1.4 B	2.8	2 U	0.24 B	0.36 B
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.026 B	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	10.0 U	10 U	4.25 B	10 U	10 U	10 U	10 U	10 U	10 U
Chloride (mg/l)	250	1.32	0.739	2.12	3.2	1.2	1.9	1.5	1.7	1.9	2.48
Color	15	NA	5.0 U	5	5	10	NA	NA	**250**	**20**	NA
Cyanide, Total (mg/l)	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		288	339	294	290	306	312	280	345	286	302
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	2.09	1.21	0.792	0.81	0.98	0.83	0.56	0.54	0.4	0.55
Phenols (mg/l)	0.001	**0.005**	0.005 U	0.005 U	**0.014**	0.005 U	**0.003 B**	**0.015**	**0.009**	0.005 U	0.005 U
Sulfate (mg/l)	250	31.7	50	25.2	24	38	34	31	27.7	22.7	19.4
Total Dissolved Solids (mg/l)		3,320	312	332	310	340	330	340	310	320	260
Total Kjeldahl Nitrogen (mg/l)		0.1 U	0.1 U	0.12	0.146	0.073 B	0.153	0.0432 B	0.149	0.291	0.163
Total Organic Carbon (mg/l)		2.25	15.4	4.35	1.4	0.45 B	0.74 B	2.4	2	0.67 B	0.81 B

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling

R = Rejected by data validator

TABLE 1
MW-11D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/08/08	08/05/09	10/26/09
VOLATILE COMPOUNDS (µg/L)											
Acetone	50	10 U	NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA
Acrylonitrile	5	10 U	NA	10 U	NA	100 UJ	NA	100 UJ	NA	100 U	NA
Chloroform	7										
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/08/08	07/14/09	10/26/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		1,180	NA	340 B	NA	100 UJ+	NA	135	NA	219	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	3.9 U	NA	4.5 B	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	32.8	NA	23.1	NA	50.0 U	NA	50.0 U	NA	50 U	NA
Boron	1,000					500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		119,000	98,800	97,300	102,000	74,300	8,090	94,300 J	83,600	102,000	83,100
Chromium	50	6.4 B	NA	1.3 U	NA	5.00 UJ	NA	5.00 U	NA	5 U	NA
Cobalt		1.8 U	NA	1.8 U	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**2,800**	**2,380**	**808**	**468**	107	155	**341 J**	60.0 U	**413**	60 U
Lead	25	3 U	3 U	3 U	3 U	3.00 UJ	5.39	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		13,800	10,800	12,000	12,200	9,350	1,000 U	11,500	9,970	12,400	10,200
Manganese	300	105	60.9	36.6	13.3 B	10.0 U	10 U	12.0 UJ	10.0 U	10.0 U	10.0 U
Mercury	2					0.2 U	NA	0.200 U	NA	0.20 U	NA
Nickel	100	5.5 B	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30.0 U	NA
Potassium		1,140	1,460	1,180 J	1,260	1,000 U	52,300	1,000 U	1,020	1,000 UJ	5,000 U
Selenium	10					**16.1 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	3,510 J+	3,080 N	2,620	2,740	2,600 J	11,300	2,630	1,690	3,320	5,000 U
Vanadium		3.7 B	NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	11.2 J	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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* Duplicate analysis not within control limits

N = Spiked sample recovery not within control limits

+/- = Additionally estimated

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/20/05	10/31/05	07/20/06	01/03/07	09/25/07	12/04/07	10/28/08	12/08/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		267	268	263	146	260	120	250	260	240	250
Ammonia Nitrogen (mg/l)	2	0.017 B	0.04 U	0.04 U	0.086	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		2.8	2.1	0.78 B	1.9 B	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.026 B	0.1 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
COD (mg/l)		10 U	3.8 B	10 U	1.85 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	1.97	3.56	1.89	3.55	1.75	3.66	2.93	3.55	2.47	1.99
Color	15	10	NA	**50**	NA	8.00	NA	5.00 U	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		354	291	292	305	224	20.2	283	250	306	250
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.65	0.715	1	4.17	0.529	2.65	0.776	0.748	1.07	0.794
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.003 B**	**0.015**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	20	16.7	22.9	143	12.0	15.9	14.9	9.3	24.2	21.2
Total Dissolved Solids (mg/l)		300	320	320	360	312	255	297	277	340	300
Total Kjeldahl Nitrogen (mg/l)		0.277	0.1 U	0.0914 B	0.318	0.500 U	0.005 U	0.500 U	0.500 U	0.5 U	0.500 U
Total Organic Carbon (mg/l)		0.57 B	1.2	2.9	4.1	3.0 U	3.0 U	3.0 U	3.0 U	3 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling

R = Rejected by data validator

TABLE 1
MW-11D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Acetone	50	10 U	NS	10 U	NA	NS
Acrylonitrile	5	100 U	NS	100 U	NA	NS
Chloroform	7			16	NA	NS
Methylene Chloride	5	5 U	NS	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NS	100 U	NA	NS
Antimony	3	5 UJ	NS	5 U	NA	NS
Arsenic	25	5 UJ	NS	5 U	NA	NS
Barium	1,000	50.0 U	NS	50.0 U	NA	NS
Boron	1,000	500 U	NS	500 U	NA	NS
Cadmium	5	5.00 U	NS	5.00 U	5.00 U	NS
Calcium		93,700	NS	84,800	95,200	NS
Chromium	50	10.0 U	NS	10.0 U	NA	NS
Cobalt		20.0 U	NS	20.0 U	NA	NS
Copper	200	10.0 U	NS	10.0 U	NA	NS
Iron	300	100	NS	154	266	NS
Lead	25	3.0 U	NS	3.0 U	3.0 U	NS
Magnesium		11,600	NS	10,100	9,690	NS
Manganese	300	16.4	NS	10 UJ	13.9	NS
Mercury	2	0.20 U	NS	0.20 U	NA	NS
Nickel	100	30.0 U	NS	30.0 U	NA	NS
Potassium		5,000 U	NS	5,000 UJ	5,000 U	NS
Selenium	10	3.0 U	NS	3.0 U	NA	NS
Sodium	20,000	5,000 U	NS	5,000 UJ	5,000 U	NS
Vanadium		30.0 U	NS	30.0 U	NA	NS
Zinc		21.5 J	NS	10 UJ	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J = Concentration is an estimated value

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* Duplicate analysis not within control limits

N = Spiked sample recovery not within control limits

+/- = Additionally estimated

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/06/10	11/02/10	11/09/11	12/30/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		260	NS	250 J	290	NS
Ammonia Nitrogen (mg/l)	2	0.500 U	NS	0.500 U	0.5 U	NS
BOD (mg/l)		4.00 U	NS	4.00 UJ	4 U	NS
Bromide (mg/l)	2	0.80 U	NS	8.00 UJ	0.8 U	NS
COD (mg/l)		20 U	NS	20 U	20.0 U	NS
Chloride (mg/l)	250	1.86	NS	3.05	3.67	NS
Color	15	8.00	NS	6	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 U	NS	10 U	NA	NS
Hardness (mg/l)		282	NS	253	278	NS
Hexavalent Chromium (mg/l)	0.05	0.010 U	NS	0.010 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.795	NS	0.437	0.5	NS
Phenols (mg/l)	0.001	0.005 U	NS	0.005 RU	0.0 U	NS
Sulfate (mg/l)	250	21.8	NS	14.6	14.6	NS
Total Dissolved Solids (mg/l)		280	NS	420	290.0	NS
Total Kjeldahl Nitrogen (mg/l)		0.500 U	NS	0.955 J	0.5 U	NS
Total Organic Carbon (mg/l)		3.0 U	NS	3.0 U	3.0 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling

R = Rejected by data validator

TABLE 1
MW-11S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	154 B	NA	1,220	NA
Barium	1,000	27.5 B	NA	NA	NA	NA	NA	5.8 B	NA	9.8 B	NA
Beryllium	3	0.1 U	NA	NA	NA	NA	NA	1.0 U	NA	1.0 U	NA
Boron	1,000	22.3 B	NA	NA	NA	NA	NA	15.7 B	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	2.3 JB	1 U	1.8 B	1 U
Calcium		38,500 0	49,800 0	59,000 0	43,900	54,900 0	64,500 0	50,400	36,400	43,800	54,400
Chromium	50	1.3 B	NA	NA	NA	NA	NA	1.1 B	NA	1.6 B	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2.0 U	NA	2.0 U	NA
Copper	200	14.7 B	NA	NA	NA	NA	NA	1 U	NA	3.6 B	NA
Iron	300	108 0	165 0	**871 0**	57 B	198 0	170 0	215	**1,420**	**1,800**	**2,730**
Lead	25	1.5 U	2.2 B	1.6 U	1.9 U	1 U	1 U	2.9 B	5.3	2.0 U	3 U
Magnesium		5,450 0	7,180 0	8,120 0	5,670	7,300 0	8,620 0	6,380	4,280 B	5,900	7,110
Manganese	300	11.2 B	13.8 B	36.1 0	4.8 B	14.4 B	11.1 B	7.1 B	42.4	49.1	92.4
Mercury	2	0.2 U	NA	NA	NA	NA	NA	0.1 U	NA	0.10 U	
Nickel	100	1.2 U	NA	NA	NA	NA	NA	5 U	NA	3.0 U	
Potassium		4,400 B	4,320 B	1,900 B	1,490 B	1,470 BE	1,980 B	1,240 B	880 B	1,170 B	1,420 B
Selenium	10	3 U	NA	NA	NA	NA	NA	3 U	NA	R	NA
Sodium	20,000	3,280 B	3,720 B	4,190 B	2,880 B	3,570 BE	3,540 B	2,920 B	2,140 B	2,180 B	2,750 B
Vanadium		1 U	NA	NA	NA	NA	NA	1 U	NA	2.3 B	NA
Zinc		16 B	NA	NA	NA	NA	NA	22.6	NA	5.0 U	NA

NOTES:
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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		76 0	84.7 0	112 0	94	127 0	134 0	108	83.5	120	125
Ammonia Nitrogen (mg/l)	2	0.05 U	0.05 U	0.05 U	0.05 U	0.04 U	0.04 U	0.0460 J	0.065	0.0400 U	0.04 U
BOD (mg/l)		3 U	4 U	4 U	3.7 U	2 U	2.1 0	2 U	2 U	2.00 U	
Bromide (mg/l)	2	0.298 0	0.14 0	0.24 0	0.1 U	2 U	2 U	2 U	2 U	2.00 U	2 U
COD (mg/l)		10.1 0	3 U	3 U	3 U	10 U	15.3 0	10 U	10 U	10.0 U	10 U
Chloride (mg/l)	250	2.13 0	10.3 0	10.7 0	8.69	3 U	3 U	3.88	3 U	3.00 U	3.19
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	10	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 J	NA
Hardness (mg/l)		118 0	154 0	181 0	133	164 0	197 0	152	109	134	165
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	6.6 0	7.15 0	**10.1 0**	7.1	2.4 0	1.57 0	2.80	**11.1**	2.50	1.55
Phenols (mg/l)	0.001	**0.02 0**	**0.039 0**	**0.024 0**	**0.009**	**0.008 0**	**0.017 0**	**0.0140**	**0.018**	0.0500 U	0.05 U
Sulfate (mg/l)	250	13.8 0	13 0	15.1 0	12.1	28.5 0	37.9 0	22.7	15.8	27.0	22.8
Total Dissolved Solids (mg/l)		131 0	352 0	165 0	137	200 0	160 0	157	96.0	187	185
Total Kjeldahl Nitrogen (mg/l)		0.17 0	0.39 0	0.52 0	1.66	0.245 0	0.122 0	0.197 J	0.234	0.255	.145
Total Organic Carbon (mg/l)		1 U	1 U	1.4 0	1.36	1 U	2.27 0	1 U	1.47	1.08	2.55

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
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TABLE 1
MW-11S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	5 U	1 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	991	3,450	3,450	83.3 U	NA	NA	8,950	3,990	NA
Barium	1,000	NA	15.0 B	18.1 B	18.1 B	93.6	NA	NA	59.2	29.1	NA
Beryllium	3	NA	0.5 U	0.5 U	0.5 U	1 U	NA	NA	0.64 U	0.54 U	NA
Boron	1,000	NA	13.7 B	50 U	50 U	275	NA	NA	27 U	27 U	NA
Cadmium	5	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		23,100	41,000	33,000	35,100	35,700	30,100	45,300	40,800	29,200	38,800
Chromium	50	NA	1.3 B	4.2 B	4.2 B	1.5 U	NA	NA	19	6.6	NA
Cobalt		NA	1.0 B	2.1 B	2.1 B	1.5 U	NA	NA	7 B	2.7	NA
Copper	200	NA	2.3 B	6.9 B	6.9 B	2.7 B	NA	NA	16.2	7.6	NA
Iron	300	**501**	**758**	**3,420**	**4,200**	139 B	**6,530**	**7,600**	**11,900**	**4,900**	211
Lead	25	1.3 B	2.0 U	2.3 U	2.2 U	3.4 U	4.2 B	5.6 B	7.7 B	3 U	3 U
Magnesium		3,440 B	5,840	4,180 B	4,560	5,530	4,400	6,290	6,450 NJ	4,330	5,350
Manganese	300	16.6	56	116	126	8.4 B	223	282	**414**	153	68.2
Mercury	2		0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	5	5
Nickel	100		1.5 U	4.2 B	4.2 B	2.4 B	NA	NA	13.8	5	NA
Potassium		1,940 B	1,650 B	1,640 B	1,980	1,670	2,720	1,940	2,210 NJ	2,260	1,630
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		NA
Sodium	20,000	1,400 B	2,740 B	2,710 B	2,560	4,770 J	1,910	3,270	3,350 NJ	2,750	3,560
Vanadium		NA	1.7 B	6.0 B	6.0 B	1.3 U	NA	NA	16.4	7.2	NA
Zinc		NA	5.0 U	21.3	21.3	28.2 B	NA	NA	27.5 B	12.6	NA

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/18/00	10/05/00	10/25/01	12/05/01	10/28/02	12/09/02	09/17/03	11/06/03	05/04/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		58.2	93	82	95	90	69	81.9	56.5	38.4	110
Ammonia Nitrogen (mg/l)	2	0.04 U	0.04 U	0.079	0.061	0.037 B	0.092	0.15	0.17	0.034 B	0.04 U
BOD (mg/l)			2 U	2 U	2 U	1.7 B	1.6 B	6.9	2.8	0.84 B	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	17.7	12.2	10 U	10 U	21.1	27.1	62.2	10 U	12.6
Chloride (mg/l)	250	1.31	1.43	1.4	1.1	1.3	1.2	14	7.82	1.72	2.49
Color	15	NA	**25**	**380**	**380**	**250**	NA	NA	**2000**	**100**	NA
Cyanide, Total (mg/l)	0.2	NA	0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		71.8	126	99.6	106	112	93.3	139	128	90.3	119
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.004 B	0.001 B	NA
Nitrate Nitrogen (mg/l)	10	2.75	0.95	0.66	0.58	0.34	0.3	7.3	4.99	3.61	3.58
Phenols (mg/l)	0.001	0.005 U	**0.007**	0.005 U	**0.012**	0.005 U	**0.004 B**	**0.054**	**0.007**	0.005 U	0.005 U
Sulfate (mg/l)	250	10.7	16.5	15	16	16	12	11	10.5	6.25	11.4
Total Dissolved Solids (mg/l)		101	108	139	140	130	100	200	140	82	180
Total Kjeldahl Nitrogen (mg/l)		0.20	0.15	0.85	0.224	0.681	2.07	1.99	2.61	0.56	1.36
Total Organic Carbon (mg/l)		3.5	8.78	2.29	2.6	0.62 B	4.5	3.7	4.6	2.8	6.2

NOTES:

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TABLE 1
MW-11S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
VOLATILE COMPOUNDS (µg/L)		07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/05/07	10/28/08	12/09/08	08/05/09	10/27/09
Methylene Chloride	5	0.55 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:

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	NYSDEC Class GA Standards	SAMPLING DATE									
INORGANIC PARAMETERS (µg/L)		07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/05/07	10/29/08	12/09/08	07/15/09	10/27/09
Aluminum		4,980	NA	892	NA	2,220 J+	NA	100 U	NA	812	NA
Barium	1,000	42.9	NA	53.8	NA	50 U	NA	50.0 U	NA	80.5	NA
Beryllium	3	0.58 B	NA	0.54 U	NA	3 U	NA	3.00 U	NA	3 U	NA
Boron	1,000	27 U	NA	27 UJ	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5.00 U	5.00 U	5.00 U	5.00 U
Calcium		54,800	70,900	52,500	56,900	80,700	76,100	33,400 J	70,400	19,900	14,800
Chromium	50	7.6 B	NA	1.3 U	NA	**50.1**	NA	5.00 U	NA	14.8	NA
Cobalt		2.8 B	NA	4.6 B	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	14.5	NA	4.7 B	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**6,080**	**5,130**	**843**	**4,250**	**2,810**	**3,110**	60.0 UJ	**44,500**	**960 J**	128
Lead	25	3 U	3 U	3 U	7.9 B	3.00 UJ	3.00 U	3.00 U	17.9	3.0 U	3.0 U
Magnesium		9,250	10,800	9,020	9,480	10,700	10,300	5,750	12,300	5,650	5,000 U
Manganese	300	235	139	**2,240**	**557**	174	222	10.0 UJ	**994**	**339**	18.4
Mercury	2					0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	6.6 B	NA	6.1 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		2,230	2,190	8,400 J	2,710	2,430	2,480	4,150	6830	15800 J	5,000 U
Selenium	10		NA		NA	**12.3 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	2,740 J+	3,220	2,950	2,380	2,630 J	2,700	2,540	3,570	3,470	5,000 U
Vanadium		8.8	NA	1.9 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		12.8 B	NA	11 U	NA	27.1 J	NA	10.0 U	NA	10 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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	NYSDEC Class GA Standards	SAMPLING DATE									
CONVENTIONAL PARAMETERS		07/20/05	10/31/05	07/20/06	01/03/07	09/26/07	12/05/07	10/29/08	12/09/08	07/15/09	10/27/09
Alkalinity (mg/l)		114	165	142	81.8	250	250	92	230	51	49
Ammonia Nitrogen (mg/l)	2	0.086	0.058	1.1	0.098	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
BOD (mg/l)		2.2	2.4	5.8	11	4 U	4 U	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.028 B	0.046 B	2.0 U	1 U	2.0 U	20 U	20 U	2 U
COD (mg/l)		9.13 B	18.3	22.9	26	20 U	20 U	20 U	47	27	26
Chloride (mg/l)	250	3.83	2.26	6.5	6.52	4.34	6.34	2.15	3.16	7.61	3.29
Color	15	**500**	NA	**100**	NA	**210**	NA	11.0	NA	7	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	**2.5 B**	NA	10.0 UJ	NA	0.00 U	NA	0.01 U	NA
Hardness (mg/l)		175	222	168	181	246	232	107	226	729	37
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.010 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	**11.6**	2.26	9.76	8.25	9.20	4.11	3.96	4.480	12.900	2.03
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.005 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	12.4	14.6	13.2	9.96	14.1	17.4	5.00 U	10.0 U	6.0	5.0 U
Total Dissolved Solids (mg/l)		230	230	240	140	350	335	116	232.000	250	140
Total Kjeldahl Nitrogen (mg/l)		1.94	1.45	2.53	1.27	0.739	0.500 U	0.500 U	0.632	1.030	0.725
Total Organic Carbon (mg/l)		2.6	3.8	4.2	5.9	3.5	3.0 U	3.8	3 U	3.0 U	3.8

NOTES:

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TABLE 1
MW-11S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/30/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	NS	NS	5 U	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/30/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		NS	NS	1,730	NA	NS
Barium	1,000	NS	NS	50 U	NA	NS
Beryllium	3	NS	NS	3 U	NA	NS
Boron	1,000	NS	NS	500 U	NA	NS
Cadmium	5	NS	NS	5 U	5 U	NS
Calcium		NS	NS	85,400	88500	NS
Chromium	50	NS	NS	10 U	NA	NS
Cobalt		NS	NS	20 U	NA	NS
Copper	200	NS	NS	10 U	NA	NS
Iron	300	NS	NS	**3,430**	**2750**	NS
Lead	25	NS	NS	3 U	3 U	NS
Magnesium		NS	NS	11,900	11100	NS
Manganese	300	NS	NS	91 J	76.8	NS
Mercury	2	NS	NS	0.2 U	NA	NS
Nickel	100	NS	NS	30 U	NA	NS
Potassium		NS	NS	5000 UJ	5000 U	NS
Selenium	10	NS	NS	3 U	NA	NS
Sodium	20,000	NS	NS	5000 UJ	5000 U	NS
Vanadium		NS	NS	30 U	NA	NS
Zinc		NS	NS	18.6 UJ	NA	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

Blank cell or U = Compound was analyzed for, but not detected

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J = Concentration is an estimated value

NA = Parameter not analyzed

R = Rejected- Data qualified as unusable

+/- = Additionally estimated

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/30/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		NS	NS	250 J	260	NS
Ammonia Nitrogen (mg/l)	2	NS	NS	0.5 U	0.500 U	NS
BOD (mg/l)		NS	NS	4.0 UJ	4.000 U	NS
Bromide (mg/l)	2	NS	NS	8.0 UJ	0.800 U	NS
COD (mg/l)		NS	NS	20.0 U	20.000 U	NS
Chloride (mg/l)	250	NS	NS	1.55	2.990	NS
Color	15	NS	NS	12.0	NA	NS
Cyanide, Total (mg/l)	0.2	NS	NS	10.0 U	NA	NS
Hardness (mg/l)		NS	NS	262	267	NS
Hexavalent Chromium (mg/l)	0.05	NS	NS	0.010 U	NA	NS
Nitrate Nitrogen (mg/l)	10	NS	NS	0.817	1.020	NS
Phenols (mg/l)	0.001	NS	NS	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	NS	NS	22.2	20.800	NS
Total Dissolved Solids (mg/l)		NS	NS	380.0	290.000	NS
Total Kjeldahl Nitrogen (mg/l)		NS	NS	0.5 U	0.500 U	NS
Total Organic Carbon (mg/l)		NS	NS	3.0 U	3 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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J = Concentration is an estimated value

NA = Parameter not analyzed

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R = Rejected by data validator

TABLE 1
MW-12D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/13/99	10/19/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	0.5 U	NA	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
ND = Parameter not detected
NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/13/99	10/19/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		22.9 U	NA	NA	NA	NA	NA	6.0 U	NA	22.0 U	NA
Antimony	3	3.9 U	NA	NA	NA	NA	NA	5.0 U	NA	**6.7 B**	NA
Arsenic	25	1.6 U	NA	NA	NA	NA	NA	3.0 U	NA	3.3 B	NA
Barium	1,000	101 B	NA	NA	NA	NA	NA	93.8 B	NA	93.1 B	NA
Boron	1,000	22.3 B	NA	NA	NA	NA	NA	19.9 B	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	2.6 JB	1 U	1.4 B	1 U
Calcium		81,400 0	91,200 0	103,000 0	95,400	93,200 0	99,400	92,300	89,300	76,800	83,000
Chromium	50	0.6 U	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Cobalt		0.8 U	NA	NA	NA	NA	NA	2 U	NA	2.0 U	NA
Copper	200	59.9	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Iron	300	**517 0**	**358 0**	**379 0**	290	**355 0**	15.5 B	**365**	**631**	**486 ***	**1,440**
Lead	25	1.5 U	1.8 U	1.6 U	1.9 U	1 U	1 U	2 U	2 U	2.2 B	3 U
Magnesium		9,800 0	12,000 0	13,100 0	1,200	11,500 0	12,100	11,400	11,000	9,400	10,400
Manganese	300	31.7 0	25.9 0	179 0	180	22.8 0	1 U	16.6	16.3	21.7	31.6
Mercury	2	0.2 U						0.1 U	NA	0.10 U	
Nickel	100	1.2 U	NA	NA	NA	NA	NA	5 U	NA	3.2 B	NA
Potassium		1,710 B	10,400 0	4,930 B	6,200	5,200 E	689 BE	3,150 B	2,610 B	5,160	6,370
Selenium	10	3.2 U						3 U	NA	4.0 U	
Sodium	20,000	**21,500 0**	18,000 0	15,800 0	12,400	19,800 E	6,100	17,600	17,300	17,100	19,000
Zinc		30	NA	NA	NA	NA	NA	20.3	NA	6.2 B	NA

NOTES:
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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/13/99	10/19/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		243 0	288 0	259 0	271	280 0	250	282	278	270	251
Ammonia Nitrogen (mg/l)	2	0.25 0	0.22 0	0.33 0	0.45	0.245 0	0.161	0.139 J	0.24	0.260	.264
BOD (mg/l)		3 U	4 U	4 U	3.7 U	2 U	3.3	2 U	2 U	2.00 J	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 U	0.1 U	2 U	2 U	2.00 U	2 U	2.00 U	
COD (mg/l)		3 U	3 U	3 U	3 U	10 U	10 U	10.0 U	10 U	10.0 U	
Chloride (mg/l)	250	4.89 0	11.1 0	7.39 0	7.04	9.07 0	16.4	9.44	7.5	6.96	5.58
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	10	NA
Cyanide, Total (mg/l)	0.2	0.01 U						0.0100 U	NA	0.0100 U	
Hardness (mg/l)		244 0	277 0	311 0	288	280 0	298	278	268	231	250
Hexavalent Chromium (mg/l)	0.05	0.01 U						0.0100 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.1 0	0.21 0	2.61 0	0.14	0.1 U	0.116	0.1 U	0.1 U	0.100 U	.1 U
Phenols (mg/l)	0.001	**0.012 0**	**0.032 0**	**0.008 0**	**0.017**	0.005 U	**0.014**	0.005 U	0.01 U	0.0500 U	.05 U
Sulfate (mg/l)	250	19 0	17.3 0	16.1 0	15.7	18.8 0	22.4	18.9	12.1	17.0	17.9
Total Dissolved Solids (mg/l)		294 0	296 0	272 0	269	341 0	240	327	268	298	343
Total Kjeldahl Nitrogen (mg/l)		0.56 0	0.35 0	0.57 0	0.35	0.318 0	0.232	0.280 J	0.37	0.602	.429
Total Organic Carbon (mg/l)		1 U	1 U	1 U	1.18	1 U	6.13	1 U	2.16	1.00 U	NA

NOTES:
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TABLE 1
MW-12D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/25/01	12/05/01	10/28/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	3 U	0.4 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
ND = Parameter not detected
NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/25/01	12/05/01	10/28/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	10.0 U	20.1 U	20.1 U	83.3 U	83.3 U	83.3 U	186 B	112	NA
Antimony	3	NA	**5.0 B**	4.6 U	4.6 U	5.9 U	5.9 U	5.9 U	4.6 U		
Arsenic	25	NA	2.5 U	4.9 U	4.9 U	7 U	7 U	7 U	3.5 U		
Barium	1,000	NA	110 B	91.9 B	91.9 B	119	NA	NA	137	166	NA
Boron	1,000	NA	15.1 B	50 U	50 U	50 U	50 U	50 U	27 U		
Cadmium	5	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		78,000	91,400	92,600	89,800	89,300	94,800	102,000	109,000	96,500	78,800
Chromium	50	NA	1.00 U	0.9 U	0.9 U	1.5 U	1.5 U	1.5 U	1.4 U	1.4 U	NA
Cobalt		NA	1.00 U	1.2 U	1.2 U	1.5 U	1.5 U	1.5 U	1.7 U	1.7 U	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	3.6 B	NA	NA	2.6 U	5.7	NA
Iron	300	**754**	**498**	**358**	**458**	**1,250**	**1,800**	**1,560**	**1,310**	**3,130**	**5,000**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U
Magnesium		9,350	11,400	11,900	11,500	11,900	12,100	12,200	13,200 NJ	9,680	9,290
Manganese	300	23.8	18.0	15.4	15.3 B	20.4	**442**	**469**	**944**	**5,570**	**7,250**
Mercury	2		0.10 U	0.1 U	0.1 U	0.18 U	0.18 U	0.18 U	0.18 U	7.5	7.5
Nickel	100	NA	1.5 U	1.4 B	1.4 B	1.9 U	1.9 U	1.9 U	2.4 B	7.5	NA
Potassium		1,640 B	2,970 B	9,300	10,700	8,320	22,900	1,530	1,620 NJ	1,890	1,760
Selenium	10		5 U	4.6 UN	4.6 UN	6.9 U	6.9 U	6.9 U	5 U		
Sodium	20,000	16,600 E	15,900	14,700	15,100	16,500 J	19,500	8,910	8,580 NJ	3,940 J	3,390
Zinc		NA	5.0 U	4.9 U	4.9 U	16.2 U	16.2 U	16.2 U	11 U	11 U	NA

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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/04/00	10/25/01	12/05/01	10/28/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		266	284	280	293	284	278	308	316	285	250
Ammonia Nitrogen (mg/l)	2	0.262	0.291	0.15	0.18	0.31	0.18	0.64	0.9	**2.9**	**2.4**
BOD (mg/l)		2 U	2 U	2 U	2 U	1.6 B	2.7	6.9	2 U	5.1	3.8
Bromide (mg/l)	2		0.1 U	0.1 U	0.025 B	0.1 U	0.1 U	0.1 U	0.1 U	0.038 B	0.034 B
COD (mg/l)			10 U	10 U	11.4	10 U	6.61 B	10 U	10 U	10 U	25.6
Chloride (mg/l)	250	4.47	4.92	4.33	4.8	4.3	4.9	2.8	2.62	1.32	1.44
Color	15	NA	10	15	15	10	NA	NA	10	10	NA
Cyanide, Total (mg/l)	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		233	275	280	272	272	287	305	327	281	235
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.055 B	0.057 B	0.26	0.1 U	0.1 U	0.176	0.271
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.009**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	17.4	20.4	17.8	18	19	17	13	13	8.46	9.83
Total Dissolved Solids (mg/l)		296	321	329	320	330	300	340	330	300	250
Total Kjeldahl Nitrogen (mg/l)		0.48	0.31	0.29	0.249	0.235	0.733	0.509	0.757	3.17	3.24
Total Organic Carbon (mg/l)		1.62	3.38	1.59	0.78 B	0.25 B	2.8	0.72 B	0.67 B	2	1.7

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TABLE 1
MW-12D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		07/20/05	11/07/05	07/19/06	12/28/06	09/26/07	12/06/07	10/28/08	12/09/08	07/15/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	NS	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
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	NYSDEC Class GA Standards	SAMPLING DATE									
		07/20/05	11/07/05	07/19/06	12/28/06	09/26/07	12/06/07	10/29/08	12/09/08	07/15/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		342 B	NA	92 U	NA	314 J+	NA	100 U	NA	NS	NA
Antimony	3		NA		NA	15.0 U	NA	30.0 U	NA	NS	NA
Arsenic	25		NA		NA	12.1	NA	10.0 U	NA	NS	NA
Barium	1,000	73.7	NA	47.8	NA	50.0 U	NA	57.7	NA	NS	NA
Boron	1,000	NS	NS	NS	NA	500 U	NA	500 U	NA	NS	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	NS	5 U
Calcium		94,000	91,100	86,400	102,000	66,400	66,600	98,200 J	89,100	NS	169,000
Chromium	50	2 B	NA	1.3 U	NA	6.24	NA	5.00 U	NA	NS	NA
Cobalt		4.3 B	NA	1.8 U	NA	20.0 U	NA	20.0 U	NA	NS	NA
Copper	200	5.8 B	NA	15.2 J	NA	10.0 U	NA	10.0 U	NA	NS	NA
Iron	300	**2,570**	**3,780**	**347**	**1,330**	**1,750**	**736**	212	**1,170**	NS	**2,830**
Lead	25	3 U	3 U	3 U	6.9 B	3.00 UJ	3.00 U	3.00 U	3.00 U	NS	3.0 U
Magnesium		10,800	11,200	10,400	11,900	7,470	7,190	11,000	9,630	NS	8,120
Manganese	300	**3,480 J-**	**9,370**	**947**	**1,950**	**6,430**	**6,200**	**6,140 J**	**6,530**	NS	**709**
Mercury	2	NS	NS	NS	NA	0.2 U	NA	0.200 U	NA	NS	NA
Nickel	100	7.7 B	NA	2.7 B	NA	30.0 U	NA	30.0 U	NA	NS	NA
Potassium		19,600	1,540	13,300 J	15,100	1,080	4,240	1,460	2,000	NS	5,000 U
Selenium	10				NA	**12.8 J**	NA	5.00 U	NA	NS	NA
Sodium	20,000	8,200 J+	3,870	8,400	8,760	1,620 J	2,170	3,180	5,130	NS	5,000 U
Zinc		14.2 B	NA	50.5	NA	25.9 J	NA	15.6	NA	NS	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		07/20/05	11/07/05	07/19/06	12/28/06	09/26/07	12/06/07	10/29/08	12/09/08	07/15/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		264	277	303	307	260	250	280	290	NS	470
Ammonia Nitrogen (mg/l)	2	0.14	2	0.69	0.69	**2.24**	1.33	1.07	1.16	NS	0.552
BOD (mg/l)		4.9	11	14	16	9	4	4.00 U	5.00	NS	4 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.038 B	0.062 B	0.2 U	1 U	0.200 U	0.20 U	NS	2 U
COD (mg/l)		8.45 B	10.9	19.6 J	24.4	32	20 U	20 U	20 U	NS	20 U
Chloride (mg/l)	250	1.61	1.54	3.82	2.78	1.34	2.12	1.30	2.25	NS	1.82
Color	15	**20**	NA	**20**	NA	**36.0**	NA	8.00	NA	NS	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	**2.5 B**	NA	10.0 UJ	NA	0.00001 U	NA	NS	NA
Hardness (mg/l)		279	274	259	304	197	196	291	262	NS	457
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	NS	NA
Nitrate Nitrogen (mg/l)	10	2.44	0.19	1.64	2.45	0.359	0.588	0.427	0.209	NS	1.06
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.003 B**	**0.006**	0.005 U	0.005 U	0.005 U	0.005 U	NS	0.005 U
Sulfate (mg/l)	250	9.58	9.27	11.7	12.3	5.24	5 U	5.00 U	10.5	NS	5 U
Total Dissolved Solids (mg/l)		280	280	330	2.9	247	244	304	260	NS	490
Total Kjeldahl Nitrogen (mg/l)		0.931	2.09	1.89	1.76	2.25	1.48	1.13	1.34	NS	1
Total Organic Carbon (mg/l)		1.3	2.5	8.7	2.9	5.1	3 U	3.0 U	3 U	NS	3.0 U

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TABLE 1
MW-12D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		06/30/10	11/02/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	5 UJ	NA	5 U	NA	NS

NOTES:
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B = Analyte detected in method blank
J = Concentration is an estimated value
ND = Parameter not detected
NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 UJ	NA	100 U	NA	NS
Antimony	3	5.0 UJ	NA	5.0 U	NA	NS
Arsenic	25	5.0 UJ	NA	5.0 U	NA	NS
Barium	1,000	54.1 J	NA	73	NA	NS
Boron	1,000	500 UJ	NA	500 U	NA	NS
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	NS
Calcium		97,300 J	110,000	97,800	108,000	NS
Chromium	50	10.0 UJ	NA	10.0 U	NA	NS
Cobalt		20.0 UJ	NA	20.0 U	NA	NS
Copper	200	10.0 UJ	NA	10.0 U	NA	NS
Iron	300	276 J	**437**	280	**473**	NS
Lead	25	3.0 UJ	3.0 U	3.0 U	3.0 U	NS
Magnesium		12,300 J	12,800	11,200	11,400	NS
Manganese	300	**1,940 J**	**2,060**	**1,030 J**	**3,570**	NS
Mercury	2	0.200 UJ	NA	0.200 U	NA	NS
Nickel	100	30.0 UJ	NA	30.0 U	NA	NS
Potassium		5,000 UJ	5,000 U	12,900 J	5,000 U	NS
Selenium	10	3.0 UJ	NA	3.0 U	NA	NS
Sodium	20,000	5,000 UJ	5,000 U	6,170 J	5,000 U	NS
Zinc		11.2 J	NA	11.6 J	NA	NS

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	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		301 J	290	330 J	340	NS
Ammonia Nitrogen (mg/l)	2	0.940 J	0.606	0.694	0.5 U	NS
BOD (mg/l)		4.0 UJ	4.0 U	4.0 UJ	4.0 U	NS
Bromide (mg/l)	2	0.8 UJ	1.6 U	8.0 UJ	8.0 U	NS
COD (mg/l)		20 UJ	20 U	20 U	20 U	NS
Chloride (mg/l)	250	2.28 J	1.84	1.72	2.34	NS
Color	15	7.00 J	NA	7	NA	NS
Cyanide, Total (mg/l)	0.2	0.01 UJ	NA	10.00 U	NA	NS
Hardness (mg/l)		294 J	329	290	317	NS
Hexavalent Chromium (mg/l)	0.05	0.010 UJ	NA	0.010 U	NA	NS
Nitrate Nitrogen (mg/l)	10	0.303 J	0.094	1.07	0.123	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	7.77 J	5.00 U	8.70	9.80	NS
Total Dissolved Solids (mg/l)		330 J	350	720	300	NS
Total Kjeldahl Nitrogen (mg/l)		0.782 J	0.780	1.79 J	0.500 U	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0	3.0 U	NS

NOTES:
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TABLE 1
MW-12S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	NS	NS

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		13,200	NA	NA	NA	NA	NA	15,700	NS	NS	NS
Antimony	3	3.9 U						5.0 U	NS	NS	NS
Arsenic	25	10.8	NA	NA	NA	NA	NA	12.4	NS	NS	NS
Barium	1,000	73.8 B	NA	NA	NA	NA	NA	73.0 B	NS	NS	NS
Beryllium	3	1.9 B	NA	NA	NA	NA	NA	2.5 B	NS	NS	NS
Boron	1,000	54.7	NA	NA	NA	NA	NA	45.6 B	NS	NS	NS
Cadmium	5	0.4 U	0.51 B	0.5 U	0.3 U	2 U	1 U	2.1 JB	NS	NS	NS
Calcium		61,300 0	149,000 0	241,000 0	149,000	198,000 0	160,000	132,000	NS	NS	NS
Chromium	50	32	NA	NA	NA	NA	NA	**90.6**	NS	NS	NS
Cobalt		27.4 B	NA	NA	NA	NA	NA	14.5 B	NS	NS	NS
Copper	200	141	NA	NA	NA	NA	NA	87.0	NS	NS	NS
Iron	300	**44,600 0**	**18,400 0**	**25,100 0**	**28,100**	**3,100 0**	**10,900**	**44,100**	NS	NS	NS
Lead	25	21 0	11.8 0	14.9 0	22	2.9 B	22.9	24.7	NS	NS	NS
Magnesium		4,810 B	10,200 0	15,800 0	13,500	11,000 0	9,020	8,370	NS	NS	NS
Manganese	300	**793 0**	**341 0**	290 0	**1040**	**750 0**	**608**	**441**	NS	NS	NS
Mercury	2	0.2 U	NA	NA	NA	NA	NA	0.26	NS	NS	NS
Nickel	100	51.1	NA	NA	NA	NA	NA	89.1	NS	NS	NS
Potassium		4,770 B	5,400 0	4,190 B	3,570 B	918 BE	1,240 BE	4,450 B	NS	NS	NS
Sodium	20,000	1,650 B	2,340 B	3,530 B	2,340 B	4,370 BE	2,710 B	2,660 B	NS	NS	NS
Thallium	4	**5.3 B**	NA	NA	NA	NA	NA	6.0 UN	NS	NS	NS
Vanadium		54.8	NA	NA	NA	NA	NA	50.4	NS	NS	NS
Zinc		117	NA	NA	NA	NA	NA	159	NS	NS	NS

NOTES:
Concentrations highlighted exceed the
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	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		138 0	341 0	520 0	294	390 0	288	280	NS	NS	NS
Ammonia Nitrogen (mg/l)	2	0.05 U	0.05 U	0.05 0	**2.2**	0.261 0	0.11	0.408 J	NS	NS	NS
BOD (mg/l)		3 U	13.3 U	6 0	38.9	7.5 0	6.9	3.09	NS	NS	NS
Bromide (mg/l)	2	0.575 0	0.82 0	1.37 0	0.84	2 U	2 U	2 U	NS	NS	NS
COD (mg/l)		48.8 0	4.6 0	32.8 0	0 0	10 U	31.8	11.0	NS	NS	NS
Chloride (mg/l)	250	1 U	3.03 0	1.9 0	3 U	3 U	3 U	3 U	NS	NS	NS
Color	15	**400**	NA	NA	NA	NA	NA	**1400**	NS	NS	NS
Cyanide, Total	0.2	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NS	NS	NS
Hardness (mg/l)		173 0	414 0	667 0	428	549 0	438	364	NS	NS	NS
Hexavalent Chromium		0.01 U	NA	NA	NA	NA	NA	NA	NS	NS	NS
Nitrate Nitrogen (mg/l)	10	0.035 0	0.74 0	2.84 0	2.4	**10.7 0**	0.1 U	0.528	NS	NS	NS
Phenols (mg/l)	0.001	**0.034 0**	**0.025 0**	**0.009 0**	0.005 U	0.005 U	**0.008**	0.005 U	NS	NS	NS
Sulfate (mg/l)	250	185 0	10.8 0	15.1 0	14.9	18.1 0	13.7	10 U	NS	NS	NS
Total Dissolved Solids (mg/l)		166 0	38 0	440 0	291	496 0	256	273	NS	NS	NS
Total Kjeldahl Nitrogen (mg/l)		0.33 0	0.23 0	1.19 0	31.5	3.43 0	2.51	4.40 J	NS	NS	NS
Total Organic Carbon (mg/l)		1 U	1 U	2.33 0	5.92	1.63 0	7.85	1.28	NS	NS	NS

NOTES:
Concentrations highlighted exceed the
corresponding NYSDEC Class GA Standard
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TABLE 1
MW-12S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/24/01	12/04/01	10/24/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	5 U	NS	NS	NS	NS	NA	5 U	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/24/01	12/04/01	10/24/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	16,200	NS	NS	NS	NS	NA	1,000	740	NA
Antimony	3		**5.10 B**	NS	NS	NS	NS	NA	4.6 U	5.4 U	NA
Arsenic	25	NA	8.3 B	NS	NS	NS	NS	NA	3.5 U	3.9 U	NA
Barium	1,000	NA	69.0 B	NS	NS	NS	NS	NA	75.1	26.1	NA
Beryllium	3	NA	2.0 B	NS	NS	NS	NS	NA	0.6 U	0.54 U	NA
Boron	1,000	NA	67.4 B	NS	NS	NS	NS	NA	58.9 B	27 U	NA
Cadmium	5	0.23 B	0.5 U	NS	NS	NS	NS	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		70,500	99,700	NS	NS	NS	NS	192,000	126,000	195,000	175,000
Chromium	50	NA	30.4	NS	NS	NS	NS	NA	5.0 B	1.3	NA
Cobalt		NA	18.2 B	NS	NS	NS	NS	NA	4.3 B	1.8 U	NA
Copper	200	NA	64.4	NS	NS	NS	NS	NA	25.4	4.3 U	NA
Iron	300	**670**	**30,800**	NS	NS	NS	NS	53 U	**4,720**	**1,530**	**5,400**
Lead	25	1.3 U	18.9	NS	NS	NS	NS	3.6 U	5.4 B	3 U	4.1 B
Magnesium		3,360 B	7,510	NS	NS	NS	NS	13,000	8,360 NJ	12,400	13,900
Manganese	300	13.2 B	**513**	NS	NS	NS	NS	2.8 U	**4,580**	**1,100**	**8,760**
Mercury	2	NA	0.18 B	NS	NS	NS	NS	NA	0.18 U	0.07 U	NA U
Nickel	100	NA	39.8 B	NS	NS	NS	NS	NA	20.0	8	NA
Potassium		482 B	6,280	NS	NS	NS	NS	1,430	8,730 NJ	1,590	854
Sodium	20,000	1,240 BE	1,560 B	NS	NS	NS	NS	2,000	12,300 NJ	2,050 J	3,150
Thallium	4	NA	**8.4 B**	NS	NS	NS	NS	NA	13.0 UJ	10 UJ	NA
Vanadium		NA	47.9 B	NS	NS	NS	NS	NA	6.3	2.5	NA
Zinc		NA	108	NS	NS	NS	NS	NA	18 B	11 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE									
		05/19/00	10/04/00	10/24/01	12/04/01	10/24/02	12/10/02	09/17/03	11/06/03	05/11/04	10/26/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		191	269	NS	NS	NS	NS	578	524	478	508
Ammonia Nitrogen (mg/l)	2	0.06	0.078	NS	NS	NS	NS	0.11	**57**	0.17	**3.9**
BOD (mg/l)		2 U	2 U	NS	NS	NS	NS	4	5.8	2.8	6.9
Bromide (mg/l)	2	0.1 U	0.1 U	NS	NS	NS	NS	0.1 U	0.1 U	0.028 B	0.033 B
COD (mg/l)		98.4	83.7	NS	NS	NS	NS	33.4	9.57 B	10 U	32.9 U
Chloride (mg/l)	250	0.561	0.5 U	NS	NS	NS	NS	2.1	3.84	1.66	1.7
Color	15	NA	**60**	NS	NS	NS	NS	NA	**200**	**120**	NA
Cyanide, Total	0.2		0.01 U	NS	NS	NS	NS	NA	10 UJ	10 U	NA
Hardness (mg/l)		190	280	NS	NS	NS	NS	532	349	538	494
Hexavalent Chromium			0.01 U	NS	NS	NS	NS	NA	0.01 U	0.004 B	NA
Nitrate Nitrogen (mg/l)	10	0.275	0.152	NS	NS	NS	NS	0.041 B	0.133	2.27	0.692
Phenols (mg/l)	0.001	0.005 U	0.005 U	NS	NS	NS	NS	**0.027**	**0.007**	0.005 U	0.005 U
Sulfate (mg/l)	250	8.27	8.86	NS	NS	NS	NS	2.8	5.86	4.83	5.1
Total Dissolved Solids (mg/l)		214	314	NS	NS	NS	NS	570	350	500	500
Total Kjeldahl Nitrogen (mg/l)		12	0.18	NS	NS	NS	NS	1.07	52.2	1.91	13
Total Organic Carbon (mg/l)		4.13	4.42	NS	NS	NS	NS	5.5	6.6	2.1	2.4

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TABLE 1
MW-12S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/07/05	07/19/06	12/28/06	09/06/07	12/06/07	10/28/08	12/09/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	NS	NA	NS	NA	5 U	NA

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	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/07/05	07/19/06	12/28/06	09/06/07	12/06/07	10/28/08	12/09/08	07/15/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		3,850	NA	345 B	NA	NS	NA	NS	NA	NS	NA
Antimony	3	5.4 U	NA	5.4 U	NA	NS	NA	NS	NA	NS	NA
Arsenic	25	3.9 U	NA	4.4 B	NA	NS	NA	NS	NA	NS	NA
Barium	1,000	99.6	NA	33.4	NA	NS	NA	NS	NA	NS	NA
Beryllium	3	1.1 B	NA	0.54 U	NA	NS	NA	NS	NA	NS	NA
Boron	1,000	27 U	NA	27 UJ	NA	NS	NA	NS	NA	NS	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	NS	5 U	NS	5.00 U	NS	5.00 U
Calcium		204,000	178,000	206,000	172,000	NS	123,000	NS	152,000	NS	87,800
Chromium	50	10 B	NA	2.5 B	NA	NS	NA	NS	NA	NS	NA
Cobalt		20.8	NA	1.8 U	NA	NS	NA	NS	NA	NS	NA
Copper	200	43.6	NA	7 B	NA	NS	NA	NS	NA	NS	NA
Iron	300	**8,380**	**16,800**	**601**	**1,300**	NS	**5,120**	NS	**6,190**	NS	**315**
Lead	25	3 U	9.6 B	3 U	4.2 B	NS	3 U	NS	3.00 U	NS	5.99
Magnesium		10,300	10,700	12,300	9,960	NS	10,200	NS	10,300	NS	9,390
Manganese	300	**4,920 J-**	**7,540**	**437**	**9,170**	NS	**3,110**	NS	**4,420**	NS	**878**
Mercury	2	0.07 U	NA	0.07 U	NA	NS	NA	NS	NA	NS	NA
Nickel	100	**146**	NA	6.9 B	NA	NS	NA	NS	NA	NS	NA
Potassium		2,020	1,940	1,400 J	3,220	NS	2,060	NS	1,000 U	NS	6,260
Sodium	20,000	2,660 J+	3,280	1,950	5,750	NS	7,020	NS	1,800	NS	5,000 U
Thallium	4	10 UJ-	NA	10 UJ	NA	NS	NA	NS	NA	NS	NA
Vanadium		15.7	NA	1.5 U	NA	NS	NA	NS	NA	NS	NA
Zinc		36.2 B	NA	11 U	NA	NS	NA	NS	NA	NS	NA

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	NYSDEC Class GA Standards	SAMPLING DATE 07/20/05	11/07/05	07/19/06	12/28/06	09/06/07	12/06/07	10/28/08	12/09/08	07/15/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		417	476	443	572	NS	380	NS	440	NS	260
Ammonia Nitrogen (mg/l)	2	0.063	0.53	0.05	**26**	NS	**2.65**	NS	1.86	NS	0.5 U
BOD (mg/l)		3.1	53	5.6	13	NS	13	NS	13.0	NS	4.0 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.032 B	0.1 U	NS	1 U	NS	20 U	NS	2 U
COD (mg/l)		48.4	33.4	31	25.9	NS	122	NS	20 U	NS	22
Chloride (mg/l)	250	1.63	2.05	2.65	1 U	NS	3.60	NS	1.47	NS	16.2
Color	15	**100**	NA	**25**	NA	NS	NA	NS	NA	NS	NA
Cyanide, Total	0.2	10 U	NA	**2 B**	NA	NS	NA	NS	NA	NS	NA
Hardness (mg/l)		552	489	565	470	NS	349	NS	421	NS	258
Hexavalent Chromium		0.01 U	NA	0.01 U	NA	NS	NA	NS	NA	NS	NA
Nitrate Nitrogen (mg/l)	10	4.59	1.82	6.7	0.119	NS	1.66	NS	1.58	NS	1.5
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.005 B**	**0.03**	NS	0.005 U	NS	0.005 U	NS	0.005 U
Sulfate (mg/l)	250	7.26	8.54	10.5	1.13	NS	20 U	NS	10.0 U	NS	7.69
Total Dissolved Solids (mg/l)		430	500	560	4.7	NS	404	NS	395	NS	340
Total Kjeldahl Nitrogen (mg/l)		4.92	3.31	2.58	29.5	NS	3.79	NS	2.71	NS	0.5 U
Total Organic Carbon (mg/l)		2.5	2.2	17	4.7	NS	3.0 U	NS	3.6	NS	3.0 U

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TABLE 1
MW-12S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE				
		06/30/10	11/02/10	11/09/11	12/28/11	07/23/14
VOLATILE COMPOUNDS (µg/L)						
Methylene Chloride	5	5 UJ	NA	5 U	NA	NS

NOTES:
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NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/28/11	07/23/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		926 J	NA	142	NA	NS
Antimony	3	5.0 UJ	NA	5.0 U	NA	NS
Arsenic	25	5.0 UJ	NA	5.0 U	NA	NS
Barium	1,000	50.0 UJ	NA	50.0 U	NA	NS
Beryllium	3	3.00 UJ	NA	3.00 U	NA	NS
Boron	1,000	500 UJ	NA	500 U	NA	NS
Cadmium	5	5.00 UJ	5.00 U	5.00 U	5.00 U	NS
Calcium		133,000 J	205,000	219,000	200,000	NS
Chromium	50	10.0 UJ	NA	10.0 U	NA	NS
Cobalt		20.0 UJ	NA	20.0 U	NA	NS
Copper	200	10.0 UJ	NA	10.1	NA	NS
Iron	300	**2,780 J**	**9,720**	**991**	**377**	NS
Lead	25	3.0 UJ	8.6	3.0 U	3 U	NS
Magnesium		7,230 J	10,200	8,630	6,890	NS
Manganese	300	**925 J**	**3,750**	**709**	184	NS
Mercury	2	0.200 UJ	NA	0.200 U	NA	NS
Nickel	100	30.00 UJ	NA	30.00 U	NA	NS
Potassium		5,000 UJ	5,000 U	5,000 UJ	5,000 U	NS
Sodium	20,000	5,000 UJ	5,000 U	5,000 UJ	5,000 U	NS
Thallium	4	3.0 UJ	NA	3.0 U	NA	NS
Vanadium		30.0 UJ	NA	30.0 U	NA	NS
Zinc		21.1 J	NA	18.1 UJ	NA	NS

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	NYSDEC Class GA Standards	SAMPLING DATE				
		07/01/10	11/02/10	11/09/11	12/28/11	07/23/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		293 J	470	590 J	470	NS
Ammonia Nitrogen (mg/l)	2	0.500 UJ	1.19	1.100	0.966	NS
BOD (mg/l)		4.0 UJ	7.0	4.0 UJ	4.0 U	NS
Bromide (mg/l)	2	8.0 UJ	8.0 U	8.0 UJ	8.0 U	NS
COD (mg/l)		21 J	20 U	20 U	20 U	NS
Chloride (mg/l)	250	1.33 J	1.70	1.54	2.90	NS
Color	15	**16.0 J**	NA	**150**	NA	NS
Cyanide, Total	0.2	0.010 UJ	NA	10.000 U	NA	NS
Hardness (mg/l)		363 J	553	583	528	NS
Hexavalent Chromium		0.010 UJ	NA	0.010 U	NA	NS
Nitrate Nitrogen (mg/l)	10	1.82 J	3.88	0.336	4.44	NS
Phenols (mg/l)	0.001	0.005 UJ	0.005 U	0.005 RU	0.005 U	NS
Sulfate (mg/l)	250	7.64 J	5.00 U	5 U	6.40	NS
Total Dissolved Solids (mg/l)		390 J	580	650	490	NS
Total Kjeldahl Nitrogen (mg/l)		1.68 J	2.43	1.61	1.51	NS
Total Organic Carbon (mg/l)		3.0 UJ	3.0 U	3.0 U	3.0 U	NS

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TABLE 1
MW-13S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
VOLATILE COMPOUNDS (ug/L)											
Methylene Chloride	5	3 JB	NS	NA	NS	NS	NA	NS	NS	5 U	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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B = Analyte detected in method blank

J = Concentration is an estimated value

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
INORGANIC PARAMETERS (ug/L)											
Aluminum		75.3 B	NS	NA	NS	NS	NA	NS	NS	20,000	NS
Antimony	3	**66.9**	NS	NA	NS	NS	NA	NS	NS	**3.6 B**	NS
Arsenic	25	1.6 U	NS	NA	NS	NS	NA	NS	NS	18.3	NS
Barium	1,000	22.2 B	NS	NA	NS	NS	NA	NS	NS	151 B	NS
Beryllium	3	0.1 U	NS	NA	NS	NS	NA	NS	NS	2.6 B	NS
Boron	1,000	20 U	NS	NA	NS	NS	NA	NS	NS	NA	NS
Cadmium	5	0.4 U	NS	0.5 U	NS	NS	1 U	NS	NS	4.4 B	NS
Calcium		111,000 0	NS	80,800 0	NS	NS	93,000	NS	NS	526,000	NS
Chromium	50	14.3	NS	NA	NS	NS	NA	NS	NS	**329**	NS
Cobalt		0.8 U	NS	NA	NS	NS	NA	NS	NS	37.2 B	NS
Copper	200	1.3 U	NS	NA	NS	NS	NA	NS	NS	94.8	NS
Iron	300	21.6 B	NS	56 B	NS	NS	12 U	NS	NS	**63,300 ***	NS
Lead	25	1.5 U	NS	1.6 U	NS	NS	1 U	NS	NS	**30.2**	NS
Magnesium		13,700	NS	9,330 0	NS	NS	11,400	NS	NS	75,200	NS
Manganese	300	0.7	NS	4.2 B	NS	NS	1 U	NS	NS	**1,370**	NS
Mercury	2	0.2 U	NS		NS	NS		NS	NS	0.19 B	NS
Nickel	100	1.2 U	NS		NS	NS		NS	NS	281.	NS
Potassium		1,060 U	NS	685 B	NS	NS	606 BE	NS	NS	7,470	NS
Selenium	10	3 U	NS		NS	NS		NS	NS	4.0 U	NS
Sodium	20,000	6,660	NS	4,780 B	NS	NS	5,770	NS	NS	9,840	NS
Thallium	4	7.3 B	NS	NA	NS	NS	NA	NS	NS	3.0 U	NS
Vanadium		1 U	NS		NS	NS		NS	NS	60.1	NS
Zinc		0.1 U	NS	NA	NS	NS	NA	NS	NS	200	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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J or E = Concentration is an estimated value

E = Reported value is estimated because of the presence of interference

NA = Parameter not analyzed

* = Duplicate analysis not within control limit.

N = Spiked sample recovery not within control limits

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/09/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/18/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		271 0	NS	193 0	NS	NS	210	NS	NS	428	NS
Ammonia Nitrogen (mg/l)	2	0.05 U	NS	0.05 0	NS	NS	0.04 U	NS	NS	0.101 J	NS
BOD (mg/l)		3 U	NS	4 U	NS	NS	5.7	NS	NS	2.00 J	NS
Bromide (mg/l)	2	0.709 0	NS	0.52 0	NS	NS	2 U	NS	NS	2.00 U	NS
COD (mg/l)		3 U	NS	3 U	NS	NS	10 U	NS	NS	10.0 U	NS
Chloride (mg/l)	250	5.64 0	NS	12.2 0	NS	NS	15.9	NS	NS	17.2	NS
Color	15	**400**	NS	NA	NS	NS	NA	NS	NS	**75**	NS
Cyanide, Total	0.2	0.017	NS	NA	NS	NS	NA	NS	NS	0.0100 U	NS
Hardness (mg/l)		333 0	NS	240 0	NS	NS	279	NS	NS	1,620	NS
Hexavalent Chromium								NS		0.0100 U	NS
Nitrate Nitrogen (mg/l)	10	0.324 0	NS	3.05 0	NS	NS	0.449	NS	NS	0.346	NS
Phenols (mg/l)	0.001	0.0035 U	NS	**0.013 0**	NS	NS	**0.008**	NS	NS	0.005 U	NS
Sulfate (mg/l)	250	10.7 0	NS	9.8 0	NS	NS	22.5	NS	NS	11.9	NS
Total Dissolved Solids (mg/l)		336 0	NS	204 0	NS	NS	281	NS	NS	311	NS
Total Kjeldahl Nitrogen (mg/l)		0.08 0	NS	0.18 0	NS	NS	0.177	NS	NS	2.90	NS
Total Organic Carbon (mg/l)		1 U	NS	1 U	NS	NS	5.45	NS	NS	1.50	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

B = Analyte detected in method blank

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Rejected by data validator

TABLE 1
MW-13S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/10/02	09/17/03	11/06/03	05/13/04	10/26/04
VOLATILE COMPOUNDS (ug/L)											
Methylene Chloride	5	NA	0.4 UJ	NS	NS	NS	NS	NA	5 U	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/10/02	09/17/03	11/06/03	05/13/04	10/26/04
INORGANIC PARAMETERS (ug/L)											
Aluminum		NA	3,180	NS	NS	NS	NS	NA	60 U	92 U	NA
Antimony	3	NA	5.0 U	NS	NS	NS	NS	NA	4.6 U		
Arsenic	25	NA	2.5 U	NS	NS	NS	NS	NA	3.5 U		
Barium	1,000	NA	50.7 B	NS	NS	NS	NS	NA	32.1	25.4	NA
Beryllium	3	NA	0.5 U	NS	NS	NS	NS	NA	0.64 U		
Boron	1,000		27.3 B	NS	NS	NS	NS	NA	27 U	27 U	NA
Cadmium	5	0.2 U	0.5 U	NS	NS	NS	NS	0.94 U	0.94 U	1.1 U	1.8 B
Calcium		205,000	193,000	NS	NS	NS	NS	138,000	127,000	117,000	353,000
Chromium	50	NA	**77.4**	NS	NS	NS	NS	NA	1.4 U	1.3 U	NA
Cobalt		NA	4.4 B	NS	NS	NS	NS	NA	2.4 B	1.8 U	NA
Copper	200	NA	13.7 B	NS	NS	NS	NS	NA	2.6 U	4.3 U	NA
Iron	300	**8,770**	**6590**	NS	NS	NS	NS	**754**	53 U	54 U	**35,100**
Lead	25	3.7	2.0 U	NS	NS	NS	NS	3.6 U	3.6 U	3 U	17.3
Magnesium		24,100	21,500	NS	NS	NS	NS	14,700	13,300 NJ	12,000	28,400
Manganese	300	208	**408**	NS	NS	NS	NS	**458**	**646**	**348**	**25,900**
Mercury	2		0.1 J	NS	NS	NS	NS	NA	0.18 U	0.07 U	NA
Nickel	100		47.0	NS	NS	NS	NS	NA	2.3 B	2.1	NA
Potassium		NA	2,650 B	NS	NS	NS	NS	902	710 NJ	629	4,140
Selenium	10		5.0 JN	NS	NS	NS	NS	NA	5 U	5 U	NA
Sodium	20,000	3310 BE	12,500	NS	NS	NS	NS	7,520	8,070 NJ	9,210 J	14,100
Thallium	4		6.0 U	NS	NS	NS	NS	NA	13 UJ		
Vanadium			8.8 B	NS	NS	NS	NS	NA	1 U	1.5 U	NA
Zinc		NA	49.8	NS	NS	NS	NS	NA	11 U	11 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J or E = Concentration is an estimated value

E = Reported value is estimated because of the presence of interference

NA = Parameter not analyzed

* = Duplicate analysis not within control limit.

N = Spiked sample recovery not within control limits

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/19/00	10/09/00	10/24/01	12/04/01	10/28/02	12/10/02	09/17/03	11/06/03	05/13/04	10/26/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		615	340	NS	NS	NS	NS	420	356	353	338
Ammonia Nitrogen (mg/l)	2	0.04 U	0.04 U	NS	NS	NS	NS	0.34	0.13	0.057	0.027 B
BOD (mg/l)		2 U	2.0 U	NS	NS	NS	NS	10	5.6	4.5	0.6 B
Bromide (mg/l)	2	0.1 U	0.1 U	NS	NS	NS	NS	0.077 B	0.1 U	0.038 B	0.042 B
COD (mg/l)		NA	20.5	NS	NS	NS	NS	41.3	22.2	6.39 B	10 U
Chloride (mg/l)	250	9.41	24.1	NS	NS	NS	NS	11	14.4	1.32	20.5
Color	15	NA	15.0	NS	NS	NS	NS	NA	**50**	**20**	NA
Cyanide, Total	0.2	NA	0.0304	NS	NS	NS	NS	NA	10 UJ	10 U	NA
Hardness (mg/l)		611	570	NS	NS	NS	NS	404	372	342	998
Hexavalent Chromium			0.01 U	NS	NS	NS	NS	NA	0.01 U	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.329	NS	NS	NS	NS	0.24	0.357	0.176	0.655
Phenols (mg/l)	0.001	0.005 U	0.005 U	NS	NS	NS	NS	**0.008**	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	11.4	14.5	NS	NS	NS	NS	27	18.1	8.46	14
Total Dissolved Solids (mg/l)		494	398	NS	NS	NS	NS	500	400	410	390
Total Kjeldahl Nitrogen (mg/l)		1.1	1.2	NS	NS	NS	NS	2.72	1.11	0.731	11.2
Total Organic Carbon (mg/l)		6.13	4.74	NS	NS	NS	NS	4.4	2.4	1.4	1.9

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

B = Analyte detected in method blank

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Rejected by data validator

TABLE 1
MW-13S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/25/06	01/02/07	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
VOLATILE COMPOUNDS (ug/L)											
Methylene Chloride	5	NS	NS	5 U	NA	NS	NS	5 U	NS	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/25/06	01/02/07	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
INORGANIC PARAMETERS (ug/L)											
Aluminum		NS	NS	92 U	NA	NS	NS	NA	NS	NS	NS
Antimony	3	NS	NS	NS		NS	NS	NA	NS	NS	NS
Arsenic	25	NS	NS	NS		NS	NS	NA	NS	NS	NS
Barium	1,000	NS	NS	41.1	NA	NS	NS	NA	NS	NS	NS
Beryllium	3	NS	NS	NS		NS	NS	NA	NS	NS	NS
Boron	1,000	NS	NS	27 U	NA	NS	NS	NA	NS	NS	NS
Cadmium	5	NS	NS	1.1 U	0.76 U	NS	NS	NA	NS	NS	NS
Calcium		NS	NS	123,000	120,000	NS	NS	NA	NS	NS	NS
Chromium	50	NS	NS	6.7 B	NA	NS	NS	NA	NS	NS	NS
Cobalt		NS	NS	4.2 B	NA	NS	NS	NA	NS	NS	NS
Copper	200	NS	NS	4.3 U	NA	NS	NS	NA	NS	NS	NS
Iron	300	NS	NS	**456**	221	NS	NS	NA	NS	NS	NS
Lead	25	NS	NS	3 U	4.5 B	NS	NS	NA	NS	NS	NS
Magnesium		NS	NS	12,500	11,500	NS	NS	NA	NS	NS	NS
Manganese	300	NS	NS	**974**	**1,240**	NS	NS	NA	NS	NS	NS
Mercury	2	NS	NS	0.07 U	NA	NS	NS	NA	NS	NS	NS
Nickel	100	NS	NS	6.9 B	NA	NS	NS	NA	NS	NS	NS
Potassium		NS	NS	755	776	NS	NS	NA	NS	NS	NS
Selenium	10	NS	NS	5 UJ	NA	NS	NS	NA	NS	NS	NS
Sodium	20,000	NS	NS	9,060 J	9,660	NS	NS	NA	NS	NS	NS
Thallium	4	NS	NS	NS		NS	NS	NA	NS	NS	NS
Vanadium		NS	NS	1.5 U	NA	NS	NS	NA	NS	NS	NS
Zinc		NS	NS	11 B	NA	NS	NS	NA	NS	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound analyzed for, but not detected

B = Concentration is < the CRQL and > the IDL

J or E = Concentration is an estimated value

E = Reported value is estimated because of the presence of interference

NA = Parameter not analyzed

* = Duplicate analysis not within control limit.

N = Spiked sample recovery not within control limits

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/25/06	01/02/07	09/25/07	12/06/07	10/28/08	12/09/08	07/14/09	10/26/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		NS	NS	319	303	NS	NS	NA	NS	NS	NS
Ammonia Nitrogen (mg/l)	2	NS	NS	0.04 U	0.086	NS	NS	NA	NS	NS	NS
BOD (mg/l)		NS	NS	1.6 B	4.2	NS	NS	NA	NS	NS	NS
Bromide (mg/l)	2	NS	NS	0.017 B	0.1 U	NS	NS	NA	NS	NS	NS
COD (mg/l)		NS	NS	22	57.6	NS	NS	NA	NS	NS	NS
Chloride (mg/l)	250	NS	NS	18.4	18.6	NS	NS	NA	NS	NS	NS
Color	15	NS	NS	5	NA	NS	NS	NA	NS	NS	NS
Cyanide, Total	0.2	NS	NS	**2.3 B**	NA	NS	NS	NA	NS	NS	NS
Hardness (mg/l)		NS	NS	359	347	NS	NS	NA	NS	NS	NS
Hexavalent Chromium		NS	NS	0.01 U	NA	NS	NS	NA	NS	NS	NS
Nitrate Nitrogen (mg/l)	10	NS	NS	0.38	0.471	NS	NS	NA	NS	NS	NS
Phenols (mg/l)	0.001	NS	NS	0.005 U	0.005 U	NS	NS	NA	NS	NS	NS
Sulfate (mg/l)	250	NS	NS	17.1	19.4	NS	NS	NA	NS	NS	NS
Total Dissolved Solids (mg/l)		NS	NS	370	400	NS	NS	NA	NS	NS	NS
Total Kjeldahl Nitrogen (mg/l)		NS	NS	0.389	0.411	NS	NS	NA	NS	NS	NS
Total Organic Carbon (mg/l)		NS	NS	2.8	4.3	NS	NS	NA	NS	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

B = Analyte detected in method blank

U = Compound analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

R = Rejected by data validator

TABLE 1
MW-13S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	07/23/14
VOLATILE COMPOUNDS (ug/L)				
Methylene Chloride	5	5 UJ	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	07/23/14
INORGANIC PARAMETERS (ug/L)				
Aluminum		NA	NS	NS
Antimony	3	NA	NS	NS
Arsenic	25	NA	NS	NS
Barium	1,000	NA	NS	NS
Beryllium	3	NA	NS	NS
Boron	1,000	NA	NS	NS
Cadmium	5	NA	NS	NS
Calcium		NA	NS	NS
Chromium	50	NA	NS	NS
Cobalt		NA	NS	NS
Copper	200	NA	NS	NS
Iron	300	NA	NS	NS
Lead	25	NA	NS	NS
Magnesium		NA	NS	NS
Manganese	300	NA	NS	NS
Mercury	2	NA	NS	NS
Nickel	100	NA	NS	NS
Potassium		NA	NS	NS
Selenium	10	NA	NS	NS
Sodium	20,000	NA	NS	NS
Thallium	4	NA	NS	NS
Vanadium		NA	NS	NS
Zinc		NA	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Concentration is < the CRQL and > the IDL
J or E = Concentration is an estimated value
E = Reported value is estimated because of the presence of interference
NA = Parameter not analyzed
* = Duplicate analysis not within control limit.
N = Spiked sample recovery not within control limits

	NYSDEC Class GA Standards	SAMPLING DATE 06/30/10	11/01/10	07/23/14
CONVENTIONAL PARAMETERS				
Alkalinity (mg/l)		NA	NS	NS
Ammonia Nitrogen (mg/l)	2	NA	NS	NS
BOD (mg/l)		NA	NS	NS
Bromide (mg/l)	2	NA	NS	NS
COD (mg/l)		NA	NS	NS
Chloride (mg/l)	250	NA	NS	NS
Color	15	NA	NS	NS
Cyanide, Total	0.2	NA	NS	NS
Hardness (mg/l)		NA	NS	NS
Hexavalent Chromium		NA	NS	NS
Nitrate Nitrogen (mg/l)	10	NA	NS	NS
Phenols (mg/l)	0.001	NA	NS	NS
Sulfate (mg/l)	250	NA	NS	NS
Total Dissolved Solids (mg/l)		NA	NS	NS
Total Kjeldahl Nitrogen (mg/l)		NA	NS	NS
Total Organic Carbon (mg/l)		NA	NS	NS

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
B = Analyte detected in method blank
U = Compound analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-15D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
1,2-Dibromo-3-Chloropropane	0.04							5 U		10 U	
1,4-Dichlorobenzene	3							5 U		5 U	
Benzene	1	1 U	NA	NA	NA	NA	NA	5 U	NA	.6 J	NA
Bromomethane	5							10 U		10 U	
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
trans-1,4-Dichloro-2-Butene	5							5 U		10 U	

NOTES:

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
Aluminum		22.9 U						6.0 U	NA	22.0 U	NA
Antimony	3	3.9 U						5.0 U	NA	3.0 U	
Arsenic	25	4.4 B	NA	NA	NA	NA	NA	3 U	NA	9.7 B	NA
Barium	1,000	88.3 B	NA	NA	NA	NA	NA	87.5 B	NA	78.9 B	NA
Beryllium	3	1 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Boron	1,000	157	NA	NA	NA	NA	NA	147	NA	NA	NA
Calcium		82,100 0	131,000 0	120,000 0	111,000	103,000 0	101,000 0	87,000	85,300	78,500	94,300
Chromium	50	5.8 B	NA	NA	NA	NA	NA	2.1 B	NA	1.9 B	NA
Cobalt		7.7 B	NA	NA	NA	NA	NA	6.2 B	NA	5.8 B	NA
Copper	200	20.9 B	NA	NA	NA	NA	NA	1 U	NA	1.0 U	NA
Iron	300	**11,400 0**	**20,100 0**	**17,600 0**	**17,100**	**15,100 0**	**13,800 0**	**13,000**	**12,700**	**11,100 ***	**12,400**
Lead	25	1.5 U	2.5 B	1.6 U	1.9 U	1 B	2.1 B	2 U	2.0 U	2.0 U	3 U
Magnesium		11,500 0	18,900 0	17,200 0	15,400	13,400 0	12,800 0	10,800	10,600	9,720	11,900
Manganese	300	**395 0**	**649 0**	**584 0**	**548**	**454 0**	**408 0**	**373**	**386**	**340**	**412**
Mercury	2	0.2 U						0.10 U	NA	0.10 U	
Nickel	100	14.3 B	NA	NA	NA	NA	NA	16.4 B	NA	12.8 B	NA
Potassium		6,210 0	16,100 0	7,830 0	7,460	8,750 E	9,730 0	7,940	7,940	7,610	8,350
Selenium	10	3.2 U						3.0 U	NA	4.0 U	
Sodium	20,000	**45,000 0**	**69,000 0**	**61,300 0**	**56,600**	**56,300 E**	**48,400 0**	**33,700**	**33,800**	**26,900**	**22,600**
Vanadium		1 U						1.0 U	NA	2.0 U	
Zinc		28.2	NA	NA	NA	NA	NA	19.8 B	NA	5.0 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

B = Concentration is less than the CRQL and greater than the IDL

J = Concentration is an estimated value

NA = Parameter not analyzed

* Duplicate analysis not within control limit

+/- = Additionally estimated

CONVENTIONAL PARAMETERS

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
Alkalinity (mg/l)		470 0	539 0	511 0	520	486 0	460 0	460	458	435	450
Ammonia Nitrogen (mg/l)	2	**52.6 0**	**56.3 0**	**44.7 0**	**3.66**	**42.9 0**	**49.9 0**	**57.3 J**	**75.4**	**48.8**	**50.6**
BOD (mg/l)		3 U	6.7 U	5.5 0	4.4 U	2 U	3.3 0	2.19	4	2.00 J	2 U
Bromide (mg/l)		0.1 U	0.1 U	0.1 0	0.1 U	2 U	2 U	2 U	1 U	2.00 U	2 U
COD (mg/l)		21.7 0	10.7 0	14.1 0	13.2	16.2 0	10 U	71.7	10 U	10.0 U	10 U
Chloride (mg/l)	250	58.1 0	86.3 0	71.4 0	70.6	59.7 0	44.5 0	53.6	51.7	37.7	40.6
Color	15	**1500**	NA	NA	NA	NA	NA	**400**	NA	**90**	NA
Cyanide, Total (mg/l)	0.2	0.01 U						0.01 U	NA	0.0100 U	
Hardness (mg/l)		252 0	406 0	371 0	342	311 0	304 0	262	257	236	284
Hexavalent Chromium (mg/l)	0.05	0.01 U						0.01 U	NA	0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.2 U	0.04 U	2.48 0	0.12	0.1 U	0.1 U	0.1 U	0.1 U	0.100 U	.100 U
Phenols (mg/l)	0.001	**0.012 0**	**0.032 0**	**0.008 0**	**0.009**	**0.007 0**	**0.015 0**	**0.006**	0.01 U	**0.0540**	.05 U
Sulfate (mg/l)	250	35.5 0	8.6 0	4.5 0	5.99	10 U	13 0	10 U	10 U	10.0 U	10 U
Total Dissolved Solids (mg/l)		373 0	546 0	583 0	585	444 0	363 0	354	328	NA*	370
Total Kjeldahl Nitrogen (mg/l)		52.8 0	65 0	46.4 0	55.2	46.8 0	49.9 0	57.7 J	96.7	4.85	54.9
Total Organic Carbon (mg/l)		1 U	2.67 0	4.28 0	5.42	1 U	5.41 0	3.02	2.90	NA	7.24

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling error

R = Rejected by data validator

TABLE 1
MW-15D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
1,2-Dibromo-3-Chloropropane	0.04		10 U	5 U	5 U	5 U	5 U	5 U	5 U		
1,4-Dichlorobenzene	3		5 U	5 U	5 U	5 U	5 U	5 U	5 U		
Benzene	1	NA	0.4 U	0.5 J	NA	5 U	NA	NA	5 U	5 U	NA
Bromomethane	5		10 U	10 U	10 U	10 U	10 U	10 U	10 U		
Methylene Chloride	5	NA	5 U	0.4 J	NA	5 U	NA	NA	5 U	5 U	NA
trans-1,4-Dichloro-2-Butene	5		10 U	5 U	5 U	5 U	5 U	5 U	5 U		

NOTES:

U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	10.0 U	38.5 B	38.5 B	590	NA	NA	16,400	181	NA
Antimony	3		5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Arsenic	25	NA	2.9 B	4.9 U	4.9 U	7 U	NA	NA	6.9 B	7.7	NA
Barium	1,000	NA	132 B	93 B	93 B	97	NA	NA	195	106	NA
Beryllium	3	NA	0.5 U	0.5 U	0.5 U	1 U	NA	NA	0.77 B	0.54	NA
Boron	1,000	NA	153	109	109	95.4	NA	NA	109	82.4	NA
Calcium		90,600	150,000	130,000	122,000	117,000	121,000	123,000	273,000	118,000	127,000
Chromium	50	NA	1.8 B	2.3 B	2.3 B	5.1 B	NA	NA	**52.9**	2	NA
Cobalt		NA	10.1 B	8.3 B	8.3 B	7.5 B	NA	NA	17.9	7.4	NA
Copper	200	NA	1.0 U	1.5 U	1.5 U	3.9 B	NA	NA	32.5	4.5	NA
Iron	300	**13,400**	**21,400**	**18,900**	**18,200**	**18,600**	**17,700**	**18,500**	**44,300**	**28,800**	**16,300**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	9.3 B	3.5	3 U
Magnesium		11,200	19,700	15,800	14,800	14,100	13,600	13,700	38,200 NJ	11,900	13,300
Manganese	300	**409**	**685**	**546**	**509**	**524**	**492**	**530**	**1,120**	**554**	**506**
Mercury	2		0.10 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	15.5	15.5
Nickel	100	NA	20.0 B	18.8 B	18.8 B	17.4	NA	NA	57.7	15.5	NA
Potassium		6,440	11,700	6,810	7,810	7,070	6,930	4,640	7,720 NJ	3,930	3,110
Selenium	10		5.00 U	5.5 N	5.5 N	6.9 U	NA	NA	5 U		NA
Sodium	20,000	19,900	**22,400**	**26,000**	**27,700**	**22,400 J**	**20,800**	17,700	**25,300 NJ**	**27,200**	**21,800**
Vanadium			1.00 U	1.0 U	1.0 U	1.9 B	NA	NA	30.6	1.5 U	NA
Zinc		NA	20.5	17.0 B	17.0 B	16.2 U	NA	NA	68.6	11 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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* Duplicate analysis not within control limit

+/- = Additionally estimated

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/28/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		439	514	424	435	410	424	440	430	417	392
Ammonia Nitrogen (mg/l)	2	**39.7**	**34**	**21.4**	**22**	**17**	**24**	**23**	**23**	**17**	**14**
BOD (mg/l)		2.3	2 U	2 U	3.4	4.2	5.1	13	2.2	24	2.2
Bromide (mg/l)		0.1 U	0.106	0.1 U	0.072 B	0.1 U	0.1 U	0.061 B	0.066 B	0.054 B	0.042 B
COD (mg/l)		10 U	11.8	14.7	10 U	10 U	16.9	11.6	20	7.96 B	9.91 B
Chloride (mg/l)	250	32.9	46.5	54.9	51	33	33	44	45.7	29.7	36
Color	15	NA	**240**	**500**	**500**	**380**	NA	NA	**150**	**80**	NA
Cyanide, Total (mg/l)	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		272	456	390	3,110	350	358	364	839	344	372
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.006 B	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.053 B	0.049 B
Phenols (mg/l)	0.001	0.0	**0.01**	0.005 U	0.005 U	0.005 U	**0.021**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	6.78	5.4	3.59	3.3	3.1	3.1	2.6	2.55	3.76	4.96
Total Dissolved Solids (mg/l)		349	487	483	470	400	400	450	420	410	390
Total Kjeldahl Nitrogen (mg/l)		41.6	38.4	23	19.4	24.7	27.1	23	21.3	15.9	14.3
Total Organic Carbon (mg/l)		5.13	7.27	8.19	8.7	0.27 B	2.3	0.92 B	2.8	2.4	1.8

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

U = Compound was analyzed for, but not detected

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

NA* = Results not available due to lab scheduling error

R = Rejected by data validator

TABLE 1
MW-15D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	08/05/09	10/27/09
1,2-Dibromo-3-Chloropropane	0.04	5 UJ	5 UJ	5 UJ	5 UJ		5 UJ		5 UJ		5
1,4-Dichlorobenzene	3	5 UJ	5 UJ	5 UJ	5 UJ		5 UJ		5 UJ		5
Benzene	1	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
Bromomethane	5	10 UJ	10 UJ	10 UJ	10 UJ		10 UJ		10 UJ		10
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA
trans-1,4-Dichloro-2-Butene	5	5 UJ	5 UJ	5 UJ	5 UJ		5 UJ		5 UJ		5

NOTES:
U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

INORGANIC PARAMETERS (µg/L)	NYSDEC Class GA Standards	SAMPLING DATE 07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	07/15/09	10/27/09
Aluminum		92 U	NA	114 B	NA	100 UJ+	NA	100 U	NA	100 U	NA
Antimony	3					15.0 U	NA	30.0 U	NA	15 UJ	NA
Arsenic	25	4.1 B	NA	3.9 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Barium	1,000	78.2	NA	80.4	NA	73.3	NA	90.2	NA	82.9	NA
Beryllium	3	0.54 U	NA	0.54 U	NA	3.00 U	NA	3.00 U	NA	3 U	NA
Boron	1,000	66.6	NA	77.3 J	NA	500 U	NA	500 U	NA	500 U	NA
Calcium		102,000	113,000	107,000	116,000	99,100	91,100	108,000 J	89,500	109,000	93,900
Chromium	50	1.3 U	NA	1.3 U	NA	5.00 UJ	NA	5.00 U	NA	5 U	NA
Cobalt		5 B	NA	5.9 B	NA	20.0 U	NA	20.0 U	NA	20 U	NA
Copper	200	4.3 U	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Iron	300	**15,000**	**15,500**	**15,200**	**9,280**	**14,500**	**5,250**	**16,400 J**	**12,000**	**13,700**	**10,000**
Lead	25	3 U	3 U	3 U	3.1 B	3.00 UJ	3.00 U	3.00 U	6.11	3.00 U	3.00 U
Magnesium		10,400	10,900	10,500	11,000	9,670	8,660	10,200	8,560	10,100	8,800
Manganese	300	**427**	**455**	**449**	**392**	**400**	270	**439 J**	**365**	**412**	**448**
Mercury	2					0.200 U	NA	0.200 U	NA	0.2 U	NA
Nickel	100	11.5	NA	11	NA	30.0 U	NA	30 U	NA	30 U	NA
Potassium		3,430	3,670	2,890 J	3,390	2,450	2,570	2,900	2,320	3,260 J	5,000 U
Selenium	10		NA		NA	**11.3 J**	NA	5.00 U	NA	5 U	NA
Sodium	20,000	18,600 J+	18,900	15,700	16,000	**20,500 J**	18,700	16,800	13,900	17,200	13,300
Vanadium		1.5 U	NA	10 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	10.0 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
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CONVENTIONAL PARAMETERS	NYSDEC Class GA Standards	SAMPLING DATE 07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	07/15/09	10/27/09
Alkalinity (mg/l)		358	371	380	376	360	360	340	350	320	320
Ammonia Nitrogen (mg/l)	2	**15**	**17**	**12**	**15**	**10.9**	**10.5**	**11.4**	0.500 U	**13.2**	**12.1**
BOD (mg/l)		2 U	2.8	6.4	9.8	4 U	13	4.00 U	4.00 U	4.00 U	4.00 U
Bromide (mg/l)		0.1 U	0.184	0.033 B	0.023 B	20 UJ	1 U	20 U	20 U	2 U	2 U
COD (mg/l)		7.52 B	3.16 B	7.25 B	4.07 B	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	26.1	37	29.6	40.2	47.6	35.8	26.1	24.4	20.9	84.3
Color	15	**75**	NA	**200**	NA	**290**	NA	**125**	NA	15	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		298	327	310	335	287	263	312	259	315	271
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.02 U	NA	0.010 U	NA	0.010 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.1 U	0.1 U	0.1 U	0.051 B	0.200 UJ	0.827	0.200 U	0.200 U	0.200 U	0.200 U
Phenols (mg/l)	0.001	0.005 U	**0.004 B**	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	3.98	1.62	1.82	1.3	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Total Dissolved Solids (mg/l)		350	380	370	380	375	370	352	336	570	330
Total Kjeldahl Nitrogen (mg/l)		13.8	14.1	14.2	15.2	12.1	11.3	12.5	12.6	12.8	13.4
Total Organic Carbon (mg/l)		1.4	2.4	3.4	2.8	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
NA* = Results not available due to lab scheduling error
R = Rejected by data validator

TABLE 1
MW-15D Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/30/11	07/22/14
VOLATILE COMPOUNDS (µg/L)						
1,2-Dibromo-3-Chloropropane	0.04		5	10 U	NA	2.5 U
1,4-Dichlorobenzene	3		5	5 U	NA	5.0 U
Benzene	1	5 U	NA	5 U	NA	2.5 U
Bromomethane	5		10	5 U	NA	5.0 U
Methylene Chloride	5	5 U	NA	5 U	NA	2.5 U
trans-1,4-Dichloro-2-Butene	5		5	10 U	NA	2.5 U

NOTES:

U = Compound was analyzed for, but not detected

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J = Concentration is an estimated value

NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/30/11	07/22/14
INORGANIC PARAMETERS (µg/L)						
Aluminum		100 U	NA	100 U	NA	22.0
Antimony	3	5.0 UJ	NA	5 U	NA	0.10 J
Arsenic	25	5.0 UJ	NA	5 U	NA	3.76
Barium	1,000	84.5	NA	93.7	NA	60.27
Beryllium	3	3.00 U	NA	3 U	NA	0.50 U
Boron	1,000	500 U	NA	500 U	NA	42.0
Calcium		100,000	102,000	104,000	113,000	95,000
Chromium	50	10.0 U	NA	10 U	NA	1.55
Cobalt		20.0 U	NA	20 U	NA	3.33
Copper	200	10.0 U	NA	10 U	NA	2.59
Iron	300	**14,700**	**12,200**	**13,200**	**13,100**	**13,400**
Lead	25	3.0 U	3.0 U	3.0 U	3.0 U	1.30
Magnesium		9,790	9,400	11,100	10,200	8,400
Manganese	300	**419**	**406**	**377 J**	**410**	**346.3**
Mercury	2	0.211 J	NA	0.2 U	NA	0.20 U
Nickel	100	30 U	NA	30 U	NA	11.81
Potassium		5,000 U	5,000 U	5,000 UJ	5,000 U	1,800
Selenium	10	3 U	NA	3 U	NA	0.45 J
Sodium	20,000	17,000	14,700	13,700 J	15,800	16,000
Vanadium		30.0 U	NA	30 U	NA	0.29 J
Zinc		10.0 UJ	NA	10.0 UJ	NA	6.72 J

NOTES:

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	NYSDEC Class	SAMPLING DATE				
	GA Standards	07/06/10	11/03/10	11/09/11	12/30/11	07/22/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		340	300	350 J	350	327
Ammonia Nitrogen (mg/l)	2	**10.4**	**12.6**	**9.24**	**9.56**	**6.12**
BOD (mg/l)		4.0 U	4.0 U	4.0 U	4.0 U	0.20 U
Bromide (mg/l)		8.0 U	8.0 U	8.0 U	8.0 U	0.05 U
COD (mg/l)		20 U	20 U	20 U	20 U	19.0
Chloride (mg/l)	250	23.4	24.4	32.3	33.7	30.1
Color	15	**150**	NA	**475**	NA	**260**
Cyanide, Total (mg/l)	0.2	0.01 U	NA	10 U	NA	0.002 J
Hardness (mg/l)		291	294	304	325	270
Hexavalent Chromium (mg/l)	0.05	0.010 U	NA	0.010 U	NA	0.010 U
Nitrate Nitrogen (mg/l)	10	0.065	0.050 U	0.090	0.050 U	0.022 J
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	0.06
Sulfate (mg/l)	250	5.00 U	5.00 U	5.00 U	5.00 U	6.01
Total Dissolved Solids (mg/l)		350	330	340	380	370
Total Kjeldahl Nitrogen (mg/l)		13.0	11.1	8.37	10.5	6.60
Total Organic Carbon (mg/l)		3.0 U	3.0 U	3.0 U	3.0 U	2.73

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard

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NA* = Results not available due to lab scheduling error

R = Rejected by data validator

TABLE 1
MW-15S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	3 JB	NA	NA	NA	NA	NA	5 U	NA	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum		43.2 B	NA	NA	NA	NA	NA	69.3 B	NA	22.0 U	NA
Antimony	3	3.9 U						5.0 U	NA	3.0 U	
Barium	1,000	69 B	NA	NA	NA	NA	NA	137 B	NA	97.6 B	NA
Boron	1,000	89.2	NA	NA	NA	NA	NA	141	NA	NA	NA
Cadmium	5	0.4 U	0.4 U	0.5 U	0.3 U	2 U	1 U	2.4 JB	1 U	1.4 B	1 U
Calcium		79,000 0	111,000 0	123,000 0	127,000	114,000 0	120,000 0	116,000	101,000	84,600	106,000
Chromium	50	1.3 B	NA	NA	NA	NA	NA	2.1 B	NA	1.0 U	NA
Cobalt		1.1 B	NA	NA	NA	NA	NA	2.5 B	NA	2.0 U	NA
Copper	200	16.4 B	NA	NA	NA	NA	NA	2.5 B	NA	1.6 B	NA
Iron	300	237 0	135 0	**324 0**	45.4 B	8.3 B	28 B	160	167	44.3 B	**4,430**
Lead	25	1.5 U	1.8 U	1.6 U	1.9 U	1 U	1 U	4.4	2 U	2.0 U	8.6
Magnesium		10,700 0	15,500 0	16,800 0	16,200	14,300 0	14,900 0	14,500	12,600	9,710	12,600
Manganese	300	**1,700 0**	**2,890 0**	**2,760 0**	**2,670**	**2,300 0**	**2,170 0**	**2,280**	**2,150**	**1,770**	**2,790**
Nickel	100	4.9 B	NA	NA	NA	NA	NA	12.1 B	NA	5.5 B	NA
Potassium		2,270 B	9,250 0	5,170 0	5,450	6,800 E	7,000 0	5,720	5,140	4,510 B	NA
Selenium	10	3 U	NA	NA	NA	NA	NA	3.0 U	NA	R	NA
Sodium	20,000	**24,300 0**	**38,000 0**	**48,000 0**	**54,900**	**55,200 E**	**57,900 0**	**53,100**	**46,900**	**24,500**	**26,500**
Thallium	4	5.3 B	NA	NA	NA	NA	NA	6 UN	NA	3.0 U	NA
Vanadium		1 U						1.0 U	NA	2.0 U	
Zinc		13.5 B	NA	NA	NA	NA	NA	76.0	NA	5.0 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Concentration is < the CRQL and > the IDL
J = Concentration is an estimated value
NA = Parameter not analyzed
R = Rejected- Data qualified as unusable
+/- = Additionally estimated
** = Filtered sample

	NYSDEC Class GA Standards	SAMPLING DATE 05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/03/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		238 0	380 0	412 0	540	492 0	461 0	300	452	410	403
Ammonia Nitrogen (mg/l)	2	**2.59 0**	**34 0**	**30.6 0**	**40**	**38.1 0**	**36.2 0**	**39.2 J**	**32.1**	**33.8**	**29.6**
BOD (mg/l)		3 U	4 U	4.4 0	3.7 U	2 U	3.6 0	2 U	3	2.60	2 U
Bromide (mg/l)	2	0.1 U	0.1 U	0.1 0	0.1 U	2 U	2 U	2 U	1 U	2.00 U	
COD (mg/l)		17.4 0	24.9 0	4.8 0	3 U	13.6 0	10 U	10 U	10 U	10.0 U	17.3
Chloride (mg/l)	250	22.5 0	59.2 0	77.3 0	99.5	86.4 0	70.6 0	70.8	46.1	25.2	19.7
Color	15	**40**	NA	NA	NA	NA	NA	5 U	NA	5 U	NA
Cyanide, Total (mg/l)	0.2	0.01 U						0.0100 U	NA	0.0100 U	
Hardness (mg/l)		242 0	340 0	375 0	383	349 0	362 0	349	304	251	317
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	NA	NA	NA	0.0100 U	NA	0.0100 J	NA
Nitrate Nitrogen (mg/l)	10	3.78 0	3.61 0	3.66 0	0.05	0.1 U	0.283 0	0.190	0.17	1.78	1.91
Phenols (mg/l)	0.001	**0.012 0**	**0.046 0**	**0.007 0**	0.005 U	**0.009 0**	**0.013 0**	**0.0120**	**0.024**	0.0500 U	.05 U
Sulfate (mg/l)	250	23.7 0	15.9 0	17.2 0	15.3	10.8 0	15.5 0	10 U	10 U	11.4	18.1
Total Dissolved Solids (mg/l)		304 0	44 0	506 0	619	506 0	441 0	492	414	366	407
Total Kjeldahl Nitrogen (mg/l)		4.09 0	48.7 0	97.3 0	114	40 0	39.3 0	38.1 J	47.1	36.6	30.2
Total Organic Carbon (mg/l)		1 U	1 U	4.38 0	3.65	1 U	4.68 0	3.42	3.92	2.10	2.38

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-15S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/24/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	NA	1 U	1 J	NA	5 U	NA	NA	5 U	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/24/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
INORGANIC PARAMETERS (µg/L)											
Aluminum		NA	38.7 B	94.4 B	94.4 B	90.4 B	NA	NA	5,650	7,440	NA
Antimony	3		5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U		
Barium	1,000	NA	98.9 B	110 B	110 B	191	NA	NA	143	159	NA
Boron	1,000	NA	133	130	130	120	NA	NA	89.7	72.8	NA
Cadmium	5	0.29 B	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U
Calcium		81,000	83,700	114,000	104,000	106,000	222,000	109,000	124,000	134,000	148,000
Chromium	50	NA	1.1 B	1.2 B	1.2 B	1.5 U	NA	NA	13.9	42.7	NA
Cobalt		NA	1.6 B	2.0 B	2.0 B	2.6 B	NA	NA	7.2 B	13.7	NA
Copper	200	NA	1.0 B	1.5 U	1.5 U	1.5 B	NA	NA	6.5 B	15.1	NA
Iron	300	58.7 B	80.8 B	158	127 B	96.6 B	**15,100**	**5,930**	**8,390**	**11,300**	**1,460**
Lead	25	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	4.2 B	3.6 U	3.8 B	11.3	3 U
Magnesium		8,550	9,350	11,800	10,400	11,700	41,700	13,300	15,200 NJ	15,600	20,300
Manganese	300	**1,960**	**1,760**	**2,110**	**2,050**	**2,070**	**2,940**	**2,260**	**3,730**	**4,640**	**2,590**
Nickel	100	NA	3.9 B	5.3 B	5.3 B	8.9 B	NA	NA	15	17.1	NA
Potassium		3,240 B	5,730	5,310	5,690	4,520	6,700	2,970	3,670 NJ	3,200	2,810
Selenium	10	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U		NA
Sodium	20,000	13,500	13,200	10,800	11,000	14,200 J	19,300	14,400	16,900 NJ	17,200	**22,300**
Thallium	4	NA	**9.7 B**	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ	10 U	NA
Vanadium			1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	10.3	15.4	NA
Zinc		NA	5.0 U	5.2 B	5.2 B	148	NA	NA	19.8 B	28.3	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Concentration is < the CRQL and > the IDL
J = Concentration is an estimated value
NA = Parameter not analyzed
R = Rejected- Data qualified as unusable
+/- = Additionally estimated
** = Filtered sample

	NYSDEC Class	SAMPLING DATE									
	GA Standards	05/18/00	10/04/00	10/25/01	12/06/01	10/24/02	12/09/02	09/17/03	11/06/03	05/11/04	10/12/04
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		280	297	386	387	356	512	381	402	410	455
Ammonia Nitrogen (mg/l)	2	**18.7**	**26.6**	**24.9**	**28**	**20**	**15**	**15**	**15**	**11**	**12**
BOD (mg/l)		3.5	2.0 U	2 U	2.8	5.2	16	7.6	5.6	5.3	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.044 B	0.1 U	0.1 U	0.1 U	0.1 U	0.052 B	0.04 B
COD (mg/l)		16	11.8	10 U	10 U	7.79 B	10 U	10 U	10 U	14.3	9.3 B
Chloride (mg/l)	250	14	13.1	28.8	34	26	26	23	22.6	32.4	35.5
Color	15	NA	5.0	15	15	**500**	NA	NA	15	**100**	NA
Cyanide, Total (mg/l)	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA
Hardness (mg/l)		237	248	336	303	313	726	327	372	399	453
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	0.01 U	0.01 U	.01 U	NA	NA	0.01 U	0.004 B	NA
Nitrate Nitrogen (mg/l)	10	9.21	**16.2**	0.131	0.028 B	0.026 B	0.083 B	0.08 B	0.1 U	0.093	0.067 B
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.067**	**0.009**	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	17	24.8	12.4	9.8	13	11	10	9.44	7.41	4.73
Total Dissolved Solids (mg/l)		324	364	391	380	380	390	400	10 U	430	410
Total Kjeldahl Nitrogen (mg/l)		20.1	30.9	25.5	27.3	20.2	17.4	14.2	16.3	10.2	13.5
Total Organic Carbon (mg/l)		3.30	4.78	5.28	3	1.3	2.3	2.6	2.1	1.8	1.5

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-15S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	08/05/09	10/27/09
VOLATILE COMPOUNDS (µg/L)											
Methylene Chloride	5	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	07/15/09	10/27/09
INORGANIC PARAMETERS (µg/L)											
Aluminum		2,160	NA	508	NA	100 J+	NA	100 U	NA	1,090	NA
Antimony	3					15 U	NA	30.0 U	NA	15 UJ	NA
Barium	1,000	95.6	NA	69.1	NA	72.4	NA	84.4	NA	73.2	NA
Boron	1,000	50.3 B	NA	57.9 JB	NA	500 U	NA	500 U	NA	500 U	NA
Cadmium	5	1.1 U	1.1 U	1.1 U	0.76 U	5 U	5 U	5 U	5.00 U	5.00 U	5.00 U
Calcium		111,000	111,000	106,000	127,000	108,000	92,900	115,000 J	96,000	101,000	104,000
Chromium	50	13.4	NA	1.3 B	NA	5 UJ	NA	5.00 U	NA	18.7	NA
Cobalt		4.8 B	NA	1.8 U	NA	20 U	NA	20.0 U	NA	20 U	NA
Copper	200	6.2 B	NA	4.3 U	NA	10 U	NA	10.0 U	NA	10 U	NA
Iron	300	**4,010**	**780**	**926**	**2,500**	**750**	**3,230**	**387 J**	**364**	**1,580 J**	**533**
Lead	25	3 U	3 U	3 U	3.7 B	3.47 J	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U
Magnesium		13,700	12,000	11,000	12,600	10,200	8,540	11,200	9,220	9,760	10,300
Manganese	300	**2,450**	**1,950**	**2,230**	**2,650**	**1,660**	**1,390**	**1,980 J**	**1,760**	**1,770**	**1,620**
Nickel	100	13.1	NA	4.1 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Potassium		2,260	1,960	1,730 J	2,370	2,360	2,390	2,430	1,960	2,240 J	5,000 U
Selenium	10		NA		NA	**14.1 J**	NA	5.0 U	NA	5 U	NA
Sodium	20,000	19,200 J+	16,000	14,000	15,500	14,200 J	15,700	**24,400**	**20,400**	18,600	17,400
Thallium	4	10 UJ-	NA	10 UJ	NA	10.0 U	NA	10.0 U	NA	10 U	NA
Vanadium		5.6 B	NA	1.5 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA
Zinc		11 U	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	15.2 J	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Concentration is < the CRQL and > the IDL
J = Concentration is an estimated value
NA = Parameter not analyzed
R = Rejected- Data qualified as unusable
+/- = Additionally estimated
** = Filtered sample

	NYSDEC Class	SAMPLING DATE									
	GA Standards	07/19/05	11/02/05	07/20/06	01/03/07	09/25/07	12/04/07	10/27/08	12/08/08	07/15/09	10/27/09
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		381	338	363	389	390	360	370	370	320	350
Ammonia Nitrogen (mg/l)	2	**8.6**	**6.5**	**7.5**	**9**	**11.8**	**11.6**	**9.44**	**9.09**	**8.92**	**8.3**
BOD (mg/l)		2 U	6.7	7.8	7.3	17	24	5.00	4.00 U	4.00	9
Bromide (mg/l)	2	0.1 U	0.1 U	0.032 B	0.1 U	0.20 U	1.00 U	0.20 U	0.20 U	2.00 U	2.00 U
COD (mg/l)		10 U	3.16 B	10 U	10 U	20 U	20 U	20 U	20 U	20 U	20 U
Chloride (mg/l)	250	1.97	21.3	26.5	24.7	26.8	23.5	29.4	23.4	21.9	23.2
Color	15	**100**	NA	**20**	NA	**22.0**	NA	12.0	NA	5	NA
Cyanide, Total (mg/l)	0.2	10 U	NA	**2.8 B**	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA
Hardness (mg/l)		334	327	310	369	311	267	334	279	292	301
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 U	NA	0.01 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.65	0.106	0.125	0.048 B	0.209 J	1.12	0.2 U	0.200 U	0.200 U	0.583
Phenols (mg/l)	0.001	0.005 U	0.005 U	**0.004 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	20	4.43	4.95	3.73	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Total Dissolved Solids (mg/l)		380	360	370	390	433	465	375	365	380	410
Total Kjeldahl Nitrogen (mg/l)		9.19	5.89	8.15	10.3	14.0	12.3	10.9	10.1	9.1	10.4
Total Organic Carbon (mg/l)		1.6	2.1	3	3	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 1
MW-15S Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE					
	GA Standards	07/06/10	07/06/10**	11/03/10	11/09/11	12/30/11	07/22/14
VOLATILE COMPOUNDS (µg/L)							
Methylene Chloride	5	5 U	NA	NA	5 U	NA	2.5 U

NOTES:
U = Compound analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed

	NYSDEC Class	SAMPLING DATE					
	GA Standards	07/06/10	07/06/10**	11/03/10	11/09/11	12/30/11	07/22/14
INORGANIC PARAMETERS (µg/L)							
Aluminum		302	100 UJ	NA	438	NA	50.0
Antimony	3	5.0 UJ	5.0 UJ	NA	5 U	NA	0.11 J
Barium	1,000	69	59.8 J	NA	72	NA	44.94
Boron	1,000	500 U	NA	NA	500 U	NA	37.0
Cadmium	5	5.00 U	5.00 UJ	5.00 U	5.00 U	5.00 U	0.20 U
Calcium		94,100	84,200 J	101,000	94,500	92,300	92,000
Chromium	50	10.0 U	10.0 UJ	NA	10 U	NA	2.78
Cobalt		20.0 U	20.0 UJ	NA	20 U	NA	1.29
Copper	200	10.0 U	10.0 UJ	NA	10 U	NA	1.57
Iron	300	**620**	60.0 UJ	180	**847**	**373**	**364**
Lead	25	3.0 U	3.0 UJ	3.00 U	3.00 U	3.00 U	0.57 J
Magnesium		9,580	8,600 J	9,520	10,100	8,370	8,500
Manganese	300	**1,790**	**1,480 J**	**1,670**	**1,470 J**	**1,410**	**357**
Nickel	100	30.0 U	30.0 UJ	NA	30 U	NA	3.42
Potassium		5,000 U	5,000 UJ	5,000 U	5,000 UJ	5,000 U	1,480
Selenium	10	3.0 U	3.0 UJ	NA	3 U	NA	0.48 J
Sodium	20,000	15,600	14,200 J	13,600	12,900 J	12,300	12,900
Thallium	4	3.0 U	3.0 UJ	NA	3 U	NA	0.03 J
Vanadium		30.0 U	30.0 UJ	NA	30 U	NA	0.50 J
Zinc		10.0 UJ	12.1 J	NA	10 UJ	NA	5.41 J

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
U = Compound analyzed for, but not detected
B = Concentration is < the CRQL and > the IDL
J = Concentration is an estimated value
NA = Parameter not analyzed
R = Rejected- Data qualified as unusable
+/- = Additionally estimated
** = Filtered sample

	NYSDEC Class	SAMPLING DATE					
	GA Standards	07/06/10	07/06/10**	11/03/10	11/09/11	12/30/11	07/22/14
CONVENTIONAL PARAMETERS							
Alkalinity (mg/l)		350	NA	310	350 J	330	324
Ammonia Nitrogen (mg/l)	2	**8.63**	NA	**12.0**	**11.6**	**12.3**	**6.02**
BOD (mg/l)		5.0	NA	4.0 U	8.0	4.0 U	2.00 U
Bromide (mg/l)	2	1.60 U	NA	0.8 U	0.8 U	0.8 U	0.05 U
COD (mg/l)		20 U	NA	20 U	20 U	20 U	9.50 J
Chloride (mg/l)	250	20.3	NA	18.6	22.1	23.5	18.6
Color	15	15.0	NA	NA	**20**	NA	8.00
Cyanide, Total (mg/l)	0.2	0.01 U	NA	NA	10 U	NA	0.002 J
Hardness (mg/l)		274	NA	293	277	265	260
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.114	NA	0.310	0.165	0.117	0.160
Phenols (mg/l)	0.001	0.005 U	NA	0.005 U	0.005 RU	0.005 U	**0.16**
Sulfate (mg/l)	250	5.00 U	NA	5.00 U	5.40	12.20	8.84
Total Dissolved Solids (mg/l)		370	NA	320	320	330	340
Total Kjeldahl Nitrogen (mg/l)		12.5	NA	11.4	11.6	11.7	6.00
Total Organic Carbon (mg/l)		3.0 U	NA	3.0 U	3.0 U	3.0 U	2.56

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class GA Standard
Blank cell or U = Compound was analyzed for, but not detected
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Rejected by data validator

TABLE 2
SW-1 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE 05/22/96	3/2797	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Benzene	1	ND	NS	NA	NS	NS	NA	**2 J**	NS	5 U	NA
Bromochloromethane											
Ethyl Acetate											
Ethylbenzene	5	ND	NS	NA	NS	NS	NA	**6**	NS	5 U	NA
Methylene Chloride	5	2 JB	NA	NA	NA	NA	NA	5 U		5 U	5
Styrene	5	ND	NS	NA	NS	NS	NA	**7**	NS	5 U	NA
trans-1,3-Dichloropropene	0.4		NA	NA	NA	NA	NA	5 U		5 U	5 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE 05/22/96	3/2797	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum	100	76.4 B	NS	NA	NS	NS	NA	19.8 B	NS	22.0 U	NA
Antimony		3.9 U	NS	NA	NS	NS	NA	5.0 U	NS	5.8 B	NA
Arsenic	150	1.6 U	NS	NA	NS	NS	NA	3.0 U	NS	3.0 U	NA
Barium		53 B	NS	NA	NS	NS	NA	46.5 B	NS	40.3 B	NA
Boron	10,000	66.9	NS	NA	NS	NS	NA	75.3 B	NS	NA	NA
Cadmium	**	0.4 U	NS	0.5 U	NS	NS	1 U	2.2 JB	NS	1.3 B	1 U
Calcium		115,000 0	NS	114,000 0	NS	NS	104,000 0	106,000	NS	106,000	139,000
Chromium	**	1.1 B	NS	NA	NS	NS	NA	1.0 U	NS	1.0 U	NA
Cobalt	5	1.1 B	NS	NA	NS	NS	NA	2.0 U	NS	2.0 U	NA
Copper	**	9.4 B	NS	NA	NS	NS	NA	1.0 U	NS	1.0 U	NA
Iron	300	**590 0**	NS	**601 0**	NS	NS	**943 0**	**307**	NS	**330 ***	**45000**
Lead	**	1.5 U	NS	1.6 U	NS	NS	1 U	2.0 B	NS	2.2 B	3 U
Magnesium		11800 0	NS	10,800 0	NS	NS	10,200 0	10,400	NS	10,800	13,400
Manganese		**476 0**	NS	**483 0**	NS	NS	**360 0**	**416**	NS	**402**	**1310**
Mercury	0.77	0.2 U	NS	NA	NS	NS	NA	0.10 U	NS	0.13 B	
Nickel	**	3.4 B	NS	NA	NS	NS	NA	6.1 B	NS	6.0 B	NA
Potassium		1,850 B	NS	2,570 B	NS	NS	2,560 B	2,200 B	NS	1,560 B	2,000 B
Selenium	4.6	3.2 U	NS	NA	NS	NS	NA	3.0 U	NS	4.0 U	
Sodium		15,100 0	NS	26,000 0	NS	NS	8,870 0	6,780	NS	4,840 B	6,350
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 U	NS	2.0 U	NA
Zinc	**	2.1 U	NS	NA	NS	NS	NA	50.7	NS	10.8 B	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

U = Compound was analyzed for, but not detected
B = Concentration is less than the CRQL and greater than the IDL
J = Concentration is an estimated value
NS = Monitoring well not sampled
NA = Parameter not analyzed
N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limits
+/- = Additionally estimated
** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE 05/22/96	3/2797	06/26/97	10/08/97	02/18/98	05/27/98	08/20/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		374 0	NS	343 0	NS	NS	370 0	330	NS	502	387
Ammonia Nitrogen (mg/l)	2	**9.6 0**	NS	**14.4 0**	NS	NS	**17.6 0**	**13.5**	NS	**9.19**	**13**
BOD (mg/l)		3 U	NS	7 U	NS	NS	2.1 0	2.00 U	NS	2.00 J	2 U
Bromide (mg/l)	2	0.1 U	NS	0.1 U	NS	NS	2 U	2.00 U	NS	2.00 U	
COD (mg/l)		3 U	NS	13 0	NS	NS	10 U	10.0 U	NS	10.0 U	10 U
Chloride (mg/l)	250	18.4 0	NS	27.6 0	NS	NS	12.4 0	13.7	NS	10.7	14.4
Color	15	**60**	NS	NA	NS	NS	NA	5 U	NS	10	NA
Cyanide, Total (mg/l)	0.2	0.01 U	NS		NS	NS		0.0100 U	NS	0.0100 U	
Hardness (mg/l)		335 0	NS	328 0	NS	NS	301 0	308	NS	310	402
Hexavalent Chromium (mg/l)	0.05	0.01 U	NS		NS	NS		0.0100 U	NS	0.0100 U	
Nitrate Nitrogen (mg/l)	10	3.05 0	NS	3.01 0	NS	NS	0.55 0	0.228	NS	1.08	0.387
Phenols (mg/l)	0.001	**0.027 0**	NS	0.005 U	NS	NS	**0.01 0**	**0.009**	NS	0.0500 U	0.05 U
Sulfate (mg/l)	250	26.7 0	NS	8.7 0	NS	NS	18.2 0	13.8	NS	14.8	16.1
Total Dissolved Solids (mg/l)		373 0	NS	271 0	NS	NS	305 0	314	NS	356	384
Total Kjeldahl Nitrogen (mg/l)		12.5 0	NS	8.1 0	NS	NS	19.5 0	14.0 J	NS	9.13	16
Total Organic Carbon (mg/l)		1 U	NS	1 U	NS	NS	2.31 0	1.18	NS	2.06	8.84

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

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R = Data rejected by validator; data are unusable

TABLE 2
SW-1 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/25/01	12/06/01	10/28/02	12/10/02	09/15/03	11/06/03	05/11/04	10/12/04	07/20/05
VOLATILE COMPOUNDS (µg/L)												
Benzene	1	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA	5 U
Bromochloromethane												
Ethyl Acetate												
Ethylbenzene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA	5 U
Methylene Chloride	5	5	2 U	**7**	NA	5 U	NA	NA	5 U	5 U	NA	5 U
Styrene	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA	5 U
trans-1,3-Dichloropropene	0.4	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U			

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/25/01	12/06/01	10/28/02	12/10/02	09/15/03	11/06/03	05/11/04	10/12/04	07/20/05
INORGANIC PARAMETERS (µg/L)												
Aluminum	100	NA	10.0 U	20.1 U	20.1 U	83.3 U	NA	NA	202 B	92 U	NA	92 U
Antimony		NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U			
Arsenic	150	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U			
Barium		NA	37.8 B	36.3 B	36.3 B	39.7	NA	NA	37.6	30.8	NA	36.3
Boron	10,000	NA	42.2 B	50 U	50 U	50 U	NA	NA	27.4 B	27 U	NA	27 U
Cadmium	**	0.2 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U	1.1 U
Calcium		129,000	114,000	115,000	106,000	107,000	115,000	116,000	125,000	106,000	103,000	103,000
Chromium	**	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U	1.3 U	1.3 U	
Cobalt	5	NA	2.5 B	2.4 B	2.4 B	2.2 B	NA	NA	2.3 B	3.3	NA	2 B
Copper	**	NA	1.0 U	1.5 U	1.5 U	12.9	NA	NA	2.6 U	4.3	NA	4.3 U
Iron	300	**1,070**	**1,610**	**1,420**	**1,780**	**1,090**	**946**	**1,450**	**1,300**	**2,970**	**590**	**3,290**
Lead	**	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3	3 U	3 U
Magnesium		12,500	10,600	9,570	8,820	9,700	9,960	10,200	11,000 NJ	8,420	8,170	9,160
Manganese		**836**	**598**	**565**	**557**	**639**	**574**	**815**	**539**	**604**	**442**	**619**
Mercury	0.77		0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	3.4	3.4	
Nickel	**	NA	4.6 B	5.5 B	5.5 B	4.5 B	NA	NA	4.6 B	3.4	NA	4.8 B
Potassium		1,040 B	1,180 B	1,390 B	1,490	1,750	1,590	829	829 NJ	618	1,200	1,080
Selenium	4.6		5 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U			
Sodium		5,750	6,130	12,600	10,400	5,650 J	5,290	7,190	11,200 NJ	6,740	6,550	6,670 J+
Vanadium		NA	1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U			
Zinc	**	NA	5.0 U	5.7 B	5.7 B	16.2 U	NA	NA	11 U	11 U	NA	11 U

NOTES:
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** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/25/01	12/06/01	10/28/02	12/10/02	09/15/03	11/06/03	05/11/04	10/12/04	07/20/05
CONVENTIONAL PARAMETERS												
Alkalinity (mg/l)		351	347	320	323	316	324	330	326	308	306	301
Ammonia Nitrogen (mg/l)	2	**3.26**	**2.89**	**2.3**	**2.5**	**2.9**	**3**	1	1.1	1.4	1.8	1.8
BOD (mg/l)		2.0 U	2.0 U	2 U	1.5 B	8.5	6.3	4.9	2 U	2 U	2 U	8.2
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
COD (mg/l)		10 U	11.8	10 U	6.74 B	10 U	10 U	7.14 B	8.96 B	10 U	5.37 B	3.01 B
Chloride (mg/l)	250	8.71	12.0	14.3	14	7.1	10	11	17.4	9.65	12.1	26.1
Color	15	NA	**25.0**	**40**	**40**	**30**	NA	NA	**20**	15	NA	**20**
Cyanide, Total (mg/l)	0.2		0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA	10 U
Hardness (mg/l)		374	328	327	301	307	328	332	357	299	291	295
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	1.16	0.18	0.133	0.13	0.32	0.39	0.3	0.22	0.224	0.439	0.1 U
Phenols (mg/l)	0.001	**0.008**	0.005 U	0.005 U	0.005 U	0.005 U	**0.004 B**	**0.008**	0.005 U	0.005 U	0.005 U	0.005 U
Sulfate (mg/l)	250	16.0	14.3	11.9	12	12	12	12	11.1	10.6	11.6	3.98
Total Dissolved Solids (mg/l)		404	399	370	360	360	350	360	360	320	340	310
Total Kjeldahl Nitrogen (mg/l)		3.3	3.7	2.7	2.73	3.12	3.41	1.28	0.793	1.31	1.67	1.93
Total Organic Carbon (mg/l)		2.44	1.41	3.6	2	0.28 B	2.3	3.5	1	1	1	1.3

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

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TABLE 2
SW-1 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE										
		10/31/05	07/20/06	01/03/07	09/25/07	12/05/07	10/28/08	12/09/08	08/05/09	10/27/09	06/29/10	11/01/10
VOLATILE COMPOUNDS (µg/L)												
Benzene	1	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA
Bromochloromethane												
Ethyl Acetate		NA		NA		NA	3.6	NA	NA	NA	NA	NA
Ethylbenzene	5	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA
Methylene Chloride	5	NA	5 U	NA	5 U	NA	**10**	NA	5 U	NA	5 UJ	NA
Styrene	5	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA
trans-1,3-Dichloropropene	0.4	NA		NA		NA		NA		NA		NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

Blank cell or U = Compound was analyzed for, but not detected

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	NYSDEC Class A Standards	SAMPLING DATE										
		10/31/05	07/20/06	01/03/07	09/25/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10
INORGANIC PARAMETERS (µg/L)												
Aluminum	100	NA	92 U	NA	1,250 J+	NA	100 U	NA	538	NA	18,400 J	NA
Antimony					15.0 U	NA	30.0 U	NA	15 UJ	NA	100 UJ	NA
Arsenic	150				11.7	NA	10.0 U	NA	10 U	NA	100 UJ	NA
Barium		NA	29.7	NA	66.5	NA	58.6	NA	199	NA	2,420 J	NA
Boron	10,000	NA	27 UJ	NA	500 U	NA	500 U	NA	500 U	NA	500 UJ	NA
Cadmium	**	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	**33.2**	**11.0**	5.0 U	**97.3 J**	**18.0**
Calcium		104,000	107,000	114,000	92,300	86,800	115,000 J	144,000	127,000	99,200	518,000 J	139,000
Chromium	**				5.00 U	NA	5.00 U	NA	5 U	NA	10.0 UJ	NA
Cobalt	5	NA	1.8 U	NA	20.0 U	NA	20.0 U	NA	20 U	NA	140 J	NA
Copper	**	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA	10.0 UJ	NA
Iron	300	**2,140**	**1,070**	**1,740**	**16,800**	**14,300**	**7,220 J**	**507,000**	**104,000**	**16,400**	**2,200,000 J**	**258,000**
Lead	**	3 U	3 U	3 B	3.0 UJ	3.0 U	3.00 U	39.8	3.0 U	3.0 U	60 UJ	5.2
Magnesium		8,860	9,410	9,590	7,830	6,740	10,600	11,000	10,900 J	9,800	12,800 J	10,600
Manganese		**2,440**	**408**	**626**	**774**	**762**	**955 J**	**2,240**	**1,130**	**702**	**37,400 J**	**3,530**
Mercury	0.77				0.2 U	NA	0.200 U	NA	0.2 U	NA	0.38 J	NA
Nickel	**	NA	4.1 B	NA	30.0 U	NA	30.0 U	NA	30 U	NA	124 J	NA
Potassium		1,280	729 J	855	1,700	1,680	5,330	2,130	1,690 J	5,000 U	7,490 J	5,000 U
Selenium	4.6				8.56 J	NA	5.00 U	NA	5 U	NA	60 UJ	NA
Sodium		7,600 N	5,110	11,400	24,000 J	16,600	14,600	7,190	10,700 J	10,400	10,800 J	11,100
Vanadium					30.0 U	NA	30.0 U	NA	30 U	NA	30.0 UJ	NA
Zinc	**	NA	11 U	NA	31.5 J	NA	10.0 U	NA	10 U	NA	156 J	NA

NOTES:

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* = Duplicate analysis not within control limits

+/- = Additionally estimated

** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE										
		10/31/05	07/20/06	01/03/07	09/25/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10
CONVENTIONAL PARAMETERS												
Alkalinity (mg/l)		289	307	314	350	350	340	360	320	310	303 J	310
Ammonia Nitrogen (mg/l)	2	**2.2**	0.81	0.73	**8.97**	**14**	**4.62**	**4.76**	**5.78**	**4.85**	1.55 J	1.19
BOD (mg/l)		9.9	2.9	4.3	19	4 U	4.00 U	10.0	17.0	4.0 U	13.0 J	4.0 U
Bromide (mg/l)	2	0.1 U	0.025 B	0.1 U	2 U	1.0 U	20 U	20 U	20 U	2 U	40 UJ	20 U
COD (mg/l)		7.34 B	4.58 B	7.25 B	20 U	20 U	20 U	516	40	20 U	28 J	180
Chloride (mg/l)	250	13.5	9.31	13.8	19.9	22	21.0	19.7	17.9	19	17.0 J	17.1
Color	15	NA	30	NA	**240**	NA	**105**	NA	25 RH	NA	**25.0 J**	NA
Cyanide, Total (mg/l)	0.2	NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA	0.010 UJ	NA
Hardness (mg/l)		296	306	324	362	244	330	404	363	288	1,350 J	391
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 UH	NA	0.010 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.58	0.587	0.67	0.200 UJ	0.355	0.253	0.407	1.17	0.211	0.489 J	0.335
Phenols (mg/l)	0.001	**0.015**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.010 UJ	0.005 U
Sulfate (mg/l)	250	9.79	10.2	10.4	5.00 U	5.00 U	5.00 U	100 U	5	5 U	5.00 UJ	5.00 U
Total Dissolved Solids (mg/l)		350	320	350	315	395	365	340	390	360	370 J	460
Total Kjeldahl Nitrogen (mg/l)		2.11	1.04	0.97	9.58	15.4	5.57	35.6	7.37	5.88	5.11 J	7.55
Total Organic Carbon (mg/l)		2	2.2	2.3	3.00 U	3.0 U	3.1	3.0 U	3 U	3.0 U	6.0 J	8.7

NOTES:

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NS = Monitoring well not sampled

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TABLE 2
SW-1 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE		
		11/09/11	12/30/11	07/22/14
VOLATILE COMPOUNDS (µg/L)				
Benzene	1	5 U	NA	0.5 U
Bromochloromethane		5 U	NA	2.5 U
Ethyl Acetate		NA	NA	NA
Ethylbenzene	5	5 U	NA	2.5 U
Methylene Chloride	5	5 U	NA	2.5 U
Styrene	5	5 U	NA	2.5 U
trans-1,3-Dichloropropene	0.4	5 U	NA	0.5 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

Blank cell or U = Compound was analyzed for, but not detected

B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE		
		11/09/11	12/30/11	07/22/14
INORGANIC PARAMETERS (µg/L)				
Aluminum	100	15,300	NA	19.6
Antimony		100 U	NA	1.00 U
Arsenic	150	100 U	NA	0.50 U
Barium		**1,510**	NA	21.33
Boron	10,000	3150	NA	15.0 J
Cadmium	**	**89.6**	**8.7**	0.20 U
Calcium		281,000	136,000	95,000
Chromium	**	**36.4**	NA	0.94 J
Cobalt	5	**90.7**	NA	0.54
Copper	**	39.7	NA	0.37 J
Iron	300	**780,000 J**	**114,000**	**635**
Lead	**	60.0 U	15.0 U	1.00 U
Magnesium		12,900	11,100	8,300
Manganese		**17,400 J**	**3,000**	**209**
Mercury	0.77	0.2 U	NA	0.20 U
Nickel	**	**103**	NA	2.61
Potassium		5,000 UJ	5,000 U	727
Selenium	4.6	60 U	NA	0.50 J
Sodium		10,700 J	8,650	5,430
Vanadium		30.0 U	NA	0.13 J
Zinc	**	137 J	NA	3.98 J

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

U = Compound was analyzed for, but not detected

B = Concentration is less than the CRQL and greater than the IDL

J = Concentration is an estimated value

NS = Monitoring well not sampled

NA = Parameter not analyzed

N = Spiked sample recovery not within control limits

* = Duplicate analysis not within control limits

+/- = Additionally estimated

** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE		
		11/09/11	12/30/11	07/22/14
CONVENTIONAL PARAMETERS				
Alkalinity (mg/l)		390 J	310	279
Ammonia Nitrogen (mg/l)	2	1.79	1.03	0.106
BOD (mg/l)		19.0 J	4.0 U	2.00 U
Bromide (mg/l)	2	8 UJ	8 U	0.021 J
COD (mg/l)		140	94	5.00 J
Chloride (mg/l)	250	19.2	18.7	6.37
Color	15	**400**	NA	8.00
Cyanide, Total (mg/l)	0.2	50 U	NA	0.001 J
Hardness (mg/l)		756	385	270
Hexavalent Chromium (mg/l)	0.05	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.244	0.313	0.18
Phenols (mg/l)	0.001	0.01 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	5.30	6.50	16.20
Total Dissolved Solids (mg/l)		540	370	310
Total Kjeldahl Nitrogen (mg/l)		26.9 J	3.62	0.21 J
Total Organic Carbon (mg/l)		4.3 J	3.0 U	2.51

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

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NS = Monitoring well not sampled

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TABLE 2
SW-2 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Acetone			NS	NA	NS	NS	NA	10 U	NS	10 U	NA
Methylene Chloride	5	11 JB	NS	NA	NS	NS	NA	0.5 U	NS	5 U	NA

NOTES:
U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum	100	321	NS	NA	NS	NS	NA	37.6 B	NS	675	NA
Antimony		3.9 U	NS	NA	NS	NS	NA	5.0 U	NS	**5.2 B**	NA
Arsenic	150	1.6 U	NS	NA	NS	NS	NA	3.0 U	NS	8.8 B	NA
Barium		18.9 B	NS	NA	NS	NS	NA	14.0 B	NS	20.2 B	NA
Beryllium	**	0.1 U	NS	NA	NS	NS	NA	1.0 U	NS	1.1 B	NA
Boron	10,000	20 U	NS	NA	NS	NS	NA	22.0 B	NS	NA	NA
Cadmium	**	0.4 U	NS	0.5 U	NS	NS	1 U	2.2 JB	NS	1.2 B	1 U
Calcium		66,400 0	NS	77,600 0	NS	NS	76,900	70,500	NS	58,600	75,600
Chromium	**	0.62 B	NS	NA	NS	NS	NA	1.0 U	NS	1.0 U	NA
Cobalt	5	0.8 U	NS					2.0 U	NS	2.0 U	
Copper	**	49.5	NS	NA	NS	NS	NA	1.0 U	NS	1.2 B	NA
Iron	300	**781 0**	NS	**363 0**	NS	NS	**380**	204	NS	**1,560 ***	**496**
Lead	**	1.5 U	NS	1.6 U	NS	NS	1.5 B	2.0 U	NS	2.6 B	3 U
Magnesium		6,550 0	NS	8,060 0	NS	NS	7,700	7,230	NS	6,290	8,850
Manganese		50.7 0	NS	45.1 0	NS	NS	19.2	8.6 B	NS	75.7	70
Mercury	0.77	0.22	NS	NA	NS	NS	NA	0.10 U	NS	0.10 U	NA
Nickel	**	1.8 B	NS	NA	NS	NS	NA	5.0 U	NS	3.2 B	NA
Potassium		2,460 B	NS	1,910 B	NS	NS	2,620 BE	1,530 B	NS	2,710 B	4,320
Selenium	4.6	3.2 U	NS					3.0 U		4.0 U	
Sodium		3,650 B	NS	4,810 B	NS	NS	4,730 B	3,920 B	NS	3,730 B	5,230
Thallium	4	2.1 U	NS					6.0 UN		3.0 U	
Vanadium		1 U	NS	NA	NS	NS	NA	1.0 B	NS	3.0 B	NA
Zinc	**	8.4 B	NS	NA	NS	NS	NA	14.1 B	NS	5.1 J	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
U or blank cell = Compound was analyzed for, but not detected
B = Concentration is less than the CRQL and greater than the IDL
J = Concentration is an estimated value
NS = Monitoring well not sampled
NA = Parameter not analyzed
N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limit
+/- = Additionally estimated
** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/28/98	08/19/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		186 0	NS	190 0	NS	NS	180	192	NS	182	213
Ammonia Nitrogen (mg/l)	2	0.05 U	NS	0.25 0	NS	NS	0.04 U	0.110 J	NS	0.138	.282
BOD (mg/l)		3 U	NS	4 U	NS	NS	2 U	2.97	NS	2.00 J	2.3
Bromide (mg/l)	2	0.1 U	NS	0.12 0	NS	NS	2 U	2 U	NS	2.00 U	
COD (mg/l)		12.1 0	NS	6 0	NS	NS	15.3	10 U	NS	10.0 U	22
Chloride (mg/l)	250	3.3 0	NS	5.23 0	NS	NS	6.36	7.31	NS	8.98	13.2
Color	15	**150**	NS	NA	NS	NS	NA	**20**	NS	**80**	NA
Conductivity											
Cyanide, Total (mg/l)		10 U						0.0100 U		0.0100 U	
Hardness (mg/l)		193 0	NS	227 0	NS	NS	224	206	NS	172	225
Hexavalent Chromium (mg/l)	0.05	0.01 U						0.0100 U		0.0100 U	
Nitrate Nitrogen (mg/l)	10	0.66 0	NS	3.55 0	NS	NS	0.1 U	0.203	NS	0.303	.1 U
Phenols (mg/l)	0.001	**0.012 0**	NS	0.005 U	NS	NS	**0.018**	**0.0140**	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	10.8 0	NS	6.6 0	NS	NS	10 U	10 U	NS	10.0 U	23.8
Total Dissolved Solids (mg/l)		182 0	NS	190 0	NS	NS	237	222	NS	225	257
Total Kjeldahl Nitrogen (mg/l)		0.37 0	NS	0.22 0	NS	NS	0.914	0.200 J	NS	1.25	1.08
Total Organic Carbon (mg/l)		1 U	NS	2.76 0	NS	NS	12.6	5.67	NS	5.57	8.22

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
U = Compound was analyzed for, but not detected
H = Holding times for preparation or analysis exceeded
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Data rejected by validator; data are unusable

TABLE 2
SW-2 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/29/01	12/06/01	10/24/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/19/05
Acetone		NA	4 U	10 U	NA	10 U	NA	NA	10 U	10 U	NA	10 U
Methylene Chloride	5	NA	3 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA	5 U

NOTES:
U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

INORGANIC PARAMETERS (µg/L)

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/29/01	12/06/01	10/24/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/19/05
Aluminum	100	NA	615	553	553	283 B	NA	NA	375 B	766	NA	92 U
Antimony		NA	5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U			
Arsenic	150	NA	2.5 U	4.9 U	4.9 U	7 U	NA	NA	3.5 U			
Barium		NA	23.6 B	21.2 B	21.2 B	18.1	NA	NA	22.2	20.7	NA	22.5
Beryllium	**	NA	0.5 U	0.5 U	0.5 U	1 U	NA	NA	0.64 U			
Boron	10,000	NA	21.6 B	50 U	50 U	50 U	NA	NA	27 U	27	NA	27 U
Cadmium	**	0.21 B	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U	1.1 U
Calcium		64,300	74,100	78,200	75,400	70,700	80,200	84,800	79,300	74,000	84,000	83,300
Chromium	**	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U			
Cobalt	5		1.0 U	1.2 U	1.2 U	1.5 U	NA	NA	1.7 U			
Copper	**	NA	1.0 U	1.5 U	1.5 U	1.4 U	NA	NA	2.6 U	4.3 U	NA	4.3 U
Iron	300	**460**	**1,500**	**1,030**	**515**	**587**	**463**	**1,290**	**704**	**1,410**	**1,130**	**467**
Lead	**	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U	3 U
Magnesium		6,240	8,000	8,410	7,960	7,770	8,130	8,580	8,300 NJ	8,440	8,830	8,800
Manganese		53.1	118	56.9	86.9	81.4	61.6	68.5	71.4	105	86.7	6.9 U
Mercury	0.77	NA	0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U			
Nickel	**	NA	1.5 U	1.3 U	1.3 U	1.9 U	NA	NA	1.8 U			
Potassium		1,850 B	5,710	4,970 B	3,900	3,900	3,080	3,270	3,590 NJ	2,450	2,620	3,030
Selenium	4.6		5.0 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U			
Sodium		4,060 B	4,620 B	4,940 B	4,920	4,650 J	5,310	5,860	5,310 NJ	5,660	5,970	6,140 J+
Thallium	4		6.00 U	9.9 U	9.9 U	16.1 U	NA	NA	13 UJ			10 JJ-
Vanadium		NA	2.0 B	1.6 B	1.6 B	1.3 U	NA	NA	1.2 B	2.3	NA	1.5 B
Zinc	**	NA	8.0 B	6.2 B	6.2 B	16.2 U	NA	NA	11 U	11 U	NA	11 U

NOTES:
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* = Duplicate analysis not within control limit
+/- = Additionally estimated
** = Standards vary based on hardness

CONVENTIONAL PARAMETERS

	NYSDEC Class A Standards	SAMPLING DATE										
		05/16/00	10/03/00	10/29/01	12/06/01	10/24/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/19/05
Alkalinity (mg/l)		148	202	206	199	182	205	234	215	218	239	241
Ammonia Nitrogen (mg/l)	2	0.04 U	0.267	0.18	0.16	0.093	0.16	0.31	0.084	0.15	0.04 U	0.12
BOD (mg/l)		2 U	2.0	2 U	1.9 B	1.4 B	1.1 B	2 U	2 U	1.5 B	1.7 B	2 U
Bromide (mg/l)	2		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.028 B	0.1 U	0.1 U
COD (mg/l)		13.9	35.8	18.8	8.21 B	11.2	5 B	32.7	16.3	16.2	10.5	9.45 B
Chloride (mg/l)	250	7.31	8.59	9.11	8.9	7.4	8.8	11	8.74	7.06	9.73	8.33
Color	15	NA	**25.0**	**75**	**75**	**40**	NA	NA	**30**	**75**	NA	**30 J**
Conductivity												
Cyanide, Total (mg/l)			10.0 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA	4.2 B
Hardness (mg/l)		186	218	230	221	208	234	247	232	220	246	244
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	0.003 B
Nitrate Nitrogen (mg/l)	10	0.570	0.612	0.502	0.46	0.62	1.6	1.3	0.927	0.456	0.641	0.646
Phenols (mg/l)	0.001	0.005 U	**0.005 J**	0.005 U	0.005 U	0.005 U	**0.003 B**	**0.006**	0.005 U	0.005 U	0.005 U	**0.004 B**
Sulfate (mg/l)	250	8.81	10.6	10.6	18	14	13	9.3	8.97	6.6	9.33	5.93
Total Dissolved Solids (mg/l)		249	254	262	45	250	260	270	260	250	280	270
Total Kjeldahl Nitrogen (mg/l)		0.4	2.4	0.96	0.46	0.399	0.429	2.18	0.602	1.1	0.374	0.654
Total Organic Carbon (mg/l)		4.30	4.65	6.26	5.1	4.4	3.3	3.3	5.3	5.9	3.8	3.5

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
U = Compound was analyzed for, but not detected
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TABLE 2
SW-2 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE										
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	08/05/09	10/27/09	06/29/10	11/01/10
VOLATILE COMPOUNDS (µg/L)												
Acetone		NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA	10 UJ	NA
Methylene Chloride	5	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA

NOTES:
U = Compound was analyzed for, but not detected
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	NYSDEC Class A Standards	SAMPLING DATE										
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10
INORGANIC PARAMETERS (µg/L)												
Aluminum	100	NA	92 U	NA	1,680 J+	NA	472	NA	100 U	NA	798 J	NA
Antimony					15.0 U	NA	30.0 U	NA	15 UJ	NA	5.0 UJ	NA
Arsenic	150				10.7	NA	10.0 U	NA	10 U	NA	5.0 UJ	NA
Barium		NA	23.4	NA	50.0 U	NA	50.0 U	NA	50 U	NA	50.0 UJ	NA
Beryllium	**				3.00 U	NA	3.00 U	NA	3 U	NA	3.00 UJ	NA
Boron	10,000	NA	27 U	NA	500 U	NA	500 U	NA	500 U	NA	500 UJ	NA
Cadmium	**	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 UJ	5.00 U
Calcium		74,200	87,900	89,600	67,200	26,200	54,700 J	74,500	96,000	75,400	82,900 J	82,500
Chromium	**				5.00 U	NA	5 U	NA	5 U	NA	10.0 UJ	NA
Cobalt	5				20.0 U	NA	20 U	NA	20 U	NA	20.0 UJ	NA
Copper	**	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10 U	NA	10.0 UJ	NA
Iron	300	**304**	**1,110**	**445**	**2,660**	**606**	**867 J**	**1,100**	**309**	**483**	**1,860 J**	**2,000**
Lead	**	3 U	3 U	3 U	3.00 UJ	4.97	3.00 U	3.00 U	3.00 U	3.00 U	3.0 UJ	3.0 U
Magnesium		7,040	8,340	8,610	6,810	4,630	7,250	8,150	10,400 J	8,630	10,100 J	9,680
Manganese		37.4	68.8	73.8	158	126	44.4 UJ	79.1	48.3	75.7	180 J	243
Mercury	0.77				0.2 U	NA	0.200 U	NA	0.2 U	NA	0.2 UJ	NA
Nickel	**				30.0 U	NA	30.0 U	NA	30 U	NA	30.0 UJ	NA
Potassium		2,330 N	2,160	2,540	3,020	4,200	7,630	2,330	1,910 J	5,000 U	5,000 UJ	5,000 U
Selenium	4.6				9.5 J	NA	5.00 U	NA	5 U	NA	3.0 UJ	NA
Sodium		3,570	5,310 J	5,580	3,830 J	12,600	4,660	6,370	6,580 J	5,060	7,480 J	6,530
Thallium	4	10 JJ-	10 JJ-	10 JJ-	10.0 U	NA	10.0 U	NA	10 U	NA	3.0 UJ	NA
Vanadium		NA	1.5 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA	30.0 UJ	NA
Zinc	**	NA	11 U	NA	10.3 J	NA	10.0 U	NA	10.5 J	NA	23.2 J	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
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* = Duplicate analysis not within control limit
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	NYSDEC Class A Standards	SAMPLING DATE										
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10
CONVENTIONAL PARAMETERS												
Alkalinity (mg/l)		198	251	230	220	190	150	230	220	220	220 J	220
Ammonia Nitrogen (mg/l)	2	0.069	0.037 JB	0.098	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 UJ	0.500 U
BOD (mg/l)		0.7 B	2.2	2.6	4 R	4 U	4.00 U	8.00 U	4.00 U	4.00 U	4.0 UJ	4.0 U
Bromide (mg/l)	2	0.1 U	0.022 B	0.1 U	0.2 U	1.0 U	2.0 U	0.20 U	0.20 U	0.20 U	0.8 UJ	4.0 U
COD (mg/l)		16.3	10.4	4.76 B	20 U	21	31	20 U	21	20 U	32 J	42
Chloride (mg/l)	250	7.77	8.73	11.8	4.55	9.14	7.98	10.5	11.9 J	10.6	11.2 J	9.83
Color	15	NA	**30**	NA	**55.0**	NA	**100**	NA	12 RH	NA	**25 J**	NA
Conductivity												
Cyanide, Total (mg/l)		NA	10 U	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA	0.010 UJ	NA
Hardness (mg/l)		214	254	259	196	84	167	220	282	224	249 J	246
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 RUH	NA	0.010 UJ	NA
Nitrate Nitrogen (mg/l)	10	0.488	1.85	2.63	1.55 J	1.59	0.222	1.62	1.01	0.693	0.566 J	0.838
Phenols (mg/l)	0.001	**0.003 B**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 UJ	0.005 U
Sulfate (mg/l)	250	16.6	6.43	11.5	5.00 U	5.00 U	9.04	11.3	6.74	11.50	5.00 UJ	5.81
Total Dissolved Solids (mg/l)		250	280	300	282	148	230	276	340	290	350 J	340
Total Kjeldahl Nitrogen (mg/l)		0.295	0.287	0.406	1.07	0.698	0.845	0.568	0.5 U	0.5 U	1.46 J	1.55
Total Organic Carbon (mg/l)		5	4.7	4.4	5.2	4.5	10.7	4	3.0 U	3.1	6.3 J	3.4

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
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NA = Parameter not analyzed
NS = Monitoring well not sampled
R = Data rejected by validator; data are unusable

TABLE 2
SW-2 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE 11/01/10	11/01/10	11/09/11	12/30/11	07/21/14
VOLATILE COMPOUNDS (μg/L)						
Acetone		NA	NA	10 U	NA	2.0 J
Methylene Chloride	5	NA	NA	5 U	NA	2.5 U

NOTES:
U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE 11/01/10	11/01/10	11/09/11	12/30/11	07/21/14
INORGANIC PARAMETERS (μg/L)						
Aluminum	100	NA	NA	100 U	NA	**1,380**
Antimony		NA	NA	5 U	NA	0.33 J
Arsenic	150	NA	NA	5 U	NA	1.06
Barium		NA	NA	50 U	NA	34.38
Beryllium	**	NA	NA	3 U	NA	0.10 J
Boron	10,000	NA	NA	500 U	NA	13.3 J
Cadmium	**	5.00 U	5.00 U	5.00 U	5.00 U	0.08 J
Calcium		82,500	82,500	82,200	79,700	78,000
Chromium	**	NA	NA	10 U	NA	2.77
Cobalt	5	NA	NA	20 U	NA	1.01
Copper	**	NA	NA	10 U	NA	9.09
Iron	300	**2,000**	**2,000**	**701**	**972**	**2,300**
Lead	**	3.0 U	3.0 U	3.0 U	3.0 U	2.67
Magnesium		9,680	9,680	9,120	11,200	8,300
Manganese		243	243	79.5 J	287	190.2
Mercury	0.77	NA	NA	0.2 U	NA	0.20 U
Nickel	**	NA	NA	30 U	NA	3.33
Potassium		5,000 U	5,000 U	5,000 UJ	7,080	3,190
Selenium	4.6	NA	NA	3 U	NA	0.65 J
Sodium		6,530	6,530	7,340 J	**21,400**	7,840
Thallium	4	NA	NA	3 U	NA	0.03 J
Vanadium		NA	NA	30 U	NA	4.06 J
Zinc	**	NA	NA	10 UJ	NA	82.61

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
U or blank cell = Compound was analyzed for, but not detected
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NA = Parameter not analyzed
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** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE 11/01/10	11/01/10	11/09/11	12/30/11	07/21/14
CONVENTIONAL PARAMETERS						
Alkalinity (mg/l)		220	220	230 J	260	225
Ammonia Nitrogen (mg/l)	2	0.500 U	0.500 U	0.500 U	0.500 U	0.137 J
BOD (mg/l)		4.0 U	4.0 U	4.0 UJ	4.0 U	2.00 U
Bromide (mg/l)	2	4.0 U	4.0 U	0.8 UJ	8.0 U	0.031 J
COD (mg/l)		42	42	20 U	22	80.0
Chloride (mg/l)	250	9.83	9.83	8.73	44	10.2
Color	15	NA	NA	**21**	NA	**20.0**
Conductivity				478	855	NA
Cyanide, Total (mg/l)		NA	NA	10 U	NA	0.006
Hardness (mg/l)		246	246	243	245	230
Hexavalent Chromium (mg/l)	0.05	NA	NA	0.01 U	NA	0.01 U
Nitrate Nitrogen (mg/l)	10	0.838	0.838	1.1	0.093	0.99
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 RU	0.005 U	0.03 U
Sulfate (mg/l)	250	5.81	5.81	10.70	8.90	11.10
Total Dissolved Solids (mg/l)		340	340	360	340	260
Total Kjeldahl Nitrogen (mg/l)		1.55	1.55	1.41 J	0.5 U	0.81
Total Organic Carbon (mg/l)		3.4	3.4	3.0 U	6.9	4.14

NOTES:
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TABLE 2
SW-3 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
VOLATILE COMPOUNDS (µg/L)											
Acetone		10 U	NS	NA	NS	NS	NA	10 U	NS	10 U	NA
Methylene Chloride	5	3 JB	NS	NA	NS	NS	NA	0.8 U	NS	5 U	NA

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
Blank cell or U = Compound was analyzed for, but not detected
B = Analyte detected in method blank
J = Concentration is an estimated value
NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
INORGANIC PARAMETERS (µg/L)											
Aluminum	100	22.9 U	NS	NA	NS	NS	NA	98.8 B	NS	79.8 B	NA
Antimony		3.9 U						5.0 U		3.0 U	
Barium		22 B	NS	NA	NS	NS	NA	45.5 B	NS	22.6 B	NA
Boron	10,000	29.8 B	NS	NA	NS	NS	NA	59.8 B	NS	NA	NA
Cadmium	**	0.4 U	NS	0.5 U	NS	NS	1 U	2.6 JB	NS	1.0 U	1 U
Calcium		65600 0	NS	91900 0	NS	NS	87300 0	80400	NS	60,500	75,900
Chromium	**	1.4 B	NS	NA	NS	NS	NA	1.0 U	NS	1.0 U	NA
Cobalt	5	0.8 U						2.0 U		2.0 U	
Copper	**	45.7	NS	NA	NS	NS	NA	1.0 U	NS	1.0 U	NA
Iron	300	**486**	NS	**8160 0**	NS	NS	**604 0**	**632**	NS	**497 ***	**1050**
Lead	**	1.5 U	NS	2.9 B	NS	NS	1 U	2.0 U	NS	2.0 U	3 U
Magnesium		8170	NS	12300 0	NS	NS	11400 0	11000	NS	8,730	11,100
Manganese		106	NS	**4500 0**	NS	NS	161 0	172	NS	99.6	121
Mercury	0.77	0.2 U						0.10 U		0.10 U	
Nickel	**	1.2 U						5.0 U		3.0 U	
Potassium		2550 B	NS	3080 B	NS	NS	3160 B	2870 B	NS	2,310 B	2,700 B
Selenium	4.6	3.4 B	NS	NA	NS	NS	NA	3.0 U	NS	4.0 U	NA
Sodium		10800	NS	26200 0	NS	NS	19900 0	18200	NS	12,200	14,800
Vanadium		1 U						1.0 U		2.0 U	
Zinc	**	2.1 U	NS	NA	NS	NS	NA	22.6	NS	51.1	NA

NOTES:
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NS = Monitoring well not sampled
NA = Parameter not analyzed
* = Duplicate analysis not within control limit
+/- = Additionally estimated
** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE									
		05/22/96	03/27/97	06/26/97	10/08/97	02/18/98	05/27/98	08/19/98	11/04/98	05/12/99	10/20/99
CONVENTIONAL PARAMETERS											
Alkalinity (mg/l)		162 0	NS	231 0	NS	NS	260 0	238	NS	218	228
Ammonia Nitrogen (mg/l)	2	**2.15 0**	NS	**6.53 0**	NS	NS	**7.81 0**	**3.80 J**	NS	**3.03**	**3.3**
BOD (mg/l)		3 U	NS	23.9 U	NS	NS	5.4 0	5.67	NS	2.00 J	2 U
Bromide (mg/l)	2	0.303 0	NS	0.1 U	NS	NS	2 U	2.00 U	NS	2.00 U	2 U
COD (mg/l)		29.6 0	NS	108 0	NS	NS	10 U	11.0	NS	10.0 U	10 U
Chloride (mg/l)	250	**8061 0**	NS	33.2 0	NS	NS	24.5 0	25.3	NS	21.0	22.8
Color	15	**150**	NS	NA	NS	NS	NA	**40**	NS	**40**	NA
Conductivity											
Cyanide, Total (mg/l)		0.01 U						0.0100 U		0.0100 U	
Dissolved Oxygen											
Hardness (mg/l)		198 0	NS	280 0	NS	NS	265 0	246	NS	187	235
Hexavalent Chromium (mg/l)	0.05	0.01 U						0.0100 U		0.0100 U	
Nitrate Nitrogen (mg/l)	10	2.27 0	NS	5.9 0	NS	NS	2.06 0	2.70	NS	3.36	3.62
Phenols (mg/l)	0.001	**0.02 0**	NS	0.005 U	NS	NS	**0.017 0**	0.00500 U	NS	0.0500 U	.05 U
Sulfate (mg/l)	250	12.3 0	NS	8.7 0	NS	NS	14.1 0	12.9	NS	11.4	20.7
Total Dissolved Solids (mg/l)		229 0	NS	296 0	NS	NS	277 0	313 J	NS	282	309
Total Kjeldahl Nitrogen (mg/l)		2.56 0	NS	9 0	NS	NS	8.94 0	5.62	NS	3.92	3.7
Total Organic Carbon (mg/l)		1 U	NS	11.2 0	NS	NS	5.56 0	3.90	NS	5.00	3.79

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TABLE 2
SW-3 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class	SAMPLING DATE										
	A Standards	05/16/00	10/03/00	10/29/01	12/06/01	10/21/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/21/05
VOLATILE COMPOUNDS (µg/L)												
Acetone		NA	5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	3.2 J
Methylene Chloride	5	NA	5 U	5 U	NA	5 U	NA	NA	5 U	5 U	NA	0.6 U

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
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NA = Parameter not analyzed
NS = Monitoring well not sampled

	NYSDEC Class	SAMPLING DATE										
	A Standards	05/16/00	10/03/00	10/29/01	12/06/01	10/21/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/21/05
INORGANIC PARAMETERS (µg/L)												
Aluminum	100	NA	167 B	44.9 B	44.9 B	83.3 U	NA	NA	84.7 B	92 U	NA	127 B
Antimony			5.0 U	4.6 U	4.6 U	5.9 U	NA	NA	4.6 U	4.6 U	4.6 U	5.4 U
Barium		NA	37.7 B	37.4 B	37.4 B	27.7	NA	NA	29.8	24.6	NA	38.8
Boron	10,000	NA	44.1 B	50 U	50 U	50 U	NA	NA	27 U	27 U	27 U	37.8 B
Cadmium	**	0.20 U	0.5 U	0.8 U	1.2 U	1.3 U	1.3 U	0.94 U	0.94 U	1.1 U	1.1 U	1.1 U
Calcium		64,600	89,300	90,000	80,400	70,500	82,700	86,000	75,800	73,900	82,800	82,200
Chromium	**	NA	1.0 U	0.9 U	0.9 U	1.5 U	NA	NA	1.4 U			1.3 U
Cobalt	5		1.0 U	1.2 U	1.2 U	1.5 U	NA	NA	1.7 U			1.8 U
Copper	**	NA	1.4 B	1.5 U	1.5 U	2.5 B	NA	NA	2.6 U	4.3 U	NA	4.3 U
Iron	300	**852**	**514**	**379**	**532**	**383**	220	**317**	**417**	**399**	**594**	**554**
Lead	**	1.3 U	2.0 U	2.3 U	2.2 U	3.4 U	3.4 U	3.6 U	3.6 U	3 U	3 U	3 U
Magnesium		8,080	12,000	12,100	10,600	9,470	10,700	10,800	9,380 NJ	9,430	10,900	11,300
Manganese		146	67.2	82.6	142	63.6	102	49.8	75.6	72.2	113	100 J-
Mercury	0.77		0.1 U	0.1 U	0.1 U	0.18 U	NA	NA	0.18 U	72.2	72.2	0.07 U
Nickel	**		1.5 U	2.2 B	2.2 B	1.9 U	NA	NA	1.8 U	1.9 U	NA	2.1 B
Potassium		1,850 B	3,250 B	3,620 B	3,570	3,640	2,760	1,800	2,440 NJ	1,620	2,120	1,730
Selenium	4.6	NA	5.0 U	4.6 UN	4.6 UN	6.9 U	NA	NA	5 U			
Sodium		8,520	13,100	16,000	13,500	10,900 J	12,400	12,900	10,100 NJ	11,200 J	13,000	12,700 J+
Vanadium			1.0 U	1.0 U	1.0 U	1.3 U	NA	NA	1 U	1 U	1 U	
Zinc	**	NA	5.0 U	4.9 U	4.9 U	16.2 U	NA	NA	11 U	11 U	11 U	14.1 B

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	NYSDEC Class	SAMPLING DATE										
	A Standards	05/16/00	10/03/00	10/29/01	12/06/01	10/21/02	12/10/02	09/15/03	11/06/03	05/05/04	10/26/04	07/21/05
CONVENTIONAL PARAMETERS												
Alkalinity (mg/l)		185	244	239	233	178	250	247	211	227	244	211
Ammonia Nitrogen (mg/l)	2	1.44	1.63	**2.03**	**2.5**	1.0	**3.8**	0.49	1.1	0.92	1.1	0.093
BOD (mg/l)		2.0 U	2.0 U	2 U	2.5	4.7	5.6	1.9 B	0.51 B	1.2 B	1.9 B	2.8
Bromide (mg/l)	2	0.100 U	0.1 U	0.1 U	0.03 B	0.1	0.1 U	0.1 U	0.1 U	0.031 B	0.029 B	0.1 U
COD (mg/l)		19.1	10 U	10 U	6.52 B	8.13 B	10 U	10 U	14.8	10 U	10.8	10.4
Chloride (mg/l)	250	11.4	18.8	24	21	13	17	19	14.1	14.4	17.6	15.1
Color	15	NA	10.0	**30**	**30**	**35**	NA	NA	**30**	**25**	NA	**30**
Conductivity												
Cyanide, Total (mg/l)			0.01 U	10 U	10 U	10 U	NA	NA	10 UJ	10 U	NA	3.5 B
Dissolved Oxygen												
Hardness (mg/l)		195	272	275	244	274	251	259	228	223	252	252
Hexavalent Chromium (mg/l)	0.05		0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	0.003 B
Nitrate Nitrogen (mg/l)	10	2.08	4.26	3.12	2.1	1.8	2	3.3	1.75	2.23	2.42	2.43
Phenols (mg/l)	0.001	0.00500 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.002 B**	0.005 U	0.005 U	0.005 U	**0.006**	0.005 U
Sulfate (mg/l)	250	10.3	12.8	11.8	14	12	13	9.6	8.3	2.23	8.67	8.17
Total Dissolved Solids (mg/l)		243	307	333	300	250	300	310	250	270	280	280
Total Kjeldahl Nitrogen (mg/l)		2.1	2.3	3.1	3.03	1.75	4.34	1.05	1.70	1.34	1.73	0.74
Total Organic Carbon (mg/l)		6.52	2.31	6.15	5.1	6.8	2.6	4.4	4.5	3.1	3.1	3.7

NOTES:
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TABLE 2
SW-3 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Class A Standards	SAMPLING DATE												
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	08/05/09	10/27/09	06/29/10	11/01/10	11/09/11	12/30/11
VOLATILE COMPOUNDS (µg/L)														
Acetone		NA	10 U	NA	10 UJ	NA	10 UJ	NA	10 U	NA	10 UJ	NA	10 U	NA
Methylene Chloride	5	NA	5 U	NA	5 U	NA	5 U	NA	5 U	NA	5 UJ	NA	5 U	NA

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

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B = Analyte detected in method blank

J = Concentration is an estimated value

NA = Parameter not analyzed

NS = Monitoring well not sampled

	NYSDEC Class A Standards	SAMPLING DATE												
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10	11/09/11	12/30/11
INORGANIC PARAMETERS (µg/L)														
Aluminum	100	NA	92 U	NA	100 UJ+	NA	230	NA	210	NA	100 UJ	NA	100 U	NA
Antimony		5.4 U	5.4 U	5.4 U	15.0 U	NA	30.0 U	NA	15 UJ	NA	5.0 UJ	NA	5 U	NA
Barium		NA	28.4	NA	50.0 U	NA	50.0 U	NA	50 U	NA	50.0 UJ	NA	107	NA
Boron	10,000	NA	30.8 B	NA	500 U	NA	500 U	NA	500 U	NA	500 UJ	NA	500 U	NA
Cadmium	**	1.1 U	1.1 U	0.76 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 UJ	5.00 U	5.00 U	5.00 U
Calcium		76,000	79,600	79,400	73,600	60,400	70,700 J	71,900	91,900	59,700	72,800 J	75,900	76,400	78,600
Chromium	**	1.3 U	1.3 U	1.3 U	5.00 U	NA	5.00 U	NA	5 U	NA	10.0 UJ	NA	10 U	NA
Cobalt	5	1.8 U	1.8 U	1.8 U	20.0 U	NA	20.0 U	NA	20 U	NA	20.0 UJ	NA	20 U	NA
Copper	**	NA	4.3 U	NA	10.0 U	NA	10.0 U	NA	10.5	NA	10.0 UJ	NA	10 U	NA
Iron	300	**419**	**409**	288	263	**425**	**653 J**	300	**742**	**493**	**1,250 J**	**322**	**801**	**774**
Lead	**	3 U	3 U	3 U	3.00 UJ	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U	3.0 UJ	3.0 U	3.0 U	3.0 U
Magnesium		9,020	10,100	9,550	9,070	7,480	9,640	9,570	11,600 J	8,120	10,500 J	10,700	10,100	9,380
Manganese		62.2	55.4	70.5	78.4	120	114 J	112	201	112	242 J	100	192 J	226
Mercury	0.77	0.07 U	0.07 U	0.07 U	0.200 U	NA	0.200 U	NA	0.2 U	NA	0.200 UJ	NA	0.2 U	NA
Nickel	**	NA	1.9 U	NA	30.0 U	NA	30.0 U	NA	30 U	NA	30.0 UJ	NA	30 U	NA
Potassium		1,930 N	1,410	1,670	1,690	1,530	3,010	1,800	1,830 J	5,000 U	5,000 UJ	5,000 U	5,000 UJ	5,000 U
Selenium	4.6				**15.7 J**	NA	5.00 U	NA	5 U	NA	3.1 J	NA	3 U	NA
Sodium		7,660	10,100 J	9,300	12,700 J	8,910	8,640	17,600	10,300 J	7,790	10,800 J	10,400	10,500 J	8,460
Vanadium					30.0 U	NA	30.0 U	NA	30 U	NA	30.0 UJ	NA	30 U	NA
Zinc	**	NA	11 U	NA	10.0 UJ	NA	10.0 U	NA	15.6 J	NA	10.0 UJ	NA	10 UJ	NA

NOTES:

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** = Standards vary based on hardness

	NYSDEC Class A Standards	SAMPLING DATE												
		11/08/05	07/27/06	01/02/07	09/26/07	12/05/07	10/28/08	12/09/08	07/15/09	10/27/09	06/29/10	11/01/10	11/09/11	12/30/11
CONVENTIONAL PARAMETERS														
Alkalinity (mg/l)		198	235	226	240	240	200	250	220	190	215 J	200	240 J	230
Ammonia Nitrogen (mg/l)	2	0.42	0.1	0.92	1.07	**2.86**	0.761	1.77	0.5 U	0.5 U	0.500 UJ	0.500 U	0.918	1.370
BOD (mg/l)		4.1	4.1	1.8 B	4	4 U	4.00 U	4.00 U	4.00 U	4.00 U	4.0 UJ	4.0 U	4.0 UJ	4.0 U
Bromide (mg/l)	2	0.1 U	0.023 B	0.1 U	0.200 U	1.0 U	2.0 U	0.20 U	2.00 U	0.20 U	1.6 UJ	1.6 U	8.0 UJ	8.0 U
COD (mg/l)		13.8	10.1	5.07 B	20 U	20 U	20 U	20 U	20	20 U	22 J	20 U	20 U	20 U
Chloride (mg/l)	250	14	14.5	14.2	4.51	14.9	12.7	13.5	13.5	11.4	13.9 J	12.9	13.5	14.4
Color	15	NA	**20**	NA	**24.0**	NA	**44.0**	NA	15 RH	NA	**35 J**	NA	**17**	NA
Conductivity													501	733
Cyanide, Total (mg/l)		NA	10.4 ^	NA	10.0 UJ	NA	0.00001 U	NA	0.01 U	NA	0.010 UJ	NA	10 U	NA
Dissolved Oxygen													10.9	
Hardness (mg/l)		227	240	238	221	182	216	219	277	183	225 J	234	232	235
Hexavalent Chromium (mg/l)	0.05	NA	0.01 U	NA	0.01 U	NA	0.010 U	NA	0.01 RH	NA	0.010 UJ	NA	0.01 U	NA
Nitrate Nitrogen (mg/l)	10	2.12	2.78	2.6	0.200 U	1.64	1.80	2.17	1.45	1.37	1.13 J	2.17	1.61	1.45
Phenols (mg/l)	0.001	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 UJ	0.005 U	0.005 RU	0.005 U
Sulfate (mg/l)	250	13.8	7.1	9.23	5.00 U	6.16	5.27	11.4	7.94	11.1	5.00 UJ	5.00 U	9.50	5.70
Total Dissolved Solids (mg/l)		260	260	290	285	282	277	235	340	270	250 J	390	650	270
Total Kjeldahl Nitrogen (mg/l)		0.818	0.39	1.38	1.37	3.12	1.18	2.29	0.771	0.638	0.966 J	0.539	1.98 J	0.67
Total Organic Carbon (mg/l)		3.9	4.3	2.9	3.0 U	3.0 U	4.2	3.0 U	3.0 U	3.9	4.9 J	3.0 U	3.0 U	3.0 U

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

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TABLE 2
SW-3 Analytical Results-Quarterly Sampling
City of Johnstown Landfill, Johnstown, New York

VOLATILE COMPOUNDS (µg/L)	NYSDEC Class A Standards	07/21/14	
Acetone		2.5	J
Methylene Chloride	5	2.5	U

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Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
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INORGANIC PARAMETERS (µg/L)	NYSDEC Class A Standards	07/21/14	
Aluminum	100	41.9	
Antimony		0.10	J
Barium		23.52	
Boron	10,000	19.9	J
Cadmium	**	0.20	U
Calcium		71,000	
Chromium	**	1.02	
Cobalt	5	0.21	J
Copper	**	0.63	J
Iron	300	**320**	
Lead	**	1.00	U
Magnesium		9,700	
Manganese		63.9	
Mercury	0.77	0.20	U
Nickel	**	1.42	
Potassium		1,490	
Selenium	4.6	0.33	J
Sodium		8,790	
Vanadium		0.51	J
Zinc	**	3.45	J

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+/- = Additionally estimated
** = Standards vary based on hardness

CONVENTIONAL PARAMETERS	NYSDEC Class A Standards	07/21/14	
Alkalinity (mg/l)		219	
Ammonia Nitrogen (mg/l)	2	0.276	
BOD (mg/l)		2.00	U
Bromide (mg/l)	2	0.026	J
COD (mg/l)		9.50	J
Chloride (mg/l)	250	13.8	
Color	15	**20**	
Conductivity		NA	
Cyanide, Total (mg/l)		0.002	J
Dissolved Oxygen		NA	
Hardness (mg/l)		220	
Hexavalent Chromium (mg/l)	0.05	0.01	U
Nitrate Nitrogen (mg/l)	10	1.90	
Phenols (mg/l)	0.001	**0.01**	**J**
Sulfate (mg/l)	250	11.90	
Total Dissolved Solids (mg/l)		300	
Total Kjeldahl Nitrogen (mg/l)		0.82	
Total Organic Carbon (mg/l)		3.33	

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
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H = Holding times for preparation or analysis exceeded
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TABLE 2a
Summary of Surface Water Results
Matthew Creek Sediment Evaluation
City of Johnstown Landfill, Johnstown, New York

Sample ID	**Units**	**NYSDEC Class A Standard**	**SW-4**		**SW-DUP-1 (SW-4)**		**SW-5**		**SW-6**	
Sampling Date			*Hardness Based Std Value*	**7/23/2014**	*Hardness Based Std Value*	**7/23/2014**	*Hardness Based Std Value*	**7/23/2014**	*Hardness Based Std Value*	**7/23/2014**
Inorganic Parameters										
Aluminum	µg/l	100		104		139		36.6		26.3
Antimony	µg/l			0.25 J		0.24 J		0.25 J		0.23 J
Arsenic	µg/l	150		0.64		0.63		0.42 J		0.44 J
Barium	µg/l			30.77		32.28		32.49		31.56
Beryllium	µg/l	**	1,100	0.5 U	1,100	0.5 U	1,100	0.5 U	1,100	0.5 U
Cadmium	µg/l	**	13.10	0.2 U	13.59	0.2 U	13.34	0.2 U	12.81	0.2 U
Calcium	µg/l			103,000		106,000		104,000		100,000
Chromium	µg/l	**	1,389	1.1	1,426	1.19	1,408	0.88 J	1,367	0.81 J
Cobalt	µg/l	5		0.87		0.89		0.68		0.56
Copper	µg/l	**	37.5	0.47 J	38.6	0.55 J	38.0	0.35 J	36.8	0.39 J
Iron	µg/l	300		3,060		3,440		1,850		1,420
Lead	µg/l	**	310.2	0.29 J	320.9	0.29 J	315.5	1 U	303.9	1 U
Magnesium	µg/l	35,000		9,550		10,000		9,840		9,750
Manganese	µg/l	300		410.9		431.9		360.7		302.2
Mercury	µg/l	0.77		0.2 U		0.2 U		0.2 U		0.2 U
Nickel	µg/l	**	1,175	1.75	1,208	1.75	1,192	1.41	1,156	1.36
Potassium	µg/l			869		890		911		988
Selenium	µg/l	4.6		5 U		5 U		5 U		5 U
Silver	µg/l	0.1		0.4 U		0.4 U		0.4 U		0.4 U
Sodium	µg/l			6,470		6,720		7,160		6,600
Thallium	µg/l	4		0.5 U		0.5 U		0.5 U		0.5 U
Vanadium	µg/l	14		0.23 J		0.28 J		0.18 J		0.14 J
Zinc	µg/l	**	294.6	4.21 J	302.8	6.55 J	298.7	3.90 J	289.7	3.59 J
Hardness										
Hardness	mg/l			297		307		302		291

TABLE 2a
Summary of Surface Water Results
Matthew Creek Sediment Evaluation
City of Johnstown Landfill, Johnstown, New York

Sample ID	**Units**	**NYSDEC Class A Standard**	**SW-7**		**SW-8**		**SW-9**	
Sampling Date			*Hardness Based Std Value*	**7/23/2014**	*Hardness Based Std Value*	**7/23/2014**	*Hardness Based Std Value*	**7/23/2014**
Inorganic Parameters								
Aluminum	µg/l	100		57.6		55		51.4
Antimony	µg/l			0.14 J		0.19 J		0.2 J
Arsenic	µg/l	150		0.41 J		0.44 J		0.34 J
Barium	µg/l			32.18		32.07		31.04
Beryllium	µg/l	**	1,100	0.5 U	1,100	0.5 U	1,100	0.5 U
Cadmium	µg/l	**	12.94	0.2 U	14.18	0.2 U	12.57	0.2 U
Calcium	µg/l			101,000		109,000		97,600
Chromium	µg/l	**	1,377	1.06	1,471	0.93 J	1,348	1
Cobalt	µg/l	5		0.44		0.48		0.45
Copper	µg/l	**	37.1	0.62 J	40.0	0.48 J	36.2	0.5 J
Iron	µg/l	300		1,490		1,280		1,200
Lead	µg/l	**	306.7	1 U	333.8	1 U	298.6	1 U
Magnesium	µg/l	35,000		10,300		11,000		10,300
Manganese	µg/l	300		275.2		259.3		239.9
Mercury	µg/l	0.77		0.2 U		0.2 U		0.2 U
Nickel	µg/l	**	1,165	1.14	1,248	1.24	1,140	1.26
Potassium	µg/l			978		1,100		1,040
Selenium	µg/l	4.6		0.4 J		5 U		5 U
Silver	µg/l	0.1		0.4 U		0.4 U		0.4 U
Sodium	µg/l			6,630		6,960		6,600
Thallium	µg/l	4		0.5 U		0.5 U		0.5 U
Vanadium	µg/l	14		5 U		0.48 J		0.51 J
Zinc	µg/l	**	291.9	3.46 J	312.7	4.33 J	285.6	3.74 J
Hardness								
Hardness	mg/l			294		319		286

TABLE 3
Sediment Sample Analytical Results
July/August 2006
City of Johnstown Landfill, Johnstown, New York

INORGANIC PARAMETERS (mg/kg)	**NYSDEC Lowest Effect Levels for Screening Contaminated Sediments (mg/kg)**	**Mathew Creek - 1**	**Mathew Creek - 2**	**Mathew Creek - 3**	**SED - 1**	**SED - 2**	**SED - 3**
Aluminum		2,620	891	1,630	1,020	1,030	4,830
Barium		13.4 J	92.5	979	16.5 J	6.53 J	26.3
Boron		5.79 J	10.2 J	1.11 J	2.5 J	0.704 U	0.902 J
Cadmium	0.6	0.065 U	0.05 U	0.044 U	0.048 U	0.044 U	0.041 U
Calcium		3,400	15,800	1,600	16,300	3,420	4,700
Chromium	26	13.5	5.21	3.73	4.29	1.74	5.41
Cobalt		8.47 J	6.77 J	1.9 J	6.02 J	0.645 J	3.4 J
Copper	16	3.18 J	2.16 J	0.777 J	1.72 J	0.868 J	5.22
Iron		5,410	49,700	5,550	15,100	3,710	9,060
Magnesium		388 J	549 J	467 J	465 J	668	915
Manganese	460	56.9	**1,600**	129	199	97.7	74.1
Mercury	0.15	0.028	0.019	0.053	0.048	0.023	0.019
Nickel	16	**16.7**	9.33	2.39 J	10.1	1.37 J	6.86
Potassium		145 J	114 J	126 J	70.3 J	99.4 J	214 J
Selenium		1.42 J	0.516 U	0.457 U	0.498 U	0.452 U	0.47 J
Sodium		50.9 U	39.1 U	85.6 J	63.7 J	34.2 U	65.5 J
Vanadium		6.92 J	9.63	7.76	6.41 J	4.44 J	16
Zinc	120	25.2	21.2	**132**	12.3	11.1	22

ORGANIC PARAMETERS (mg/kg)	NYSDEC Lowest Effect Levels for Screening Contaminated Sediments (mg/kg)	Mathew Creek - 1	Mathew Creek - 2	Mathew Creek - 3	SED - 1	SED - 2	SED - 3
Total Organic Carbon	NA	14,000	9,700	1,000	12,000	7,200	4,600

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Technical Guidance for Screening Contaminated Sediments
NA = Not applicable
U = Compound was analyzed for, but not detected
J = Concentration is an estimated value

TABLE 3a
Sieve Analysis Results
July/August 2006
City of Johnstown Landfill, Johnstown, New York

PERCENTAGE	Mathew Creek - 1*	Mathew Creek - 2	Mathew Creek - 3	SED - 1	SED - 2	SED - 3
Gravel		**3.1**	**0.8**	**7.2**	**13.9**	**18.6**
Sand		**90.3**	**93.7**	**89.8**	**82**	**70.6**
- Coarse Sand		4.8	0.5	2.8	2.5	15.3
- Medium Sand		27.2	15.5	28.2	37.5	25.3
- Fine Sand		58.3	77.7	58.8	42	30
Silt and Clay		**6.6**	**5.5**	**3**	**4.1**	**10.8**

CLASSIFICATION		Poorly-graded fine SAND	Poorly-graded fine SAND	Poorly-graded fine SAND	Poorly-graded fine to medium SAND	Well-graded gravelly SAND

NOTES:

* Sediment sample consisted primarily of organic matter with some silt.

Table 3
Sediment Samples
December 2011
City of Johnstown Landfill, Johnstown, New York

	NYSDEC Lowest Effect Level	NYSDEC Severe Effect Level	SAMPLING DATE					
			SED-1 11/09/11	SED-1 12/30/11	SED -2 11/09/11	SED -2 12/30/11	SED -3 11/09/11	SED -3 12/30/11
INORGANIC PARAMETERS (mg/kg)								
Aluminum			8,490	5,540	1,440	2,150	3,770	8,380
Antimony	2	25	24.7 U	137 U	14.4 U	14 U	15.8 U	16 U
Arsenic	6	33	24.7 U	137 U	14.4 U	14 U	15.8 U	16 U
Barium			61.7	399	15.3	19.4	31.2	29.2
Beryllium			1.48 U	8.25 U	0.864 U	0.839 U	0.947 U	0.959 U
Cadmium	0.6	9	4.03	24.1	1.44 U	1.4 U	1.58 U	1.6 U
Calcium			4,910	45,800	3,120	65,900	16,300	4,690
Chromium	26	110	10.2	27.5 U	2.88 U	3.53	5.46	8.31
Cobalt			9.88 U	55 U	5.76 U	5.6 U	6.31 U	6.4 U
Copper	16	110	5.52	27.5 U	4.21	6.29	6.81	5.97
Iron	20,000	40,000	31,100	431,000	3,070	5,750	7,970	11,000
Lead	31	110	14.8 U	82.5 U	14.5	8.4 U	9.47 U	15.1
Magnesium			1,940	6,870 U	918	6,370	2250	898
Manganese	460	1,100	762	3,700	203	135	382	139
Mercury	0.15	1.3	0.206	0.687 U	0.125	0.07 U	0.0789 U	0.08 U
Nickel	16	50	14.8 U	82.5 U	8.64 U	8.39 U	9.47 U	9.59 U
Potassium			1,230 U	6,870 U	720 U	700 U	789 U	800 U
Selenium			14.8 U	82.5 U	8.64 U	8.39 U	9.47 U	9.59 U
Silver	1	2.2	4.94 U	27.5 U	2.88 U	2.8 U	3.16 U	5.37
Sodium			1,230 U	6,870 U	720 U	700 U	789 U	800 U
Thallium			14.8 U	82.5 U	8.64 U	8.39 U	9.47 U	9.59 U
Vanadium			21.2	82.5 U	8.64 U	8.4 U	9.88	18.5
Zinc	120	270	54.2	193	16.2	31.1	27.9	29.6

NOTES:
Concentrations highlighted exceed the corresponding NYSDEC Class A Standard
U = Compound was analyzed for, but not detected
🟧 Exceeds NYSDEC Severe Level Effect

🟨 Exceeds NYSDEC Lowest Level Effect

Table 4. Summary of Sediment Results
Matthew Creek Sediment Evaluation
City of Johnstown Landfill, Johnstown, New York

Sample ID	Units	NYSDEC Lowest Effect Level	NYSDEC Severe Effect Level	NYSDEC Screening Class A	NYSDEC Screening Class B	NYSDEC Screening Class C	SED-4	SED-DUP-3 (SED-4)	SED-5	SED-6	SED-7	SED-8	SED-9
Sampling Date							07/23/14	07/23/14	07/23/14	07/23/14	07/23/14	07/23/14	07/23/14
INORGANIC PARAMETERS													
Aluminum	mg/kg						8,100	7,800	11,000	2,600	4,200	7,900	7,000
Antimony	mg/kg	2	25				8.3 U	7.5 U	9.5 U	7.2 U	6.8 U	3 J	11 U
Arsenic	mg/kg	6	33	<10	10 - 33	>33	13	9.6	14	9.7	6.1	7.7	8.6
Barium	mg/kg						55	48	76	30	31	76	55
Beryllium	mg/kg						0.43 J	0.42 J	0.57 J	0.16 J	0.23 J	0.49 J	0.4 J
Cadmium	mg/kg	0.6	9	<1	1 - 5	>5	1.6 U	1.5 U	1.9 U	1.4 U	1.4 U	0.2 J	0.2 J
Calcium	mg/kg						13,000	6,900	7,000	6,900	4,600	13,000	9,400
Chromium	mg/kg	26	110	<43	43 - 110	>110	9.8	9.6	12	7.2	6.3	15	14
Cobalt	mg/kg						9.3	6	6.5	9	4.7	19	20
Copper	mg/kg	16	110	<32	32 - 150	>150	7.8	7.3	10	4.9	4.4	11	10
Iron	mg/kg	20,000	40,000				36,000	24,000	38,000	25,000	13,000	21,000	26,000
Lead	mg/kg	31	110	<36	36 - 130	>130	7.8 J	7.2 J	11	5.7 J	6 J	18	16.0
Magnesium	mg/kg						1,400	1,300	1,400	540	1,100	1,600	1,400
Manganese	mg/kg	460	1,100				1,200	420	240	280	300	840	930
Mercury	mg/kg	0.15	1.3	<0.2	0.2 - 1	>1	0.06 J	0.07 J	0.09 J	0.04 J	0.04 J	0.14 J	0.13 J
Nickel	mg/kg	16	50	<23	23 - 49	>49	11	9.4	11	12	5.4	29	21
Potassium	mg/kg						460	390	550	170 J	210 J	470 J	350 J
Selenium	mg/kg						3.3 U	3 U	3.8 U	2.9 U	2.7 U	4.9 U	4.3 U
Silver	mg/kg	1	2.2	<1	1 - 2.2	>2.2	1.6 U	1.5 U	1.9 U	1.4 U	1.4 U	2.4 U	2.1 U
Sodium	mg/kg						99 J	85 J	100 J	50 J	56 J	140 J	79 J
Thallium	mg/kg						3.3 U	3 U	3.8 U	2.9 U	2.7 U	4.9 U	4.3 U
Vanadium	mg/kg						20	18	24	8.5	14	21	20
Zinc	mg/kg	120	270	<120	120 - 460	>460	35	33	46	18	21	44	46
Total Organc Carbon													
TOC - Rep	%						2.43	4.90	5.36	4.43	2.10	9.76	4.82
TOC - Rep	%						2.18	4.68	4.82	5.52	1.99	9.92	4.28

NOTES:

Concentrations highlighted exceed the corresponding NYSDEC Class A Standard

U = Compound was analyzed for, but not detected

B = Concentration is less than the CRQL and greater than the IDL

J = Concentration is an estimated value

NS = Monitoring well not sampled

NA = Parameter not analyzed

N = Spiked sample recovery not within control limits

* = Duplicate analysis not within control limits

+/- = Additionally estimated

🟧 Exceeds NYSDEC Severe Effect Level

🟨 Exceeds NYSDEC Class A Screening Level

APPENDIX E – EXCAVATION WORK PLAN

E-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the Site owner or their representative will notify the Department. Currently, this notification will be made to:

Kelly Duval

Environmental Engineer

New York State Department of Environmental Conservation

232 Golf Course Road
Warrensburg, NY 12885
Telephone: (518) 623-1272

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent, plans for Site re-grading, intrusive elements or utilities to be installed below the landfill cap, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;

- A summary of environmental conditions anticipated in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;

- A schedule for the work, detailing the start and completion of all intrusive work,

- A summary of the applicable components of this EWP;
- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;
- A copy of the contractor’s health and safety plan, in electronic format, if it differs from the HASP provided in Appendix F of this document;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with all required chemical testing results.

E-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based soil screening will be performed by a qualified environmental professional during all remedial and development excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed regardless of when the invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work, after issuance of the COC.

Soils will be segregated based on previous environmental data and screening results into material that requires off-Site disposal, material that requires testing, material that can be returned to the subsurface, and material that can be used as cover soil.

E-3 STOCKPILE METHODS

Soil stockpiles will be continuously encircled with a silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC.

E-4 MATERIALS EXCAVATION AND LOAD OUT

A qualified environmental professional or person under their supervision will oversee all invasive work and the excavation and load-out of all excavated material.

The owner of the property and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the Site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the Site.

Loaded vehicles leaving the Site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

A truck wash will be operated on-Site. The qualified environmental professional will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the Site until the activities performed under this section are complete.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-Site soil tracking.

The qualified environmental professional will be responsible for ensuring that all egress points for truck and equipment transport from the Site are clean of dirt and other materials derived from the Site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

E-5 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

All trucks will be washed prior to leaving the Site. Truck wash waters will be collected and disposed of off-Site in an appropriate manner.

All trucks loaded with Site materials will exit the vicinity of the Site using only approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive Sites; (b) use of city mapped truck routes; (c) prohibiting off-Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-Site in order to minimize off-Site disturbance. Off-Site queuing will be prohibited.

E-6 MATERIALS DISPOSAL OFF-SITE

All soil/fill/solid waste excavated and removed from the Site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this Site is proposed for unregulated off-Site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-Site management of materials from this Site will not occur without formal NYSDEC approval.

Off-Site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C/D recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-Site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

E-7 MATERIALS REUSE ON-SITE

Chemical criteria for on-Site reuse of material have been approved by NYSDEC consist of the 6 NYCRR Part 375 Protection of Groundwater Soil Cleanup Objectives. The qualified environmental professional will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material does not remain on-Site. Contaminated on-Site material, including historic fill and contaminated soil, that is acceptable for re-use on-Site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Any demolition material proposed for reuse on-Site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-Site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site will not be reused on-Site.

E-8 FLUIDS MANAGEMENT

All liquids to be removed from the Site, including excavation dewatering and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the Site, but will be managed off-Site.

Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a SPDES permit.

E-9 COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the landfill cap will be restored in a manner that complies with the ROD. The demarcation layer, consisting of orange snow fencing material or equivalent material will be replaced to provide a visual reference to the top of the ‘Remaining Contamination Zone’, the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this Site Management Plan. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the ‘Remaining Contamination. A figure showing the modified surface will be included in the subsequent Periodic Review Report and in any updates to the Site Management Plan.

E-10 BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the Site will be approved by the qualified environmental professional and will be in compliance with provisions in this SMP prior to receipt at the Site.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the Site.

All imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Solid waste will not be imported onto the Site.

Trucks entering the Site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

E-11 STORMWATER POLLUTION PREVENTION

Barriers and hay bale checks will be installed and inspected once a week and after every storm event (equal to or more than 0.6 inches of rain). Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters

Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

E-12 CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs), unless the Site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive Site work will be promptly communicated by phone to NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the periodic reports prepared pursuant to Section 5 of the SMP.

E-13 COMMUNITY AIR MONITORING PLAN

As part of the detailed planning documentation, a Community Air Monitoring Plan (CAMP) must be included. Guidance can be obtained in Appendix 1A of DER-10, Generic CAMP. At a minimum, the CAMP must include:

- Details of the perimeter air monitoring program;
- Action levels to be used;
- Methods for air monitoring;

- Analytes measured and instrumentation to be used; and

- A figure of the location(s) of all air monitoring instrumentation. A figure showing specific locations must be presented for monitoring stations based on generally prevailing wind conditions, with a note that the exact locations to be monitored on a given day will be established based on the daily wind direction.

Air monitoring locations will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations. If a sensitive receptor, such as a school, day care or residential area is adjacent to the site, a fixed monitoring station should be located at that site perimeter, regardless of wind direction, and discussed in the text.

Exceedances of action levels listed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers.

E-14 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-Site. If nuisance odors are identified at the Site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the property owner’s Remediation Engineer, and any measures that are implemented will be discussed in the Periodic Review Report.

All necessary means will be employed to prevent on- and off-Site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-Site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-Site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

E-15 DUST CONTROL PLAN

A dust suppression plan that addresses dust management during invasive on-Site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-Site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.

- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.

- Gravel will be used on roadways to provide a clean and dust-free road surface.

- On-Site roads will be limited in total area to minimize the area required for water truck sprinkling.

E-16 OTHER NUISANCES

A plan for rodent control will be developed and utilized by the contractor prior to and during Site clearing and Site grubbing, and during all remedial work.

A plan will be developed and utilized by the contractor for all remedial work to ensure compliance with local noise control ordinances.

APPENDIX F - HEALTH AND SAFETY PLAN

ARCADIS
Infrastructure · Water · Environment · Buildings

Site Specific Health and Safety Plan

Revision 12 7/1/2014

Project Name: Johnstown Landfill

Project Number: 02384000.2014
Client Name: City of Johnstown
Date: 3/31/2016
HASP Expires 3/31/2017
Revision: 2

Approvals:

HASP Developer: Christine Thomas

Project Manager: Daniel Lang

HASP Reviewer: X

Emergency Information

Site Address: Johnstown, New York

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Emergency Other (specify)		
Client Contact	Christopher Vose	518-736-4014
WorkCare (non-lifethreatening injury/illness)		1-800-455-6155
Project H&S	Emmanuel Sousa	518-250-7321
Task Manager	Katie Bidwell	518-250-7387
Project Manager	Daniel Lang	518-250-7358
Corporate H&S Specialist	Julie Santaniello	978-551-0033
Corporate H&S Director	Denis Balcer	614-778-9171

Hospital Name and Address:

St. Mary's Hospital
427 Guy Park Ave.
Amsterdam, NY 12010

Hospital Phone Number: 518-842-1900

Incident Notification Process

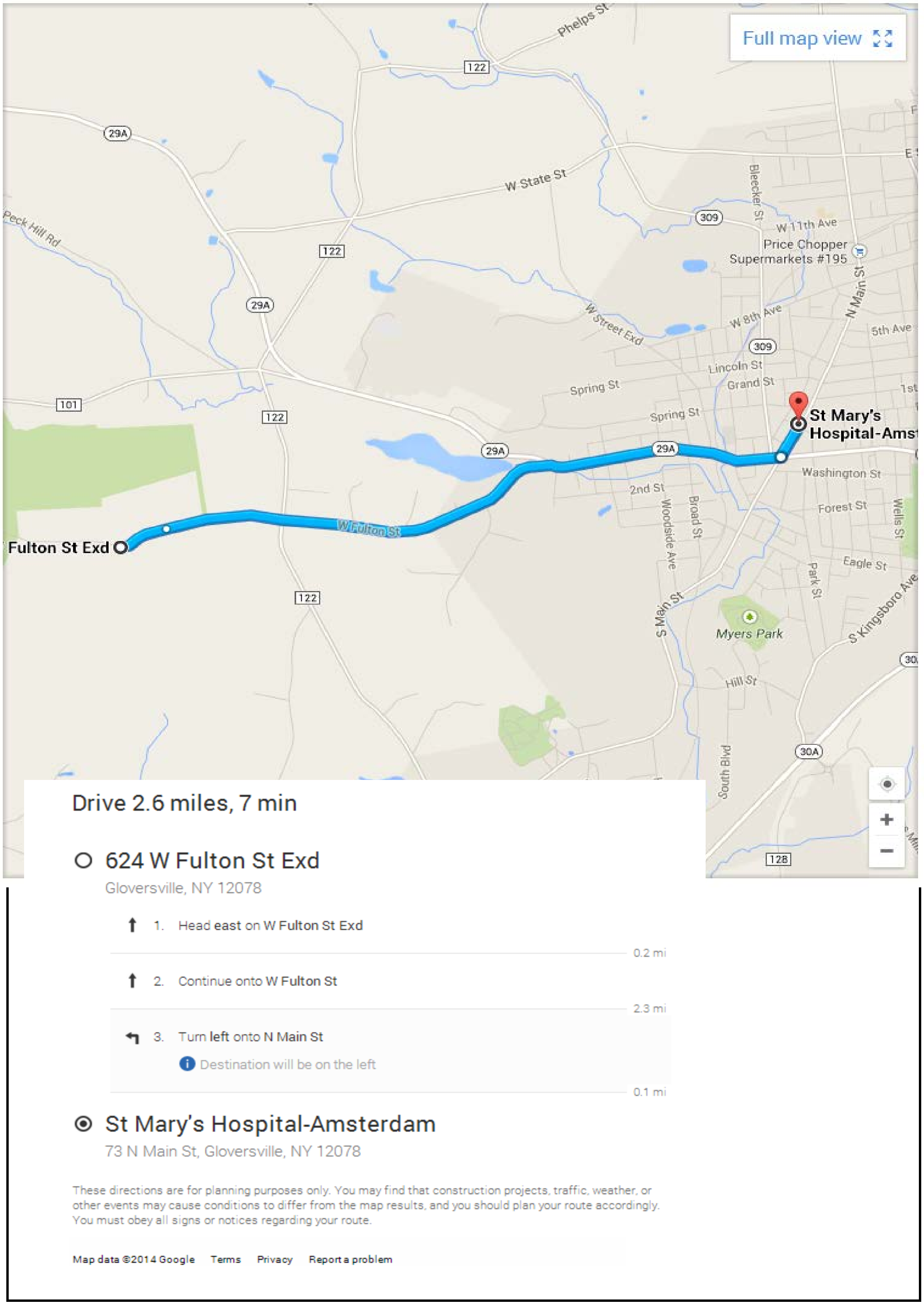
1 Dial 911/Facility Emergency Number/WorkCare as applicable
2 Contact PM/Supervisor Daniel Lang
3 Contact Corporate H&S Denis Balcer
4 Contact Client Christopher Vose

Complete below, as applicable, or clear cell contents:

Location of Assembly Area(s): West Fulton Street - Pull off outside front gate

Nearest Storm Shelter:

Route to the Hospital



Drive 2.6 miles, 7 min

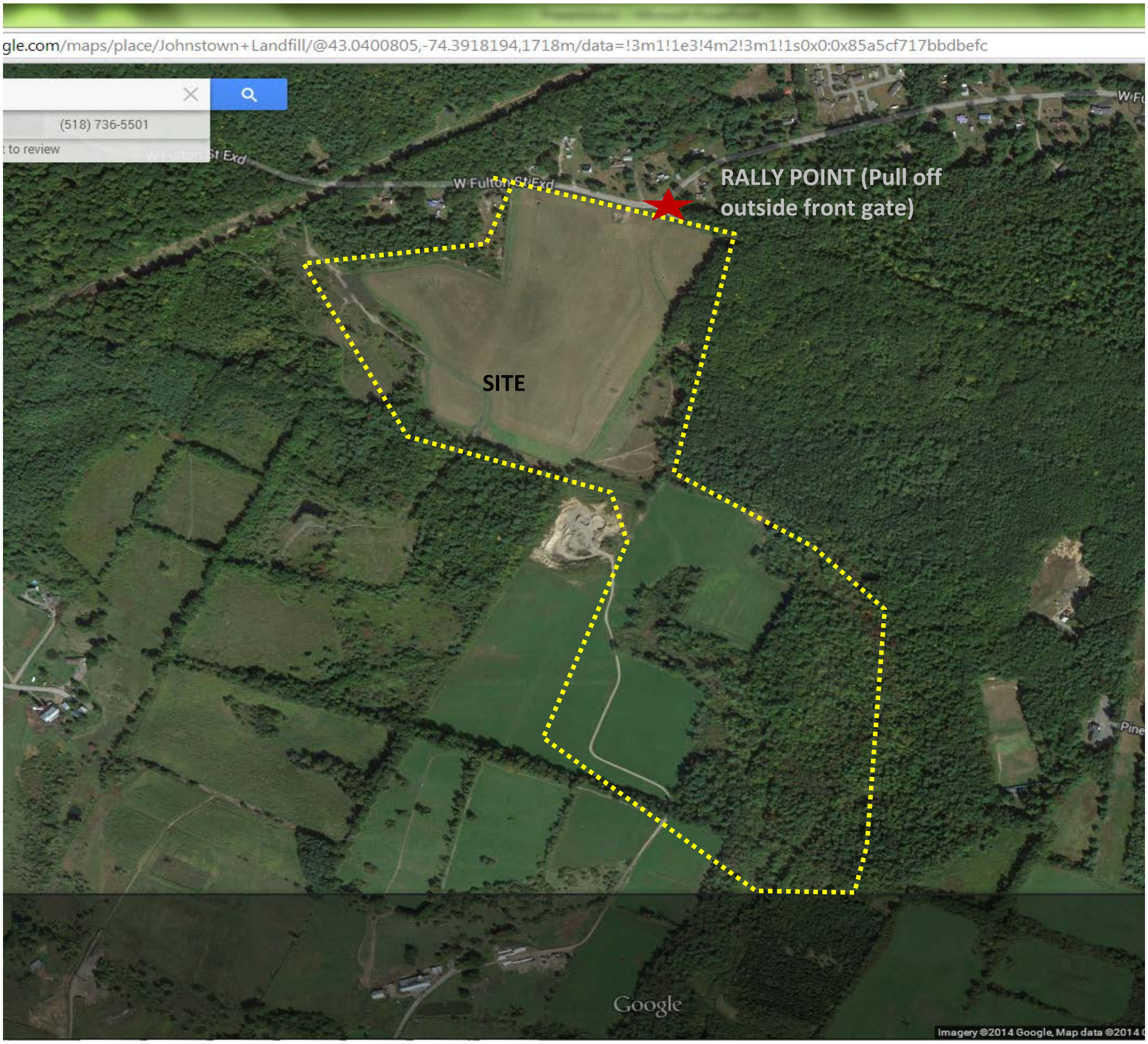
○ 624 W Fulton St Exd

Gloversville, NY 12078

1. Head east on W Fulton St Exd — 0.2 mi
2. Continue onto W Fulton St — 2.3 mi
3. Turn left onto N Main St
   Destination will be on the left — 0.1 mi

◉ St Mary's Hospital-Amsterdam

73 N Main St, Gloversville, NY 12078



RALLY POINT (Pull off outside front gate)

General Information

Site Type (select all applicable where work will be conducted):

☐ Active
☐ Bridge
☐ Buildings
☐ Commercial
☐ Construction
☐ Military Installation
☐ Inactive Industrial
☐ Active Industrial
☑ Landfill
☐ Marine
☐ Mining
☐ Parking Lot/Private Roadway
☐ Railroad
☐ Remote Area
☐ Residential
☐ Retail
☐ Roadway (public, inlcuding right-of-way)
☐ Water Treatment Plant
☐ Unknown
☐ Unsecured
☐ Utility
☐ Other (specify): ______________________________

Surrounding Area and Topography (select one):

☐ Surrounding area and topography are presented in the project work plan
☑ Surrounding area and topography (*briefly describe*):

The Johnstown Landfill is located in the Town of Johnstown, Fulton County, New York. The site is generally bordered by low density residential areas along West Fulton Street Extension to the north, and mixed wooded and agricultural lands to the east, south and west of the site. The landfill is located in a former borrow pit.

Simultaneous Operations (SimOps)

☑ Not applicable
☐ SimOps will exist on this project

Site Background (select one):

☐ Site background is presented in the project work plan
☑ Site background (*briefly describe)* :

The City used half of the 68-acre landfill site as a sanitary landfill from 1947 until 1989. Wastes from local tanneries and textile mills were accepted at the site until 1977. Wastewater treatment plant sludge was also disposed of at the landfill from 1973 until 1979. The tannery wastes contained elevated levels of chromium and the wastewater sludge contained elevated levels of chromium, iron, and lead. The landfill closure was completed in December 1996.

Project Tasks

The following tasks are identified for this project:

Examples: "Drilling/soil sampling", "Surveying", "General Inspections", "Construction Management/Inspections"

1 General Site work
2 Landfill Inspection
3 Surface water sampling
4 Sediment sampling
5

☐ Subcontractor H&S information is attached
☐ Utility clearance required.
☑ FHSHB sections apply *(list below in "Comments")*
☐ State specific H&S required:

☐ ARCADIS Standards apply to augment JSA *[list standard(s) below in "Comments"]*
☐ Journey Management Plan attached

Comments:

Sect IIA - Daily Tailgate Safety Mtgs, Sect IIF - Hygiene and Field Sanitation, Sect IIN - Biologicals/ticks, loose dogs, etc.

Roles and Responsibilities

	Name	*Role*	*Additional Responsibilities (Describe)*
1	Daniel Lang	PM	
2	Katie Bidwell	TM	
3	Emmanuel Sousa	Field Lead	
4	Emmanuel Sousa	SSO	
5			
6			

Training

All ARCADIS employees are required to have the following training:

Hazwoper 40 Hour
DOT HazMat #1
H&S Program Orientation
PPE
Defensive Driving - Smith On-Line
None
None
None
None
None
None
None
None

Client specific:

Other:

Selected ARCADIS employees are required to have the following additional training:

	Names or Numbers from above
First Aid/CPR	Emmanuel Sousa
BBP (Bloodborne Pathogens)	Emmanuel Sousa
None	
None	
None	
None	
None	
None	
None	
None	
None	
None	
None	
None	
None	

Other:

Hazard Analysis

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Division	Business Unit
All Categories	All Categories

Task 1: General Site work

Hazardous Activity #1

General-Vehicle -motor vehicle operation (all types on roadways)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	M	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Smith System (on line) Inspections Secondary: JSAs Admin. Controls (specify below)

Enter Required Controls:

Hazardous Activity #2

General-Cutting - using fixed blades such as pocket knives, Leatherman, box cutters or scissors

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	M	Motion	-
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Specialized Equipment (specify below) Secondary: Admin. Controls (specify below) JSAs PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #3

Field-Ambient environment - exposure heat, cold, sun, weather, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	M	Electrical	L
Environmental	L	Gravity	H	Mechanical	-	Motion	L
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Field H&S Handbook Secondary: H&S Standards Engineering Controls (specify below) Admin. Controls (specify below) Specialized Equipment (specify below) PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #4

Field-Mobilization/Demobilization - from a site

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	L	Driving	M	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	L
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Field H&S Handbook Engineering Controls (specify below) Secondary: JSAs Job Briefing/Site Awareness PPE (see HASP "PPE" section) Admin. Controls (specify below)

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Landfill Inspection

Task 2:

Hazardous Activity #1

Field-Walking - uneven or slippery terrain

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Secondary: Housekeeping PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #2

Field-Biological - insects, spiders, snakes, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	M	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Engineering Controls (specify below) Secondary: JSAs HASP Job Briefing/Site Awareness PPE (see HASP "PPE" section) Housekeeping

Enter Required Controls:

Hazardous Activity #3

Field-Hunting season - work activities during hunting season

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	L	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK HASP Job Briefing/Site Awareness Secondary: Cont/Emerg. Planning Engineering Controls (specify below) Admin. Controls (specify below) PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 3: Surface water sampling

Hazardous Activity #1

Field-Surface water - working over or near water bodies

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	L	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	-
Personal Safety	L	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Engineering Controls (specify below) JSAs Secondary: Job Briefing/Site Awareness Cont/Emerg. Planning PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #2

Field-Remote areas, work in these locations

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Specialized Training per Standard Cont/Emerg. Planning Communications Plan Admin. Controls (specify below) JSAs Secondary: Job Briefing/Site Awareness Specialized Equipment (specify below)

Enter Required Controls:

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 4: Sediment sampling

Hazardous Activity #1

Field-Sampling - manual soil sampling (hand auger, trowel, etc)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	L	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Job Rotation Job Briefing/Site Awareness Secondary: Inspections Specialized Equipment (specify below) PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #2

Field-Sampling - sample cooler preparation

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	-	Gravity	M	Mechanical	L	Motion	L
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) See HASP "Monitoring" section Secondary: Job Briefing/Site Awareness Admin. Controls (specify below) Work Plan PPE (see HASP "PPE" section)

Enter Required Controls:

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	**Property**	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 5: 0

Hazardous Activity #1

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #2

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazard Communication (HazCom)/Global Harmonization System (GHS)

☐ HAZCOM/GHS for this project is managed by the client or general contractor

List the chemicals anticipated to be used by ***ARCADIS*** *on this project per HazCom/GHS requirements.*
(Modify quantities as needed)

	Acids/Bases	Qty
☑	Not applicable	
☐	Hydrochloric acid	<500 ml
☐	Nitric acid	<500 ml
☐	Sulfuric acid	<500 ml
☐	Sodium hydroxide	<500 ml
☐	Zinc acetate	<500 ml
☐	Ascorbic acid	<500 ml
☐	Acetic acid	<500 ml
☐	Other:	
	____________	
	____________	
	____________	

	Decontamination	Qty
☐	Not applicable	
☑	Alconox	≤ 5 lbs
☐	Liquinox	≤ 1 gal
☐	Acetone	≤ 1 gal
☐	Methanol	≤ 1 gal
☐	Hexane	≤ 1 gal
☐	Isopropyl alcohol	≤ 4 gal
☐	Nitric acid	≤ 1 L
☐	Other:	
	____________	
	____________	
	____________	

	Calibration	Qty.
☑	Not applicable	
☐	Isobutylene/air	1 cyl
☐	Methane/air	1 cyl
☐	Pentane/air	1 cyl
☐	Hydrogen/air	1 cyl
☐	Propane/air	1 cyl
☐	Hydrogen sulfide/air	1 cyl
☐	Carbon monoxide/air	1 cyl
☐	pH standards (4,7,10)	≤ 1 gal
☐	Conductivity standards	≤ 1 gal
☐	Other:	
	____________	

	Fuels	Qty.
☑	Not applicable	
☐	Gasoline	≤ 5 gal
☐	Diesel	≤ 5 gal
☐	Kerosene	≤ 5 gal
☐	Propane	1 cyl
☐	Other:	
	____________	

	Kits		Qty.
☑	Not applicable		
☐	Hach (specify):	____________	1 kit
☐	DTECH (specify):	____________	1 kit
☐	EPA 5035 Soil (specify kit):	____________	1 kit
☐	Other:		
	____________	____________	
	____________	____________	

	Remediation	Qty.
☑	Not applicable	
☐	____________	
☐	____________	
☐	____________	
☐	____________	
☐	____________	

	Other:	Qty.
☑	Not applicable	
☐	Spray paint	≤ 6 cans
☐	WD-40	≤ 1 can
☐	Pipe cement	≤ 1 can
☐	Pipe primer	≤ 1 can
☐	Mineral spirits	≤ 1 gal

		Qty.
☐	____________	
☐	____________	
☐	____________	
☐	____________	
☐	____________	
☐	____________	

Material safety data sheets (MSDSs)/Safety Data Sheets (SDSs) must be available to field staff.
Indicate below how MSDS information will be provided:

☐ Not applicable
☐ Printed copy in company vehicle
☐ Printed copy in the project trailer/office
☑ Printed copy attached
☐ Electronic copy on field computer

☐ Contractor MSDSs/SDSs are not applicable
☐ Contractor MSDSs/SDSs are attached
☐ Contractor MSDSs/SDSs will be on site and located: ____________

☐ Bulk quantities of the following materials will be stored: ____________

Contact the project H&S contact for information in determining code and regulatory requirements associated with bulk storage of materials.

Monitoring

☐ Chemical air monitoring is not required for this project.

For projects requiring air monitoring, list the *__relevant__* *constituents representing a hazard to site workers.*

Constituent	Max. Conc.	Units	TWA	Units	STEL	Units	IDLH	Units	LEL/UEL (%)		VD Air=1	VP (mm Hg)	IP (eV)
Cadmium	30	ppm	0.005	m,O	NA	-	9	m,N	NA/NA	0	NA	NA	NA
None			9999	-	0	-	0	-	0	0	0	0	0
None			9999	-	0	-	0	-	0	0	0	0	0
None			9999	-	0	-	0	-	0	0	0	0	0
None			9999	-	0	-	0	-	0	0	0	0	0
None			9999	-	0	-	0	-	0	0	0	0	0

Notes: TWAs are ACGIH 8 hr-TLVs unless noted.

p-ppm m-mg/m3
s- skin c-ceiling
r- resipirable i-inhalable

c2- ceiling (2 hr) se-sensitizer
"9999" - NA O-OSHA PEL
N-NIOSH 10 hr REL

"#N/A" -Constituent is not in database, manually enter information

Monitoring Equipment and General Protocols

Air monitoring is required for any task or activity where employees have potential exposure to vapors or particulates above the TWA. Action levels below are appropriate for most situations. *__Contact the project H&S contact for all stop work situations__*. *Select monitoring frequency and instruments to be used.*

Monitoring Frequency: At each Landfill vent
Indicator Tube/Chip Frequency: Indicator tube/chip monitoring not required

	Instrument	Action Levels	Actions
☐	Photoionization Detector	< 0.000	Continue work
		0.000 - 0.0	Sustained >5 min. continuous monitor, review eng. controls and PPE, proceed with caution
	Lamp (eV):	> 0.0	Sustained >5 min. stop work, contact SSO
☐	Flame Ionization Detector (FID)	< 0.0	Continue work
		0.0 - 0.0	Sustained >5 min. continuous monitor, review eng. controls and PPE, use caution
		> 0.0	Sustained >5 min. stop work, contact SSO
☑	LEL/O2 Meter	0-5% LEL	Continue work
		>5-10% LEL	Continuous monitor, review eng. controls, proceed with caution
	☐ ☐	>10% LEL	Stop work, evacuate, contact SSO
		19.5%-23.5% O2	Normal, continue work
		<19.5% O2	O2 deficient, stop work, evacuate, cont. SSO
		>23.5% O2	O2 enriched, stop work, evacuate, contact SSO
☐	Indicator: tube chip	≤PEL/TLV	Continue work
		>PEL/TLV	Stop work, review eng. controls and PPE, contact SSO
	Compound(s):		
☐	Particulate Monitor (mists, aerosols, dusts in mg/m^3)	< 2.5	Continue work
		2.5 - 5.000	Use engineering controls, monitor continuously
		> 5.000	Stop work, review controls, contact SSO
☑	Other: CO, H2S	Specify: CO >25 ppm; H2S > 10 ppm	Specify: Stop work, review controls, contact SSO

One or more constituents listed above is a particulate hazard. Use wetting as the primary control to eliminate dust hazards.

Personal Protective Equipment (PPE)

See JSA or Permit for the task being performed for required PPE *. If work is not conducted under a JSA or Permit, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for* *<u>all tasks during field work</u>* *(outside of field office trailers and vehicles) not covered by a JSA or Permit on this project:*

Minimum PPE required to be worn by all staff on project:

☑ Hard hat
☑ Safety glasses
☐ Safety goggles
☐ Face shield
☐ Hearing protection
☐ Rain suit
☐ Other: ________

☐ Snake chaps/guards
☐ Briar chaps
☐ Chainsaw chaps
☐ Sturdy boot
☑ Steel or comp. toe boot
☐ Metatarsal boot
____
____

Specify Type:

☐ Coveralls: ________
☐ Apron: ________
☑ Chem. resistant gloves: nitrile
☐ Gloves other: ________
☐ Chemical boot: ________
☐ Boot other: ________
☑ Traffic vest,shirt or coat: Class II
☐ Life vest: ________

Task specific PPE:

Comments:

Medical Surveillance (*check all that apply*)

☐ Medical Surveillance is not required for this project.
☑ HAZWOPER medical surveillance applies to all ARCADIS site workers on the project.
☐ HAZWOPER medical surveillance applies to all subcontractors on the project.
☐ HAZWOPER medical surveillance applies to all site workers on the project except:

☐ Other medical surveillance required (describe type and who is required to participate):

☐ Client drug and/or alcohol testing required.

Hazardous Materials Shipping and Transportation (*check all that apply*)

☐ Not applicable, no materials requiring a Shipping Determination (SD) will be transported or shipped
☐ A SD has been reviewed and provided to field staff
☑ A SD is attached
☐ All HazMat will be transported under Materials of Trade by ARCADIS (see generic MOT SD Form)
☐ Other (specify):

Roadway Work Zone Safety (*check all that apply*)

☑ Not applicable for this project
☐ All or portions of the work conducted under a TCP
☐ All or portions of the work conducted under a STAR Plan
☐ TCP or STAR Plan provided to field staff
☐ TCP or STAR Plan attached
☐ Other (specify):

ARCADIS Commercial Motor Vehicles (CMVs)

This section is applicable to ARCADIS operated vehicles only

☑ This project will **<u>not</u>** utilize CMV drivers
☐ This project will utilize CMV drivers

Site Control (*check all that apply*)

☑ Not applicable for this project.
☐ Site control protocols are addressed in JSA or other supporting document (attach)
☐ Maintain an exclusion zone of ____________ ft. around the active work area
☐ Site control is integrated into the STAR Plan or TCP for the project
☐ Level C site control - refer to Level C Supplement attached
☐ Other (specify):

Decontamination (*check all that apply*)

☐ Not applicable for this project.
☐ Decontamination protocols are addressed in JSA or other governing document (attach)
☑ Level D work- wash hands and face prior to consuming food, drink or tobacco.
☐ Level D Modified work- remove coveralls and contain, wash hands and face prior to consuming food, drink or tobacco. Ensure footwear is clean of site contaminants
☐ Level C work - refer to the Level C supplement attached.
☐ Other (specify):

Sanitation (*check all that apply*)

☑ Mobile operation with access to off-site restrooms and potable water
☐ Restroom facilities on site provided by client or other contractor
☐ Project to provide portable toilets (1 per 20 workers)
☐ Potable water available on site
☐ Project to provide potable water (assume 1 gal./person/day)
☐ Project requires running water (hot and cold, or tepid) with soap and paper towels

Safety Briefings (*check all that apply*)

☑ Safety briefing required daily
☐ Safety briefing required twice a day
☐ Safety briefings required at the following frequency: ______________________________
☐ Subcontractors to participate in ARCADIS safety briefings
☐ ARCADIS to participate in client/contractor safety briefings
☐ Other (specify):

Safety Equipment and Supplies

Safety equipment/supply requirements are addressed in the JSA or Permit for the task being performed. *If work is not performed under a JSA or Permit, the following safety equipment is required to be present on site in good condition (Check all that apply):*

☑ First aid kit
☑ Bloodborne pathogens kit
☑ Fire extinguisher
☑ Eyewash (ANSI compliant)
☑ Eyewash (bottle)
☑ Drinking water
☐ Other:
____

☑ Insect repellent
☑ Sunscreen
☐ Air horn
☐ Traffic cones
☐ 2-way radios
☐ Heat stress monitor
____
____

Behavior Based Safety Program (*check all that apply*)

☑ TIP required at the following frequency on this project:
Select One: ______ mhrs ________ time(s) ______ Define: ____1____
☐ H&S Field Assessment required at the following frequency on this project:
Select One: ______ mhrs ________ time(s) ______ Define: ________
☐ Other (specify):

List tasks anticipated for TIP activity:

____
____
____
____

Near miss reporting enhances our H&S program. Take the time to enter near misses into 4-Sight.

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

☐ Subcontractor Acknowledgement Form attached

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachments

Attachments

Job Safety Analysis

General

JSA ID	10637	**Status**	(3) Completed
Job Name	Environmental-Surface water sampling	**Created Date**	2/13/2014
Task Description	Collect Surface Water/Sediment Samples	**Completed Date**	03/31/2014
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	City of Johnstown
Project Number	02384000.2014
Project Name	Johnstown Landfill
PIC	
Project Manager	Bruce Nelson

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Christine Thomas	7/21/2014	7/21/2014	Daniel Lang	þ
HASP Reviewer	Curtis Whipple	7/22/2014	7/22/2014		þ
Quality Reviewer					þ

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Surface water sampling from shoreline	1	Muscle strains from carrying equipment to smapling locations.	Make multiple trips if necessary. Coolers with samples will get heavier as job progesses. Use smaller coolers to keep loads light. Do not overfill backpacks.	Field H&S Handbook V(G)
		2	Slips from walking on wet surfaces near shoreline.	Wear boots with good tread and avoid heavily muddied areas.	
		3	Water entering boots can increase the chance for blisters and other skin issues with feet/ankles.	Wear rubber outer boots when appropriate. Waders should be worn when wading into deeper water.	
		4	Falling into water can cause injury/drowning	Wear PFD if falling into water deeper than waist high is a hazard, or if working proximal to turbulent / fast moving water. TRACK water conditions every day as rain/snow thaw can cause water conditions to worsen. Person walking through water should minimize what they are carrying so they can maintain balance.	
2	Sediment Sampling from Shore	1	Slips, Trips, Falls	Survey area for slippery muddy conditions. Use caution while walking near shore. Wear adequate footwear.	
		2	Drowning	Water depth is less than 1 foot deep. Use caution when walking near shore. Use buddy system.	
		3	Muscle strain from bending or moving awkwardly.	Plan route to water. Make more trips to carry tools and equipment. Do not bend or over reach to collect sample.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Required
Eye Protection	safety glasses		Required
Foot Protection	boots		Required
	rubber boots	Hip or chest wadders	Recommended

	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
Head Protection	hard hat		Recommended
Miscellaneous PPE	personal flotation device	Work vest	Recommended
	traffic vest--Class II or III	Class II	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Recommended
	first aid kit		Required
Personal	eye wash (specify type)	Bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended
	water/fluid replacement		Recommended
Traffic Control	traffic cones		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**		
Employee: **Role** **Review Type** **Completed Date**		

Job Safety Analysis

General

JSA ID	15	**Status**	
Job Name	General Industry-Driving - passenger	**Created Date**	2/10/2012
Task Description	Driving Passenger Vehicle or Pick Up	**Completed Date**	02/10/2012
Template	TRUE	**Auto Closed**	FALSE

Client / Project

Client	City of Johnstown
Project Number	02384000.2014
Project Name	Johnstown Landfill
PIC	
Project Manager	Bruce Nelson

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Christine Thomas	7/21/2014	7/21/2014	Daniel Lang	
Reviewer	Curtis Whipple	7/22/2014	7/22/2014		

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Performing Pre-trip inspections and adjustments.	1	Failure to conduct pre- trip inspection of vehicle can lead to vehicle accident.	Use TRACK to conduct inspection of the vehicle. Walk around vehicle to verify tire pressure, no signs of leaking fluids, overall vehicle condition. Use vehicle inspection checklist as necessary.	
		2	Failure to adjust mirrors, seats, and controls prior to driving can lead to vehicle accident.	Adjust all mirrors, seats and vehicle controls prior to driving vehicle. Become familiar with electronic controls, such as turn signals, windshield wipers, air conditioning, and radio prior to vehicle operation.	
		3	Cuts and scrapes to hands and fingers while checking engine fluids.	Use TRACK to plan inspection activity in the engine compartment. Wear protective gloves if reaching in poorly illuminated areas of the engine.	
		4	Pinch and crush hazards to the hands and fingers while checking engine fluids or closing doors.	Identify and keep hands and fingers away from pinch hazards from the doors and vehicle hood or tailgate (if present).	
		5	Awkward body positions while checking tires, spare tire, undercarriage, or engine compartment.	Maintain a neutral body position and avoid awkward reaches under the vehicle or in engine compartment.	
		6	Failure to inspect vehicle emergency equipment may result in extensive vehicle damage or delay treatment in the event of injury	Conduct equipment inspections by visibly inspecting fire extinguisher and first aid kit for cleanliness, in date items/tags, readiness for use.	
2	Vehicle loading and unloading	1	Object placement obstructing rear, side or blindspot view	Avoid placing objects in a manner that obstructs your view, brake equipment down to a smaller more manageable size to keep low profile in vehicle. If hanging clothes in vehicle, place in manner that does not obstruct blind spots.	
		2	Unsecure objects causing pedal, steering or gear shift obstruction or injury during vehicle operation.	Secure all loads in vehicle (both in the bed of trucks and in passenger cabin) to prevent unanticipated movement or shifting that could injure driver, passenger, or affect safe operation of vehicle.	
		3	Obstruction of vehicle safety equipment caused by object placment in vehicle.	Keep emergency equipment clear and unobstructed to ensure ready availablity.	

3	Vehicle operation	1	Failure to use Smith System "5-Keys" increases risk of accident and injruy.	Use the Smith System "5-Keys", maintain space cushion around vehicle, maintain 4 second rule and add a second for each addtional hazard (wet roads, snow, etc). Brake gradually, keep eyes moving, check mirrors every 6-8 seconds, use turn signals, focus on relavent objects, use early lane positioning when approaching turns.	
		2	Injury or death from failure to wear seatbelt	Always wear seatbelts when operating or riding in vehicles.	
		3	Cell phone and electronic device use while driving increases the risk of accident and injury.	Use of cell phones or other electronic devices while driving is prohibited.	
		4	Use of radar detectors encourages speeding, resulting in increased risk for accident or injury.	Use of radar detectors and similar devices is prohibited.	
		5	Intruders attempting to enter vehicle while stopped at intersections, and/or while it is vacant. Doors opening during an accident.	Lock doors before driving vehicle and always after leaving the vehicle- unless client requires vehicles to remain unlocked while onsite.	
4	Routine maintenance	1	Lack of routine vehicle maintenance can lead to engine and control failures, potential vehicle accident.	Vehicle should have routine maintenance and service to keep in good operating condition.	
		2	Pinch and crush hazards to hands and fingers while replacing engine fluids or closing doors/hood.	Inspect and identify the pinch and crush hazards, and keep hands/fingers clear when closing hood, tailgates, or doors.	
		3	Burn hazards to hands from checking/replacing fluids in engine compartment.	When practical allow engine to cool prior to servicing or adding fluids. Use protective gloves.	
		4	Vehicle damage from improper fuse replacement	Never replace a fuse with a higher amperage than the one being replaced. Only replace fuses of type being replaced.	

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Traffic Control	Other	Roadway emergency kit	Required

Review Comments

Reviewer		Comments

Job Safety Analysis

General

JSA ID		**Status**	(3) Completed
Job Name		**Created Date**	
Task Description		**Completed Date**	
Template		**Auto Closed**	TRUE

Client / Project

Client	City of Johnstown
Project Number	02384000.2014
Project Name	Johnstown Landfill
PIC	
Project Manager	Bruce Nelson

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Christine Thomas	7/21/2014	7/21/2014	Daniel Lang	þ
HASP Reviewer	Curtis Whipple	7/22/2014	7/22/2014	Daniel Lang	þ

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	
3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	

Job Safety Analysis

General

JSA ID		**Status**	(3) Completed
Job Name		**Created Date**	
Task Description		**Completed Date**	
Template		**Auto Closed**	TRUE

		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

ARCADIS

Control Number:TGM - ______________________________

TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name: 54 Second Street and Associated Properties

Project Location: Albany, NY

Date:

Time:

Conducted by:

Signature/Title:

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

☐ Additonal permits or checklists attached

USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JLAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.

☐ Gravity (i.e., ladder, scaffold, trips) (L M H)
h: ______
c: ______

☐ Electrical (i.e., utilities, lightning) (L M H)
h: ______
c: ______

☐ Chemical (i.e., fuel, acid, paint) (L M H)
h: ______
c: ______

☐ Sound (i.e., machinery, generators) (L M H)
h: ______
c: ______

☐ Motion (i.e., traffic, moving water) (L M H)
h: ______
c: ______

☐ Pressure (i.e., gas cyl., wells) (L M H)
h: ______
c: ______

☐ Biological (i.e., ticks, poison ivy) (L M H)
h: ______
c: ______

☐ Personal (i.e. alone, night, not fit) (L M H)
h: ______
c: ______

☐ Mechanical (i.e., augers, motors) (L M H)
h: ______
c: ______

☐ Environment (i.e., heat, cold, ice) (L M H)
h: ______
c: ______

☐ Radiation (i.e., alpha, sun, laser) (L M H)
h: ______
c: ______

☐ Driving (i.e. car, ATV, boat, dozer) (L M H)
h: ______
c: ______

Comments:

Signature and Certification: I have read and understand the project specific HASP for this project.

Printed Name/Signature/Company	Sign In Time	Sign Out Time

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.800.455.6155** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party protperty damage - field supervisor will immediately notify the Project or Task Manager

Place any additional signatures on the back of this form.

WorkCare 1.800.455.6155

<u>You</u> have STOP WORK authority

A Real Commitment, A Daily Issue: Safety

Utilities and Structures Checklist

Project: Johnstown Landfill
Project Number: 02384000.2014
Date:
Work locations applicable to this clearance checklist:

Pre-Field Work

One Call or "811" notified 48-72 hours in advance of work? ☐ Yes ☐ No
Utility companies notified during the One Call process ☐ See attached ticket

List any other utilities requiring notification: ☐ None

Client provided utility maps or "as built" drawings showing utilities? ☐ Yes ☐ No

Field Work

Markings present: ☐ Paint ☐ Pin flags/stakes ☐ Other ☐ None
Subsurface Utility Lines of Evidence Used (3 Minimum):

☐ One Call/"811"
☐ Client Provided Maps/Drawings
☐ Client Clearance
☐ Interviews: Name(s)/Affiliation(s)

Did persons interviewed indicate depths of any utilities in the subsurface?
☐ Yes, depths provided:

☐ Did not know or refused to answer

Comments:

☑ Site Inspection
☐ GPR
☐ Air-Knife
☐ Hydro-Knife
☐ Public Records/Maps
☐ Radiofrequency
☐ Metal Detector
☐ Handauger
☐ Potholing
☐ Probing
☐ Private Locator: Name and Company:
☐ Marine Locator: Name and Company:
☐ Other:

Tips for Successful Utility Location:
1. No excessive turning or downward force of handaugers/shovels, etc.
2. No hammering- no pickaxes-no digging bars-no hurrying or shortcutting
3. Select alternate/backup locations for clearance
4. Utilities may run directly under asphalt/concrete or be > 5 ft depth
5. Be on site when utilizing private utility locators

TRACK

Site Inspection

During inspections look for the following ("YES" requires follow up investigation):

			Utility color codes		
a)	Natural gas line present (evidence of a gas meter)?		Yellow	☐ Yes	☐ No
b)	Evidence of subsurface electric lines :		Red		
	i)	Conduits to ground from electric meter?		☐ Yes	☐ No
	ii)	Overhead electric lines absent		☐ Yes	☐ No
	iii)	Light poles, electric devices with no overhead lines?		☐ Yes	☐ No
c)	Evidence of water lines:		Blue		
	i)	Water meter on site?		☐ Yes	☐ No
	ii)	Fire hydrants in vicinity of work?		☐ Yes	☐ No
	iii)	Irrigation systems?		☐ Yes	☐ No
d)	Evidence of sewers or storm drains:		Green		
	i)	Restrooms or kitchen on site?		☐ Yes	☐ No
	ii)	Gutter down spouts going into ground		☐ Yes	☐ No
	iii)	Grates in ground in work area		☐ Yes	☐ No
e)	Evidence of telecommunication lines:		Orange		
	i)	Fiber optic warning signs in areas?		☐ Yes	☐ No
	ii)	Lines from cable boxes running into ground?		☐ Yes	☐ No
	iii)	Conduits from power poles running into ground?		☐ Yes	☐ No
	iv)	Aboveground boxes or housings in work area?		☐ Yes	☐ No
f)	Underground storage tanks:				
	i)	Tank pit present?		☐ Yes	☐ No
	ii)	Product lines running to dispensers/buildings?		☐ Yes	☐ No
	iii)	Vent present away from tank pit?		☐ Yes	☐ No
g)	Proposed excavation markings in work area?		White	☐ Yes	☐ No
h)	Other:				
	i)	Evidence of linear asphalt or concrete repair		☐ Yes	☐ No
	ii)	Evidence of linear ground subsidence or change in vegetation?		☐ Yes	☐ No
	iii)	Manholes or valve covers in work area?		☐ Yes	☐ No
	iv)	Warning signs ("Call Before you Dig", etc) on or adjacent to site?		☐ Yes	☐ No
	v)	Utility color markings not illustrated in this checklist?		☐ Yes	☐ No
i)	Aboveground lines in or near the work area:				
	i)	< 50 kV within 10 ft of work area?		☐ Yes	☐ No
	ii)	>50 - 200 kV within 15 ft of work area?		☐ Yes	☐ No
	iii)	>200-350 kV within 20 ft of work area?		☐ Yes	☐ No
	iv)	>350-500 kV within 25 ft of work area?		☐ Yes	☐ No
	v)	>500-750 kV within 35 ft or work area?		☐ Yes	☐ No
	vi)	>750-1000 kV within 45 ft of work area?		☐ Yes	☐ No

Comments:

Do not initiate intrusive work if utilities are suspected to be present in area and are not located, markings are over 14 days old, or if clearance methods provide incomplete or conflicting information. Do not perform intrusive work within 30 inches of a utility marking without hand clearing.

Name and signature of person completing the checklist:

Name: ____________________
Signature: ____________________
Date: ____________________

ARCADIS

SHIPPING/TRANSPORTATION DETERMINATION

(Rev.4, 8/10)

General Information *(Need Help?)*

Revision Number	
Project Name	Johnstown Landfill
Project Number	02384000.2014
City of Shipment	Johnstown, NY
City of Destination	
Analytical/MSDS/Hazard Information Attached?	No

Description of Material to be Shipped/Transported

Soil samples possibly containing RCRA metals.

Determination

X	Not Restricted/Regulated
	Hazardous Material

Complete for Hazardous Materials (Refer to 49 CFR 172.101 or IATA DGR section 4.2)

Proper Shipping Name	
UN or ID Number	
Hazard Class	
Packing Group	

"X"	*How Do You Want to Ship/Transport This Material?*	*24/7 Emergency Number Required? (FedEx criteria)*	*Packing Instruction / Shipping Guide / Support Package*
	Materials of Trade Exception	No	
	Excepted Quantity	No	
	Limited Quantity (Ltd Qty)	Ground –Yes Air - No	
	Special Permit/49 CFR 173.13	Ltd Qty Ground –Yes Ltd Qty Air – No Non-Ltd Qty- Yes	
	UN Specification Ground, Non-Bulk	Yes	
	UN Specification Ground, Bulk	Yes	
	UN Specification Air, Passenger or Cargo Aircraft	Yes	
	UN Specification Air, Cargo Aircraft Only	Yes	
	Other:	Yes/No	
	Batteries (Excepted)	No	ARCADIS Guide US050
	Compressed Gases (Non-flammable)	Yes	ARCADIS Guide US020
	Dry Ice	No	ARCADIS Guide US015
	Radioactive Material, Excepted Package, Limited Quantity of Material	No	ARCADIS Guide US016
X	Sample Coolers (Print Guide and provide to field staff)	NA	ARCADIS Guide US001

Other Determinations

	This material is a Hazardous Waste (being offered under a Hazardous Waste Manifest)
	This material is a Hazardous Substance (49 CFR 172.101 appendix A)
	This material is a Marine Pollutant or Severe Marine Pollutant (49 CFR 172.101 appendix B)

Method of Shipment/Transportation

	FedEx Freight		Ground (FedEx)		Air (FedEx)	x	Lab Courier
	FedEx Custom Critical		Ground (UPS)		Air (UPS)		Rail
	Freight Other		ARCADIS Transport		Non DOT Spec.		Other
Comments:							

Special Instructions

☐ Sample cooler to be prepared in accordance with ACRADIS Shipping Guide US-001

Rationale for Determination

Due to the expected concentrations/volume of material in the mixture, the shipments are unregulated. Samples will be shipped using standard ice chests.

Regulatory Reference/Interpretation

49 CFR 172.101

Determination Performed By

Christine Thomas		7/21/2014
Name Printed	Signature	Date

QA/QC Check Performed By

Danielle Giroux	Danielle Giroux	7/21/2014
Name Printed	Signature	Date

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**	
CHEMICAL FAMILY NAME:	Detergent.	
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications	
U.N. NUMBER:	Not Applicable	
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material	
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.	
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA	
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada**	800-255-3924
	International calls	813-248-0585
BUSINESS PHONE:	914-948-4040	
DATE OF PREPARATION:	May 2011	
DATE OF LAST REVISION:	February 2008	

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS	CANADA (WHMIS) SYMBOLS	EUROPEAN and (GHS) Hazard Symbols
Non-Regulated		 Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

Risk Phrases:

R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:

S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

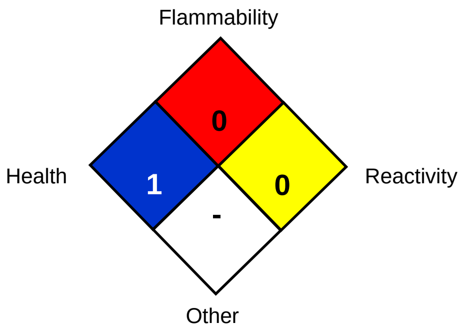
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT:	Not Flammable
AUTOIGNITION TEMPERATURE:	Not Applicable
FLAMMABLE LIMITS (in air by volume, %):	Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS:	As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact:	Not Sensitive.
Explosion Sensitivity to Static Discharge:	Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES:	Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM

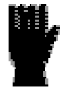


HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	**1**
FLAMMABILITY HAZARD (RED)	**0**
PHYSICAL HAZARD (YELLOW)	**0**

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: 0 = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m^3 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m^3 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: No Data available at this time.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health:	Yes	Chronic Health:	No	Fire:	No	Reactivity:	No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.
Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.
Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.
Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.
Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

APPENDIX G - FIELD SAMPLING FORMS (GROUNDWATER, SURFACE WATER, SEDIMENT AND LANDFILL INSPECTION)

ARCADIS

Groundwater Sampling Form

Page ____ of _____

Project No. ____________________ Well ID ____________ Date ________

Project Name/Location ________________________________ Weather ________

Measuring Pt. Description ________

Screen Setting (ft-bmp) ________

Casing Diameter (in.) ________

Well Material ____ PVC ____ SS ____ Other

Total Depth (ft-bmp) ________

Static Water Level (ft-bmp) ________

Water Column in Well ________

Gallons in Well ________

Calc.Gallons Purged ________

Pump Intake (ft-bmp) ________

Purge Method:
Centrifugal ________
Submersible ________
Disp. Bailer ________
Other ________

Sample Method ________

Gallons Purged ________

MP Elevation ________

Pump On/Off ________

Sample Time: Label ________

Replicate/ Code No. ________

Sampled by ________

Time	Minutes Elapsed	Rate (gpm) (mL/min)	Depth to Water (ft) TOC	Gallons Purged	pH	Cond. (µmhos) (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (^{o}C) (^{o}F)	Redox (mV)	Appearance	
											Color	Odor

Constituents Sampled	**Container**	**Number**	**Preservative**

Well Information

Well Location: ________________ Well Locked at Arrival: Yes / No

Condition of Well: ________________ Well Locked at Departure: Yes / No

Well Completion: Flush Mount / Stick Up Key Number To Well:

NOTES:

Well Casing Volumes

Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

ARCADIS

Surface Water Sample Log

Sample ID ____________________ Project/No. __________________________

Date ____________________ Sampling Personnel __________________________

Time ____________________ __________________________

Weather ____

DESCRIPTION OF SAMPLE LOCATION:

Name of Water Body __________

Depth of Water __________ Velocity __________________________

Other Comments ____

Substrate Description ____

Location ____

____

Description of Nearby Vegetation ____

FIELD PARAMETERS:

Sample Method ____

Sample Description ____

____

Temperature (°C/°F) ____________________ pH __________________________

Dissolved Oxygen ____________________ SC __________________________

Salinity ____________________ ORP __________________________

CONTAINER DESCRIPTION: From __________ Lab __________ ARCADIS

Bottle Type	Analysis	Preservative

Page ______ of ______

ARCADIS

Soil/Sediment Sample Log

Sample ID ____________________ Project/No. ____________________

Date ____________________ Sampling Personnel ____________________

Time ____________________ ____________________

Weather ____________________ ____________________

DESCRIPTION OF SAMPLE LOCATION:

_________ Soil _________ Sediment

Location ____________________ Name of Water Body ____________________

Sample depth (ft) ____________________ Location ____________________

Soil type ____________________ Depth of water ____________________

____________________ Velocity of water ____________________

Substrate description ____________________

Description of vegetation ____________________

____

FIELD PARAMETERS:

Sample Method ____________________

Sample Description ____________________

____

Color ____________________

Odor ____________________

Salinity ____________________

CONTAINER DESCRIPTION: From ________ Lab _______

Number	Container	Analysis
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
	______	______

TOTAL: ☐

City of Johnstown Landfill Closure
Post Closure Inspection -

Gas Vent ID	CO (ppm)	H_2S (ppm)	LEL (%)	OXY (%)	Comments
GV # 01					
GV # 02					
GV # 03					
GV # 04					
GV # 05					
GV # 06					
GV # 07					
GV # 08					
GV # 09					
GV # 10					
GV # 11					
GV # 12					
GV # 13					
GV # 14					
GV # 15					
GV # 16					
GV # 17					
GV # 18					
GV # 19					
GV # 20					
GV # 21					
GV # 22					
GV # 23					
GV # 24					
GV # 25					
GV # 26					
GV # 27					
GV # 28					
GV # 29					
GV # 30					
GV # 31					
GV # 32					
GV # 33					
GV # 34					
GV # 35					
GV # 36					
GV # 37					

CITY OF JOHNSTOWN LANDFILL CLOSURE
POST CLOSURE INSPECTION FORM

Date:
Weather:

Checklist

A. Capped Area

Capped area will be inspected by traversing the cover and examining for the following items:

		No	Yes
1.	Is there bare, dead or damaged grassed area?	___	___
2.	Is there evidence of cracks or subsidence?	___	___
3.	Is there evidence of burrowing by animals?	___	___
4.	Is there any deep-rooted vegetation present?	___	___
5.	Is there any erosion damage to grassed areas?	___	___
6.	Is there any low spots or settlement in cap system?	___	___

Comments: *(Required for each Yes answer)*

1.
2.
3.
4.
5.
6.

B. Site Drainage System

The drainage system will be inspected by traversing the full length of the system and examining for the following:

		No	Yes
1.	Is there any erosion damage to swales?	___	___
2.	Is there any debris in swales?	___	___
3.	Sediment in swales, ditches or culverts?	___	___
4.	Evidence of ponding water?	___	___

Comments: *(Required for each Yes answer)*

1.

2.

3.

4.

C. Monitoring Wells

Monitoring wells will be inspected for the following:

		No	Yes
1.	Is there any damage to the lock or locking cap?	___	___
2.	Is there any evidence of erosion of soils in the immediate area around the well casing?	___	___
3.	Is there any damage to the protective casing?	___	___
4.	Is concrete collar (well seal) cracked or settled?	___	___

Comments: *(Required for each Yes answer)*

1.

2.

3.

4.

D. Gas Vents

Gas vents will be inspected for the following:

		No	Yes
1.	Is there any damage to the risers?	___	___
2.	Are any insert screens broken or missing?	___	___

Comments: *(Required for each Yes answer)*

1.

2.

E. Security

Site security of the facility will be inspected by examining the following items:

		No	Yes
1.	Is there any damage to fence and gates?	___	___

Comments: *(Required for each Yes answer)*

1.

F. Access Road

Site access road will be inspected by examining the following items:

	No	Yes
1. Is there any surface erosion to the site access road?	___	___

Comments: *(Required for each Yes answer)*

1.

G. Landfill Gas Migration

On-site air quality will be checked using instruments capable of detecting combustible and toxic gases.

Description of Monitoring Results:

____
Inspector

______________________________ ______________
Signature Date

APPENDIX H - Quality Assurance Project Plan

Infrastructure · Water · Environment · Buildings

Quality Assurance Project Plan

Johnstown Landfill
Fulton County, New York

NYSDEC Site Number: 518002

August 2015

Quality Assurance Project Plan

Johnstown Landfill
Fulton County, New York

NYSDEC Site Number: 518002

Prepared for:
New York State Department of
Environmental Conservation

Prepared by:
ARCADIS
855 Route 146, Suite 210
Clifton Park, New York 12065
518.250.7300

Our Ref.:
02384000.2015

Date:
August 2015

Worksheets

Appendices

1. Introduction

This Quality Assurance Project Plan (QAPP) has been developed to meet the requirements of the activities to be performed consistent with the remedial program at the Johnstown City Landfill Site (hereinafter referred to as the “Site”) located in Johnstown, Fulton County, New York. It provides details on the sampling, analytical parameters, laboratory methods of analysis, quality assurance/quality control (QA/QC) requirements, and data validation.

The Site was remediated in accordance with the Interim Order on Consent between Johnstown and the United States Environmental Protection Agency (EPA) dated October 4, 1988 and the Record of Decision (ROD), Site # 518002, which was executed on March 31, 1993. Since contaminated soil and groundwater remains onsite within the capped landfill, the City of Johnstown is working with the New York State Department of Environmental Conservation (NYSDEC) to establish an Environmental Easement for the Site. The remedial program at the site includes Institutional Controls (ICs) and Engineering Controls (ECs) that are required by the Environmental Easement.

1.1 Development of the QAPP

As described on EPA’s Quality System Website (http://www.epa.gov/QUALITY/qapps.html), the purpose of a QAPP is to: (1) document the planning, implementation and assessment procedures for a project, as well as specific quality assurance and quality control activities; and (2) integrate the technical and quality aspects of the project to provide a "blueprint" for obtaining the type and quality of environmental data and information needed for a specific decision or use.

In March 2005, the Intergovernmental Data Quality Task Force developed a policy and guidance document to fulfill the project-specific requirements of Part B of American National Standards Institute/American Society for Quality Control (ANSI)/ASCQ E4, to ensure that Federal departments and agencies produce consistent QAPPs that reflect a systematic planning approach to collection and use of environmental data. That guidance document—the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) Manual V1, March 2005 (EPA 2005a) — was followed in the development of this QAPP.

1.2 Project Setting and History

The Site is located in Johnstown, Fulton County, New York and is identified as Block 148 and Lot 1-59 on the Johnstown Tax Map. The Site is located approximately 1.5 miles northwest of the city of Johnstown and 1.75 miles west of the city of Gloversville. The Site is an approximately 68-acre area bounded by low density residential areas along West Fulton Street Extension to the north and mixed wooded and agricultural lands to the east, south, and west.

The Johnstown landfill was used as an open refuse disposal facility from 1947 to 1960 before being converted to a sanitary landfill. The landfill accepted industrial wastes from local tanneries and textile plants until April 1979, and sludge from the Gloversville-Johnstown Joint Sewage Treatment Plant from 1973 to April 1979. Landfill operations ceased in June 1989. Much of the tannery wastes were disposed in the landfill as chromium-treated hide trimmings and other materials. Sewage sludge was disposed in the landfill at a rate of approximately 20,000 cubic yards per year. The sludge contained chromium, iron, and lead. There are no records available which detail the total amount of industrial wastes accepted by the landfill.

The Site was placed on the National Priorities List of Superfund Sites by the EPA (I.D. No. NYD980506927) and the New York State Registry of Inactive Hazardous Waste Disposal Sites by the NYSDEC (I.D. No. 518002). The landfill closure was completed in December 1996. The City of Johnstown entered into an Order on Consent with NYSDEC to remediate the property. Under the Order on Consent and the ROD, all known soil contamination was consolidated into the on-Site landfill. Remedial activities were completed at the Site in July 1997. Following the latest Five-Year Review Report and subsequent annual reports, the EPA has concluded that there are no risks presented at the Site in either groundwater or soils and none are expected as long as the Site use does not change and the engineered and access controls are properly operated, monitored, and maintained. However, since remaining contaminated soil and groundwater exists within the landfill, implementation and management of the ECs and ICs are required in order to evaluate the ongoing performance and effectiveness of the remedy. The Site Management Plan (ARCADIS 2015) specifies the methods for implementing the ECs and the ICs that are required.

1.3 Applicability of the QAPP

This QAPP supports the implementation and management of ECs and ICs at the Site. Detailed descriptions of the work activities are presented in the Site Management Plan. The elements of Site monitoring are anticipated to include:

- Sampling and analysis of all appropriate media (i.e., groundwater, surface water, and sediment);

- Assessing compliance with applicable NYSDEC standards, criteria, and guidance, in particular, ambient groundwater and surface water standards and Technical Guidance for Screening Contaminated Sediments;

- Assessing achievement of the remedial performance criteria;

- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting human health and the environment; and

- Preparing the necessary reports for the various monitoring activities.

1.4 Remedial Action Objectives

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. The RAOs for the Site were identified in the ROD and include preventing human and animal contact with contaminated soil from the landfill surface, preventing erosion of contaminated surface soil through surface-water runoff; minimizing the infiltration of rainfall or snow melt into the landfill, therefore, reducing the quantity of water percolating through the landfill materials and leaching out contaminants; mitigating the off-site migration of contaminated groundwater; preventing unacceptable exposure to off-site contaminated groundwater; restoring groundwater quality to levels which do not exceed state or federal drinking water standards; preventing ingestion of onsite groundwater; control generation and preventing migration of subsurface landfill gas, and preventing unacceptable exposure to landfill vapors.

2. Document Overview

The UFP-QAPP guidance includes a series of 37 worksheets that are used to present the critical information required in a QAPP. This QAPP has been developed using these worksheets to ensure consistent content and presentation of project-specific information and streamline the review of QAPPs by regulators and others. This QAPP provides information associated with the following four key topics:

- Project Management and Objectives
- Measurement and Data Acquisition
- Assessment and Oversight
- Data Review

Several attachments are also included with this QAPP, including:

- Field sampling Standard Operating Procedures (SOPs)
- Laboratory Quality Assurance Plans and SOPs
- Laboratory certifications

When elements required by the UFP-QAPP are present in other documents (e.g., Standard Operating Procedures or SOPs), careful cross-referencing of these other documents can be used in lieu of repeating information, in accordance with the UFP-QAPP. Following this guidance, this QAPP references other supporting documents, including the Site Management Plan. These planning documents are companion documents to this QAPP.

3. References

ARCADIS of New York, Inc. 2015. City of Johnstown Landfill, Site Management Plan. August 2015.

USEPA. 2005a. Intergovernmental Data Quality Task Force. *Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual.* Version 1, March 2005. Publication Numbers: USEPA: EPA-505-B-04-900A, Department of Defense: DTIC ADA 427785. http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

USEPA. 2005b. Intergovernmental Data Quality Task Force. *Uniform Federal Policy for Quality Assurance Project Plans. Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities.* Version 1, March 2005. Publication Numbers: USEPA: EPA-505-B-04-900B, Department of Defense: DTIC ADA 426957. http://www.epa.gov/swerffrr/pdf/qaqc_v1_0305.pdf.

USEPA. 1993. Superfund Record of Decision: Johnstown City Landfill, New York, March 1993.

USEPA. 2010. Third Five Year Review Report Johnstown City Landfill Superfund Site, Fulton County, Town of Johnstown, New York, December 2010.

WORKSHEETS

Quality Assurance Project Plan Worksheet #1 – Title and Approval Page

Site Name/Project Name:	Johnstown Landfill/New York State Department of Environmental Conservation (NYSDEC) Site Number: 518002
Site Location:	Johnstown, Fulton County, New York
Document Title:	*Quality Assurance Project Plan, August 2015*
Lead Organizations:	NYSDEC and United States Environmental Protection Agency (EPA) Region 2
Preparer's Name and Organizational Affiliation:	Jennifer Singer, ARCADIS
Preparer's Contact Information:	50 Fountain Plaza, Suite 600, Buffalo, NY 14202, 716.667.6664, jennifer.singer@arcadis.com
Preparation Date:	August 2015
ARCADIS Project Manager:	
	Signature
	Doug Weeks, ARCADIS
ARCADIS Project Quality Assurance Coordinator:	
	Signature
	Dennis Capria, ARCADIS
NYSDEC Project Manager:	
	Signature
	Kelly Duval, NYSDEC
EPA Region 2 Remedial Project Manager:	
	Signature
	George Jacob, EPA Region 2

Quality Assurance Project Plan Worksheet #1 – Title and Approval Page

City of Johnstown Project Manager	
	Signature
	Christopher Vose, City of Johnstown

Document Control Number: **QAPP-00**

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Site Name/Project Name:	Johnstown Landfill
Site Location:	Johnstown, Fulton County, New York
Site Number/Code:	EPA I.D. Number: NYD980506927 NYSDEC I.D. Number: 518002
Operable Unit:	Not applicable (NA)
Contractor Name:	ARCADIS of New York, Inc.
Contractor Number:	NA
Contract Title:	NA
Work Assignment Number:	NA
Identify guidance used to prepare Quality Assurance Project Plan (QAPP):	Uniform Federal Policy for Quality Assurance Project Plans, Manual V1 (2005)
Identify regulatory program:	Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
Identify approval entities:	NYSDEC and EPA Region 2
Indicate whether the QAPP is a generic or a project-specific QAPP?	This is a project-specific QAPP and may be updated, as required, for future work at the site.
List dates of scoping sessions that were held:	NA
List dates and titles of QAPP documents written for previous site work, if applicable:	NA
List organizational partners (stakeholders) and connection with lead organization:	City of Johnstown – Responsible Party ARCADIS – Owner’s Contractor, QAPP Preparer
List data users:	EPA Region 2, NYSDEC, City of Johnstown, and ARCADIS
Lead organizations’ Project Managers:	George Jacob, EPA Region 2, Remedial Project Manager (RPM) Kelly Duval, NYSDEC, Project Manager

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	**Required Information**	**Cross-reference to Related Information and Documents**
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1 Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	The Table of Contents is provided following the QAPP cover page Worksheet #2 QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	Worksheet #3 Distribution List Worksheet #4-1 and 4-2 Project Personnel Sign-Off
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	Worksheet #5 Project Organizational Chart Worksheet #6 Communication Pathways Worksheet #7 Personnel Responsibilities and Qualifications Worksheet #8 Personnel Training Requirements
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History and Background	- Project Planning Session Documentation (including data needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History and Background - Site Maps (historical and present)	Worksheet #9 Project Team Planning Sessions Participants Sheet Worksheet #10 Problem Definition for Project Data Quality Objectives (DQOs) Site setting and background and information regarding the project are included in the introduction section. Site maps are located in the Site Management Plan.

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Cross-reference to Related Information and Documents
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific Project Quality Objectives - Measurement Performance Criteria Table	Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements Worksheet #12-1 through #12-5 Measurement Performance Criteria for project analytes.
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	Worksheet #13 Secondary Data Criteria and Limitations
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	Worksheet #14 Summary of Project Tasks, Worksheet #15-1 and #15-2 Reference Limits and Evaluation for specific monitoring activities Worksheet #16 Project Schedule/Timeline

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Cross-reference to Related Information and Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control (QC) Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing and Inspection Table	Worksheet #17 Sampling Design and Rationale, Worksheet #18 Sampling Locations and Methods/SOP Requirements for the project, QAPP Worksheet #19 Analytical SOP Requirements (Sample Containers Preservation and Holding Times), Worksheet #20 Sample Quantities and Control Frequencies, Worksheet #21 Field Sampling SOP References and Worksheet #22 Field Equipment Calibration, Maintenance, Testing and Inspection The field sampling SOPs are presented in Appendix A to this QAPP

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Cross-reference to Related Information and Documents
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing and Inspection Table	Worksheet #23 Analytical SOP References, Worksheet #24 Analytical Instrument Calibration Worksheet #25 Analytical Instrument and Equipment Maintenance, Testing and Inspection The analytical SOPs are presented in Appendix B
3.3 Sample Collection Documentation, Handling, Tracking and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody (COC) Form and Seal	Worksheet #26 Sample Handling System Worksheet #27 Sample Custody Requirements An example of the COC form can be found in SOP F-01 included in Appendix A
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	Worksheet #28-1 through #28-5 present QC sample information for project analytes
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	Worksheet #29 Project Documents and Records Worksheet #30 Analytical Services

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Cross-reference to Related Information and Documents
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	Worksheet #31 Planned Project Assessments Worksheet #32 Assessment Findings and Corrective Action Responses
4.2 QA Management Reports	- QA Management Reports Table	Worksheet #33 QA Management Reports

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Cross-reference to Related Information and Documents
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	Worksheet #34 Verification (Step I) Process, Worksheet #35 Validation (Steps IIa and IIb) Process, Worksheet #36 Validation (Steps IIa and IIb) Summary Worksheet #37 Usability Assessment
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	None	NA

Quality Assurance Project Plan Worksheet #3 – Distribution List

Quality Assurance Project Plan (QAPP) Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number
George Jacob	Project Manager	United States Environmental Protection Agency (EPA) Region 2	212.637.4266	jacob.george@epa.gov	QAPP-00
Kelly Duval	Project Manager	New York State Department of Environmental Conservation (NYSDEC)	518.623.1272	kelly.duval@dec.ny.gov	QAPP-00
Christopher Vose	Project Manager	City of Johnstown	518.786.4014	cvose@cityojohnstown.ny.gov	QAPP-00
Doug Weeks	Project Manager	ARCADIS	518.250.7378	doug.weeks@arcadis.com	QAPP-00
Katie Bidwell	Task Manager/Field Team Leader	ARCADIS	518.250.7387	katie.bidwell@arcadis.com	QAPP-00
Dennis Capria	Project Quality Assurance Coordinator	ARCADIS	315.671.9299	dennis.capria@arcadis-us.com	QAPP-00
Candace Fox	Laboratory Project Manager	Alpha Analytical	716.427.5223	cfox@alphalab.com	QAPP-00
James Todaro	Laboratory Quality Assurance Officer	Alpha Analytical	508.898.9220	jtodaro@alphalab.com	QAPP-00

Note:
Copies of the QAPP will be distributed to the individuals listed above. The copies will include the following documents: QAPP and any subsequent QAPP revisions and addenda.

Quality Assurance Project Plan Worksheet #4-1 – Project Personnel Sign-Off (ARCADIS)

Organization/Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Doug Weeks	Project Manager	518.250.7378		
Katie Bidwell	Task Manager/Field Team Leader	518.250.7387		
Dennis Capria	Quality Assurance Coordinator	315.671.9299		

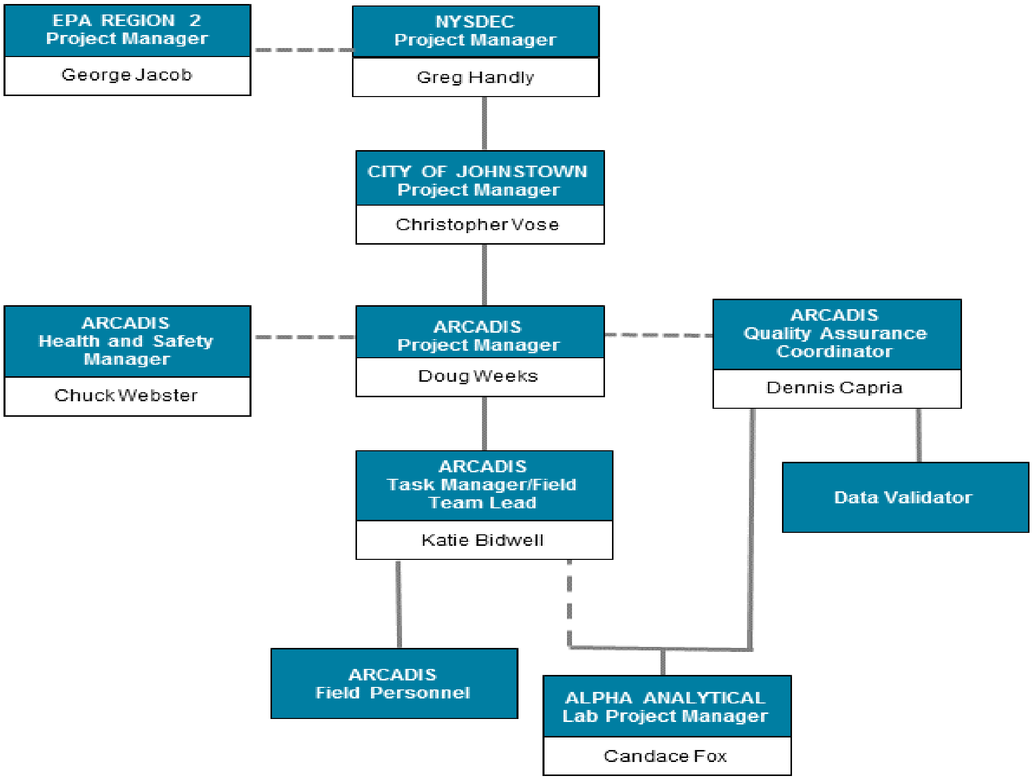
Note:
The project personnel sign-off table above documents key project personnel who have read the applicable sections of, and will perform required activities in accordance with the QAPP.

Quality Assurance Project Plan Worksheet #4-2 – Project Personnel Sign-Off (Alpha)

Organization/Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Candace Fox	Laboratory Project Manager	716.427.5223		
James Todaro	Laboratory Quality Assurance Officer	508.898.9220		

Note:
The project personnel sign-off table above documents key project personnel who have read the applicable sections of, and will perform the tasks as described in the QAPP.

Quality Assurance Project Plan Worksheet #5 – Project Organization Chart



Quality Assurance Project Plan Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
Point of Contact with United States Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) Project Managers	Project Manager	Christopher Vose, City of Johnstown Engineer	518.786.4014	Will provide documents to EPA and NYSDEC Representatives
Manage all Project Phases	Project Manager	Doug Weeks, ARCADIS	518.250.7378	Will serve as the ARCADIS liaison to the client.
	Task Manager	Katie Bidwell, ARCADIS	518.250.7387	
Coordinate Field Program	Field Team Leader	Katie Bidwell, ARCADIS	518.250.7387	To be notified by field personnel of field-related questions or problems by phone or e-mail by close-of-business (COB) the next business day.
QAPP changes in the field	Project Quality Assurance Coordinator	Dennis Capria, ARCADIS	315.671.9299	To be notified by ARCADIS Field Team Leader of any changes to QAPP made in the field and the reasons by phone or e-mail within two business days. Will promptly notify the Project Manager of any such changes.
Reporting Lab Data Quality Issues	Laboratory Quality Assurance Officer	James Todaro, Alpha Analytical	508.898.9220	Will report all QA/QC issues with project field samples to Project Manager and Project QA Manager within two business days.

Quality Assurance Project Plan Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
Field and Analytical Corrective Actions	Project QA Coordinator	Dennis Capria, ARCADIS	315.671.9299	Will evaluate the need for corrective action for field and analytical issues in conjunction with the Project Manager, the Field Team Leader or the Laboratory QA Manager, as appropriate.
Reporting Lab Data Validation Issues	Data Validator	ARCADIS or subcontractor[1]	Not applicable	Verify/validate the laboratory analytical data with criteria developed in the QAPP and identify any QA/QC issues to the ARCADIS Project Manager and ARCADIS QA Coordinator within two business days of identification of the issue. The ARCADIS Project Manager will communicate to City of Johnstown, EPA, and NYSDEC as needed.
Release of Analytical Data	Project QA Coordinator	Dennis Capria ARCADIS	315.671.9299	Will approve release of final analytical data following completion of validation.
QAPP Amendments	Project QA Coordinator	Dennis Capria ARCADIS	315.671.9299	Will approve major changes to the QAPP in conjunction with the ARCADIS Project Manager, EPA Project Manager, and NYSDEC Project Manager before the changes are implemented.

Note:

[1] Data validation will be performed by a third party data validator, either from ARCADIS's team of in-house project chemists/data validators or from a subcontracted data validation service. The ARCADIS QA Coordinator will oversee the data validator.

Quality Assurance Project Plan Worksheet #7 – Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Education and Experience Qualifications
George Jacob	Project Manager	United States Environmental Protection Agency (EPA) Region 2	Designated as the EPA's Project Manager
Kelly Duval	Project Manager	New York State Department of Environmental Conservation (NYSDEC)	Representative for the State agency
Christopher Vose	Project Manager	City of Johnstown	Representative for responsible party
Doug Weeks	Project Manager	ARCADIS	B.S. Civil Engineering; over 23 years of experience
Katie Bidwell	Task Manager/Field Team Leader	ARCADIS	B.A. Geology; over 10 years of experience
Dennis Capria	Project Quality Assurance (QA) Manager	ARCADIS	B.S. Biology, minor in Chemistry; 26 years of experience
Chuck Webster	Health and Safety Manager	ARCADIS	B.S. Political Science; M.S. Safety; 22 years of experience
Candace Fox	Laboratory Project Manager	Alpha Analytical	B.A. Biology; 26 years of experience
James Todaro	Laboratory Quality Assurance Officer	Alpha Analytical	B.A. Biology; over 35 years of experience

Except for EPA, NYSDEC, and City of Johnstown team members, the responsibilities of the various team members are summarized below by organization.

Quality Assurance Project Plan Worksheet #7 – Personnel Responsibilities and Qualifications

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ARCADIS

Project Manager

Responsibilities and duties include:

- ensuring that the contract is adhered to throughout project performance
- primary liaison with City of Johnstown, EPA, and NYSDEC and conducts regular active status meetings
- ensuring that all activities are conducted in accordance with contractual specifications
- ensuring compliance with project scope, schedule and budget
- management of coordinating project team
- management of subcontractors
- management of all staff, materials and equipment
- ensure that all personnel assigned to the project, including subcontractors, review the technical plans before any task associated with the project is initiated; also ensure that personnel possess the requisite training and certifications
- participate in the development of the field program, evaluation of data, reporting, and the development of conclusions and recommendations

QA Manager

Responsibilities and duties include:

- ensuring that the QA procedures and objectives in the project-specific work plans are met
- ensuring management and staff are aware of associated QA policies and procedures
- reviewing field and analytical data to ensure adherence to QA/QC procedures
- ensuring the quality of data before inclusion in associated reports
- assessment of field and laboratory audits
- review, evaluation, and validation of analytical data for the project and will participate in interpreting and presenting analytical data
- providing technical guidance to direct the task leaders on a day-to-day or as-needed basis to ensure the application of QA/QC procedures

Health and Safety Manager

Responsibilities and duties include:

- develop, implement and monitor procedures for the Site Specific HASP
- coordinate all Health and Safety Training and Medical Monitoring
- ensure field activities are in compliance with health and safety requirements
- authority to stop work due to health and safety concerns (It is important to note that all personnel have Stop Work Authority)
- implement corrective actions to ensure an accident free work environment

Quality Assurance Project Plan Worksheet #7 – Personnel Responsibilities and Qualifications

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Task Manager/Field Team Leader

Responsibilities and duties include:

- provides field and QA/QC oversight during on-site activities
- coordinating on-site subcontractor activities
- controlling on-site materials and ensuring that they are stored properly
- effective day-to-day management of the on-site project staff
- design field procedures and ensure proper implementation of the field procedures by the project team
- maintaining consistent communication with the PM regarding progress
- ensuring accurate field data produced by sampling personnel under their supervision
- ensuring that QC procedures are followed and documented
- coordinate field and laboratory schedules pertaining to relevant site activities
- review field instrumentation, maintenance and calibration to meet quality objectives
- prepare reports pertaining to relevant field activities
- coordinate field activities with ARCADIS field personnel

Field Personnel

Responsibilities and duties include:

- perform field procedures as set forth in the field sampling standard operating procedures presented in this QAPP
- perform field analyses and collect QA samples
- calibrate, operate and maintain field equipment
- reduce field data
- maintain sample custody
- prepare field records and logs

ARCADIS Subcontractors (e.g., Alpha Analytical)

Analytical Laboratories

General responsibilities and duties of the analytical laboratories include:

- perform sample analyses and associated laboratory QA/QC procedures
- supply sampling containers and shipping containers
- maintain laboratory custody of samples

Quality Assurance Project Plan Worksheet #7 – Personnel Responsibilities and Qualifications

- adhere to all protocols in the QAPP

Laboratory Project Manager

Responsibilities and duties include:

- serve as primary communication link between ARCADIS and laboratory technical staff
- monitor workloads and maintain availability of resources
- oversee preparation of analytical reports
- supervise in-house chain-of-custody

Laboratory QA Manager

Responsibilities and duties include:

- monitor the day-to-day quality of data produced by the laboratory for this project
- ensure and document the reliability of the data
- will maintain and review quality control data
- conduct audits of all laboratory activities and data packages and deliverables

Quality Assurance Project Plan Worksheet #8 – Special Personnel Training Requirements

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Activities	40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) / 8-hour HAZWOPER Annual Refresher	Certified Training Professionals	NA	Field personnel	ARCADIS personnel: To Be Determined (TBD)	ARCADIS Corporate database
Analytical Chemistry	National Environmental Laboratory Accreditation Program (NELAP) Accreditation	Primary Accrediting State	NA	NA	Alpha Analytical 8 Walkup Drive Westborough, MA 01581-1019 508.898.9220	Alpha Analytical 8 Walkup Drive Westborough, MA 01581-1019 508.898.9220
Additional health and safety training/certification requirements are listed in the *Site-Specific Health and Safety Plan.*						

Note:
Current HAZWOPER training certificates will be maintained electronically in a company database for each employee performing work at the site where 40-hour training is required for the position assignment. Certificates for field personnel will be made available to the EPA upon request.

Quality Assurance Project Plan Worksheet #9 – Project Team Planning Sessions Participants Sheet

Project Name: Johnstown Landfill	**Site Location:** Johnstown, Fulton County, New York
Projected Date(s) of Sampling: Semi-Annual Surface Water Sampling – sampling date to be determined (TBD); Annual Groundwater Sampling – sampling date TBD; Annual Sediment Sampling – sampling date TBD; Landfill Inspections – 1st, 2nd, 3rd, and 4th quarters	**Project Manager:** Doug Weeks, ARCADIS
Date of Session: Formal planning session were not held for the project. ARCADIS will email the City of Johnstown Project Manager prior to each scheduled sampling event and site inspection. This worksheet will be updated in the event that planning sessions/communications regarding the site requirements are held.	

Quality Assurance Project Plan Worksheet #10 – Problem Definition – Data Quality Objectives

Step 1: State the Problem

The Johnstown Landfill was used as an open refuse disposal facility from 1947 to 1960 before being converted to a sanitary landfill. The landfill accepted industrial wastes from local tanneries and textile plants until April 1979, and sludge from the Gloversville-Johnstown Joint Sewage Treatment Plant from 1973 to 1989. Landfill operations ceased in June 1989. Much of the tannery wastes were disposed of as chromium-treated hide trimmings and other materials. The sewage sludge contained chromium, iron, and lead. There are no records available which detail the total amount of industrial wastes accepted by the landfill. Remedial work was performed at the Site in conformance with the Record of Decision (ROD) and Order on Consent. Currently, the site contains contamination within a closed, capped landfill, left after completion of the remedial action.

Step 2: Identify the Goal of the Study

The procedures required to manage remaining contamination at the Site after completion of the remedial action include:

- Implementation and management of all Engineering and Institutional Controls;
- Environmental media monitoring;
- Maintenance of landfill containment systems (i.e., landfill cap and associated drainage features); and
- Performance of periodic inspections, certification of results, and submittal of Periodic Review Reports.

Step 3: Identify Information Inputs

Exposure to remaining contamination in soil/fill at the Site is prevented by a landfill cap placed over the Site. A series of Institutional Controls are required by the ROD to: (1) implement, maintain, and monitor Engineering Control Systems; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; and (3) the imposition of property deed restrictions to prevent the installation of drinking water wells at the Site and to restrict activities which could affect the integrity of the cap. Work activities associated with the Engineering Controls and Institutional Controls relevant to the scope of this QAPP include:

- Site-wide inspections will be performed on a quarterly basis to assess compliance with all Institutional Controls and an evaluation of the condition and effectiveness of Engineering Controls. Inspections will include air monitoring.
- Groundwater monitoring activities will be performed on an annual basis to assess the performance of the remedy and monitor the progress of natural attenuation processes (or other frequency as determined by NYSDEC), until residual groundwater concentrations are found to be at an acceptable level.
- Groundwater monitoring will be performed on an annual basis to assess the performance of the remedy.
- Surface water will be performed on a semiannual basis and sediment sampling will be performed on an annual basis to verify that landfill contaminants are not affecting Mathew Creek.

Step 4: Define the Boundaries of the Sampling

The Site is located in Johnstown, Fulton County, New York, and is identified as Block 148 and Lot 1-59 on the Johnstown Tax Map. The Site is located approximately 1.5 miles northwest of the city of Johnstown and 1.75 miles west of the city of Gloversville. The Site is an approximately 68-acre area bounded by

Quality Assurance Project Plan Worksheet #10 – Problem Definition – Data Quality Objectives

low density residential areas along West Fulton Street Extension to the north and mixed wooded and agricultural lands to the east, south, and west. The groundwater, surface water, and sediment sampling occurs onsite and within the surrounding vicinity of the Site. Sampling locations are indicated on the Site Plan figures included in the SMP.

Step 5: Develop the Analytic Approach

Typically, the decision on whether data can be used will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions will be noted. A decision rule is adopted that 90 percent of the data points not be rejected or deemed unusable as a condition for use of the data set for decision-making purposes. The usable data will be evaluated versus the performance standards. The required reporting limits are also documented in Worksheet #15 so that the lowest achievable detection limit will be reported by the laboratory.

Step 6: Specify Performance or Acceptance Criteria

Specifications for this step call for: (1) giving forethought to corrective actions to improve data usability; and (2) understanding the representative nature of the sampling design. Corrective actions are described within this document. The representative nature of the sampling design has been assured by discussions among professionals familiar with the Site and the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data

The overall QA objective is to develop and implement procedures for field sampling, chain of custody (COC), laboratory analysis, and reporting that will provide results to support the evaluation of site data against applicable project action limits/screening criteria (summarized in Worksheet #15). Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

Quality Assurance Project Plan Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

The City of Johnstown, ARCADIS and overseeing agencies (i.e., EPA, NYSDEC, NYSDOH) will use the data.

What will the data be used for?

The data will be collected in support of the Site Management Plan (SMP) in order to evaluate the performance and effectiveness of the remedy for the Johnstown Landfill.

What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)

Groundwater Monitoring. Groundwater monitoring will be performed on an annual basis to assess the performance of the remedy and progress of natural attenuation processes. Each of the Site monitoring wells will be sampled annually and analyzed for 6 New York Codes, Rules, and Regulations (NYCRR) Part 360 baseline parameters (i.e., alkalinity, ammonia, biochemical oxygen demand [BOD], bromide, chemical oxygen demand [COD], chloride, color, hardness, nitrate, sulfate, total Kjeldahl nitrogen [TKN], cyanide, total organic carbon [TOC], total dissolved solids [TDS], phenolics, metals[1], hexavalent chromium, mercury, and volatile organic compounds [VOCs]). Prior to collecting groundwater samples, field parameters (i.e., pH, conductivity, turbidity, dissolved oxygen [DO], temperature, and oxidation-reduction potential [REDOX]) will be measured using a water quality meter.

Surface Water Sampling. Surface water monitoring will be conducted in Mathew Creek on a semiannual schedule to assess if landfill contaminants are affecting surface water associated with Mathew Creek. The surface water samples will be analyzed for the 6 NYCRR Part 360 routine parameters (i.e., alkalinity, ammonia, BOD, bromide, COD, chloride, hardness, nitrate, sulfate, TKN, TOC, TDS, phenolics, and metals[2]) and baseline parameters (i.e., alkalinity, ammonia, BOD, bromide, COD, chloride, color, hardness, nitrate, sulfate, TKN, cyanide, TOC, TDS, phenolics, metals[1], hexavalent chromium, mercury, and VOCs). Prior to collecting surface water samples, field parameters (i.e., pH, conductivity, turbidity, DO, temperature, and REDOX) will be measured using a water quality meter.

Sediment Sampling. Sediment sampling will be performed on an annual basis to assess if landfill contaminants are affecting sediment associated with Mathew Creek. The sediment samples will be analyzed for target analyte list (TAL) metals[3] and TOC.

Site-Wide Inspections. Site-wide inspections will be performed on a quarterly schedule. An inspection form will be completed, and will compile sufficient information to assess the following: (1) compliance with all institutional controls, including Site usage; (2) evaluation of the condition and continued effectiveness of engineering controls; and (3) general Site conditions at the time of the inspection. The Site inspection will include collecting air quality readings at the landfill vents and surrounding ambient conditions using a four gas monitor (i.e., hydrogen sulfide, carbon monoxide, oxygen, and combustible gases).

How “good” do the data need to be in order to support the environmental decision?

The data need to be of sufficient quality to meet data quality objectives for the site. Analytical reporting limits should be sufficiently low to achieve screening criteria presented in Worksheets #15-1 and #15-2.

Quality Assurance Project Plan Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

How much data are needed? (number of samples for each analytical group, matrix and concentration)
The number of samples and analyses for each media are summarized in Worksheet #20
Where, when, and how should the data be collected/generated?
Sample collection will begin in June 2015. Sampling methods and protocols will be in accordance with the standard operating procedures (SOPs) presented in Appendix A.
Who will collect and generate the data?
ARCADIS and its subcontractors.
How will the data be reported?
All monitoring results will be reported to NYSDEC in the annual Enviromenal Monitoring Report. Also, if required by the NYSDEC, a letter report will be prepared subsequent to each sampling event.
How will the data be archived?
Data will be archived by ARCADIS in its Clifton Park, New York office.

Notes:

[1] Metals included in the 6 NYCRR 360 baseline parameters include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, copper, cobalt, iron, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[2] Metals included in the 6 NYCRR 360 routine parameters include: cadmium, calcium, chromium, iron, lead, magnesium, manganese, potassium, and sodium.

[3] TAL metals include: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #12-1 – Measurement Performance Criteria (Volatile Organic Compounds [VOCs] in Water)

Matrix	Water
Analytical Group	VOCs
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-05, F-08	SW846 8260/ L-16	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	Percent recovery (%R): 70-130%	Surrogate	A
		Accuracy/Bias Contamination	< Reporting Limit (RL)	Blanks (field, trip, equipment, method)	S&A
		Accuracy/Bias	%R: Laboratory-specific limits	Laboratory control sample (LCS)	A
		Accuracy/Bias	% Relative abundance, see analytical SOP	Instrument performance check: bromofluorobenzene (BFB)	A
		Precision	Area response and retention times, see analytical SOP	Internal standard	A
		Accuracy/Bias	%R: Laboratory-specific limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	%R: Laboratory-specific limits	Matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[3]	A
		Precision	RPD < 20%	MS/MSD or LCS/LCSD[3]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] Sufficient sample size for MS/MSD and/or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no site-specific samples are supplied.

Quality Assurance Project Plan Worksheet #12-2 – Measurement Performance Criteria (General Chemistry Parameters in Water)

Matrix	Water
Analytical Group	Wet Chemistry
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-05, F-08	*Alkalinity:* SM2320B/L-01 *Ammonia:* EPA 350.1/L-02 *Biochemical Oxygen Demand:* SM5210B/L-03 *Bromide, Chloride, Sulfate:* EPA 300.0/ L-04 *Chemical Oxygen Demand:* EPA 410.4/ L-05 *Color:* SM2120B/L-06 *Hardness:* SM2340B/L-13 *Nitrate:* EPA 353.2/L-07 *Total Kjeldahl Nitrogen:* EPA 351.3/L-08 *Cyanide:* SW846 9010/9012/L-09 *Total Organic Carbon:* SM5310C/L-10 *Total Dissolved Solids:* SM2540C/L-11 *Total Phenol:* EPA 420.1/L-12 *Hexavalent Chromium:* SW846 7196A/ L-15	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%	Initial and continuing calibration verification	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS)/matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	Laboratory duplicate or MS/MSD or LCS/LCSD[3]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] Sufficient sample size for MS/MSD and/or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no site-specific samples are supplied.

Quality Assurance Project Plan Worksheet #12-3 – Measurement Performance Criteria (Metals in Water)

Matrix	Water
Analytical Group	Metals
Concentration Level	All

Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**[3]	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
F-05, F-08	SW-846 6010/6020/7470/ L-13/L-14/L-17	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%	Initial and continuing calibration verification	A
		Precision – lab	Certain metals %R: 80-120%; see analytical SOP	Interference check sample (A and AB)	A
		Precision – lab	%R: 70-130%	Reporting limit verification (CRI)	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS)/matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[3]	A
		Accuracy/Bias	%R: 80-120%	LCS	A
		Accuracy/Bias	%R: 75-125%	Post-digestion spike	A
		Precision	Percent difference (%D)< 10%	Serial dilution[4]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] Sufficient sample size for MS/MSD and/or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no site-specific samples are supplied.

[4] Performed as needed only for analytes with concentration > 50 times the method detection limit.

Quality Assurance Project Plan Worksheet #12-4 – Measurement Performance Criteria (General Chemistry Parameters in Sediment)

Matrix	Sediment
Analytical Group	Wet Chemistry
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-07	*Total Organic Carbon:* Lloyd Kahn/L-19	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%	Initial and continuing calibration verification	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS)/matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	Laboratory duplicate or MS/MSD or LCS/LCSD[3]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] Sufficient sample size for MS/MSD and/or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no site-specific samples are supplied.

Quality Assurance Project Plan Worksheet #12-5 – Measurement Performance Criteria (Metals in Sediment)

Matrix	Sediment
Analytical Group	Metals
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria[3]	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-07	SW-846 6010/7471/L-13/ L-18	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%	Initial and continuing calibration verification	A
		Precision – lab	Certain metals %R: 80-120%; see analytical SOP	Interference check sample (A and AB)	A
		Precision – lab	%R: 70-130%	Reporting limit verification (CRI)	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS)/matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[3]	A
		Accuracy/Bias	%R: 80-120%	LCS	A
		Accuracy/Bias	%R: 75-125%	Post-digestion spike	A
		Precision	Percent difference (%D)< 10%	Serial dilution[4]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] Sufficient sample size for MS/MSD and/or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no site-specific samples are supplied.

[4] Performed as needed only for analytes with concentration > 50 times the method detection limit.

Quality Assurance Project Plan Worksheet #13 – Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Groundwater and soil data	Thermo Consulting Engineers, Remedial Investigation/Feasibility Study, 1993.	Phase 1: June 1989 – June 1990 Phase 2: July 1990 – March 1992	Remedial Investigation (RI) was performed to characterize the nature and extent of contamination at the Site.	None
Groundwater, surface water, and sediment data	EPA, Third Five-Year Review Report, 2010. ARCADIS, Environmental Monitoring Annual Report, 2012. ARCADIS, Environmental Monitoring Annual Report, 2014. ARCADIS, Revised Sediment and Surface Water Evaluation of Mathew Creek, 2014.	Analytical data 1996 to present	Reports detail the remaining contamination in surface water, groundwater, and sediment.	None

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

Sampling Tasks

- Collect, process and prepare groundwater, surface water, and sediment samples to evaluate the performance and effectiveness of the remedy at the Site and monitor the progress of natural attenuation processes.
- Perform landfill inspections, including air monitoring, to verify the compliance with all institutional controls and the condition and continued effectiveness of the Site engineering controls.

Analysis Tasks

- Groundwater samples will be analyzed by Alpha Analytical for 6 New York Codes, Rules, and Regulations (NYCRR) Part 360 baseline parameters (i.e., alkalinity, ammonia, biochemical oxygen demand [BOD], bromide, chemical oxygen demand [COD], chloride, color, hardness, nitrate, sulfate, total Kjeldahl nitrogen [TKN], cyanide, total organic carbon [TOC], total dissolved solids [TDS], phenolics, metals[1], hexavalent chromium, mercury, and volatile organic compounds [VOCs]). Prior to collecting groundwater samples, field parameters (i.e., pH, conductivity, turbidity, dissolved oxygen [DO], temperature, and oxidation-reduction potential [REDOX]) will be measured using a water quality meter.
- Surface water samples will be analyzed by Alpha Analytical for 6 NYCRR Part 360 routine (i.e., alkalinity, ammonia, BOD, bromide, COD, chloride, hardness, nitrate, sulfate, TKN, TOC, TDS, phenolics, and metals[2]) and baseline parameters (i.e., alkalinity, ammonia, BOD, bromide, COD, chloride, color, hardness, nitrate, sulfate, TKN, cyanide, TOC, TDS, phenolics, metals[1], hexavalent chromium, mercury, and VOCs). Prior to collecting surface water samples, field parameters (i.e., pH, conductivity, turbidity, DO, temperature, and REDOX) will be measured using a water quality meter.
- Sediment samples will be analyzed by Alpha Analytical for target analyte list (TAL) metals[3] and TOC.
- During the site-wide inspections, a four gas monitor will be used to collect air quality readings for hydrogen sulfide, carbon monoxide, oxygen, and combustible gases.

Quality Control Tasks

The samples will be collected and processed as documented in the Site Management Plan. The QA samples are described in Worksheet #20.

Secondary Data

See Worksheet #13.

Data Management Tasks

The purpose of data management is to confirm that the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will include a significant number of samples that require a structured, comprehensive and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected, such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements: (1) sample designation system; (2) field activities; (3) sample tracking and management; (4) data management system; and (5) document control and inventory.

(1) Sample Designation System

A concise and easily understandable sample designation system is an important part of project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected, as outlined below.

Each sample will be identified by a unique sample identification number in the logbook, sampling log, and COC record using an alphanumeric code. Field samples will be linked to geographic location via location codes. Where possible, location codes will link historical sample data with new data. All field samples will be identified using the convention provided in Worksheet #18, followed by the date in "mmddyy" format (e.g. MW-2S-083015).

Blind duplicate samples will be labeled sequentially starting at 1 (e.g. DUP-001-083015).

It is noted that sample identification and labeling procedures may be modified as needed to supplement specific investigation objectives and any deviations identified.

(2) Field Activities

Field activities require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security and QA. These procedures are described in further detail in the following subsections.

Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that the field investigation is thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including, (1) field logs, (2) COC forms, and (3) instrument calibration records.

Each of these types of field documentation is described below.

- **Field Logs.** Personnel performing the field activities will keep field logs that detail observations and measurements made during the site work. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To determine, at a future date, that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it and then documenting the proper information. In addition, certain media sample locations will be surveyed to accurately record their locations. The survey crew will use its own field logs and will supply the sampling location coordinates to the Database Administrator.
- **Chain-of-Custody Forms.** COC forms are used to document and track sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the Clifton Park office. Field personnel will be briefed on the proper use of the COC procedure. A sample COC form is included in SOP F-01, Chain of Custody, Handling, Packaging and Shipping (Appendix A).
- **Instrument Calibration Records.** As part of data QA procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Worksheet #22. To demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:
    - calibration date and time
    - type and identification number of equipment
    - calibration frequency and acceptable tolerances
    - identification of individual(s) performing calibration
    - reference standards used
    - calibration data
    - information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. Erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

<u>Data Security</u>

Measures will be taken during the field investigation to confirm that samples and records are not lost, damaged or altered. When not in use, field notebooks will be locked in the field vehicle. Access to these files will be limited to the field personnel who use them.

(3) Sample Management and Tracking

A record of all field documentation will be maintained to confirm the validity of data used in the site analysis. To effectively execute such documentation, specific sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms. Copies of the completed COC forms associated with samples collected will be emailed to the Field Team Leader. Copies of all completed COC forms will be maintained in the project file. The laboratory will verify receipt of the samples electronically (via e-mail) on the following day.

When analytical data are received from the laboratory, the Data QA Manager or designee will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed up by the Data QA Manager.

(4) Data Management System

In addition to the sample tracking system, a data management system will be implemented.

Field Observations

Following each sampling event, a status memorandum will be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to summarize and provide a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Tables are typically attached to the memorandum and are used to summarize measurements that were recorded in the field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to facilitate the transfer of information to the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the COC forms and field notebooks.

Analytical Results

Analytical results will be provided by the laboratory as both an electronic data deliverable (EDD) and a hard copy format (delivered electronically in PDF format). The EDD will consist of a table in Microsoft Excel format. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Project QA Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package will be validated in accordance with procedures outlined in Worksheet #37. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of the data may not necessarily be restricted. Any qualifiers added to the results will be added manually to the EDD by the data validator.

(5) Documentation and Records

Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling and sample COC. This documentation constitutes a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained include:

- **Daily Production Documentation.** A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.
- **Sampling Information.** Detailed notes will be made as to the exact sampling location, physical observations and weather conditions (as appropriate).

Sample COC. COC forms will provide the record of responsibility for sample collection, transport and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by ARCADIS' field personnel designated to be responsible for sample custody. If the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in SOP F-01, Chain of Custody, Handling, Packaging and Shipping (Appendix A).

Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area, accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field Equipment, Calibration and Maintenance Logs

To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

Laboratory Project Files

The laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs and COC forms. The laboratory will retain project files and data packages for a period not less than 5 years.

Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated QCs. As such, logbooks, bench sheets, instrument logs and instrument printouts will be part of the permanent record of the laboratory. Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with one stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions. Information regarding the sample, analytical procedures performed, and results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, instrument used and instrument conditions. Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness and compliance with this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

Computer and Hard Copy Storage

All electronic files and deliverables will be retained by the laboratory for not less than 5 years; hard copy data packages (or electronic copies) will also be retained for not less than 5 years.

Field Data Reporting

Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Field Team Leader for adherence to the Work Plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and (as necessary) incorporated into the data evaluation process. If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs documents and data reductions will be kept in the project file at the ARCADIS office in Clifton Park, New York.

Laboratory Data Reporting

Data reports for all parameters will include, at a minimum, the following items:

- **Narrative.** Summary of activities that took place during sample analysis, including the following information:
  - laboratory name and address
  - date of sample receipt
  - cross reference of laboratory identification number to contractor sample identification
  - analytical methods used
  - deviations from specified protocol
  - corrective actions taken

  Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.
- **Analytical Results:** These will be reported according to analysis type and include the following information, as applicable:

- sample identification (ID)
- laboratory ID
- date of collection
- date of receipt
- date of extraction
- date of analysis
- method detection and reporting limits

Sample results on the report forms will be corrected for dilutions. Soil data will be reported on a dry weight basis. Unless otherwise specified, all results will be reported uncorrected for blank contamination.

For this project, three levels of data reporting have been defined, as follows:

- **Level 1** — **Minimal Reporting**: Minimal or “results only” reporting is used for analyses that, due either to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.
- **Level 2** — **Modified Reporting**: Modified reporting is used for analyses that are performed following standard EPA-approved methods and QA/QC protocols. Based on the intended data use, modified reporting may require some supporting documentation, but not full Contract Laboratory Program (CLP)-type reporting. This reporting level would include Analytical Services Protocol (ASP) Superfund and Category A reporting.
- **Level 3** — **Full Reporting**: Full CLP-type reporting is used for those analyses that, based on the intended data use, require full documentation. This reporting level would include ASP Superfund and Category B reporting.

The analytical methods to be used during the investigation activities will be performed using EPA SW-846 methodology with NYSDEC ASP Revision 2005, QA/QC requirements, and Category A and B reporting deliverables. The Category B deliverable will include, but not be limited to, raw data required to recalculate any result, including instrument printouts and quantitation reports; standards used in calibration and calculation of analytical results; sample extraction, digestion and other preparation logs; standard preparation logs; and instrument run logs.

Inspection/Audit Tasks

Performance and systems inspections/audits will be completed in the field and laboratory, as described below and in Worksheets #31 and #32.

- **Field Sampling/Health and Safety Inspections.** The Field Team Leader will monitor field performance. Field sampling/health and safety inspection summaries will contain an evaluation of field activities to verify that the activities are performed according to established procedures as described in the Site Management Plan, field sampling SOPs, and ARCADIS corporate health and safety standards. Field sampling/health and safety inspections will be performed by the ARCADIS Task Manager/Field Team Leader (or designee). The reviewer will communicate concerns to the ARCADIS Project Manager, QA Coordinator, and/or Health and Safety Manager, as appropriate.

  The number and frequency of field performance inspections conducted will be determined independently by the Task Manager/Field Team Leader. It is anticipated that the ARCADIS Task Manager/Field Team Leader will administer field performance audits at a frequency of one per year during field activities when samples are being collected from all site-related media. The observations made during field performance audits and any recommended changes/deviations to the field procedures will be recorded and documented.

  In addition, the Project QA Manager will review the rinse and trip blank data to identify potential deficiencies in field sampling and decontamination procedures. In addition, the scheduled QA/QC activities included in this QAPP will be compared with the actual QA/QC activities completed will be performed. The Task Manager/Field Team Leader and Project QA Manager will periodically confirm that work is being performed consistent with this QAPP, the SMP, and all applicable SOPs.

- **Laboratory Audits.** Internal laboratory audits are conducted periodically by the Laboratory QA Manager. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory QA manual and SOPs. Results of the audits are summarized and issued to each department supervisor, Laboratory Manager and Laboratory Director. A systems audit of each laboratory is also performed by the Data QA Manager to determine whether the procedures implemented by each laboratory comply with the QA manual and SOPs.

  As a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification, in addition to the laboratory’s internal audits. Audits are usually conducted annually and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

  ARCADIS reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the project, as deemed necessary.

- **Corrective Action.** Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP. Corrective actions include procedures to promptly investigate, document, evaluate and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

  a. Field Procedures

     If, during field work, a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action implemented by the Task Manager/Field Team Leader or a designee will be documented on a Corrective Action Form and reported to the appropriate ARCADIS Project QA Manager and Project Manager.

Examples of situations that would require corrective actions are provided below:

- protocols as defined by the QAPP, SOPs, and/or Site Management Plan have not been followed
- equipment is not in proper working order or is not properly calibrated
- QC requirements have not been met
- issues resulting from performance or systems audits have not been resolved

Project personnel will continuously monitor ongoing work performance as part of their daily responsibilities.

b. Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action taken will be documented and reported to the Project Manager and Data QA Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

- protocols as defined by this QAPP have not been followed
- predetermined data acceptance standards are not obtained
- equipment is not in proper working order or calibrated
- sample and test results are not completely traceable
- QC requirements have not been met
- issues resulting from performance or systems audits have not been resolved

Laboratory personnel will continuously monitor ongoing work performance as part of their daily responsibilities. Corrective action will be initiated at the point where the problem has been identified. At whatever level this occurs (analyst, supervisor, data review, or quality control), it will be brought to the attention of the Laboratory QA Manager and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director.

Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, re-analysis, cleanup, dilution, matrix modification or other activities.

Data Review Tasks
See Worksheets #36 and #37.

Notes:

[1] Metals included in the 6 NYCRR Part 360 baseline parameters include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, copper, cobalt, iron, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[2] Metals included in the 6 NYCRR Part 360 routine parameters include: cadmium, calcium, chromium, iron, lead, magnesium, manganese, potassium, and sodium.

[3] TAL metals include: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #15-1 Reference Limits and Evaluation (Groundwater and Surface Water)

Analyte	CAS Number	Groundwater Screening Criteria[1]	Surface Water Screening Criteria[2]	Water Reference Limits[3]	
				Laboratory Reporting Limit	Laboratory Method Detection Limit
Volatile Organic Compounds (SW-846 8260) (ug/L)					
1,1,1,2-Tetrachloroethane	630-20-6	5	5	2.5	0.7
1,1,1-Trichloroethane	71-55-6	5	5	2.5	0.7
1,1,2,2-Tetrachloroethane	79-34-5	5	**0.2**	0.5	0.144
1,1,2-Trichloroethane	79-00-5	**1**	**1**	1.5	0.5
1,1-Dichloroethane	75-34-3	5	5	2.5	0.7
1,1-Dichloroethene	75-35-4	5	0.7	0.5	0.142
1,2,3-Trichloropropane	96-18-4	**0.04**	**0.04**	2.5	0.7
1,2-Dibromo-3-chloropropane	96-12-8	**0.04**	**0.04**	2.5	0.7
1,2-Dibromoethane	106-93-4	**0.0006**	**0.0006**	2	0.65
1,2-Dichlorobenzene	95-50-1	3	3	2.5	0.7
1,2-Dichloroethane	107-06-2	0.6	0.6	0.5	0.132
1,2-Dichloropropane	78-87-5	1	1	1	0.133
1,3-Dichlorobenzene	541-73-1	3	3	2.5	0.7
1,4-Dichlorobenzene	106-46-7	3	3	2.5	0.7
2-Butanone	78-93-3	50	50	5	1.94
2-Hexanone	591-78-6	50	50	5	1
4-Methyl-2-pentanone	108-10-1	NS	NS	5	1
Acetone	67-64-1	50	50	5	1.46
Acrylonitrile	107-13-1	5	**0.07**	5	1.5
Benzene	71-43-2	1	1	0.5	0.159
Bromochloromethane	74-97-5	5	5	2.5	0.7
Bromodichloromethane	75-27-4	50	50	0.5	0.192
Bromoform	75-25-2	50	50	2	0.65
Bromomethane	74-83-9	5	5	2.5	0.7
Carbon disulfide	75-15-0	60	60	5	1
Carbon tetrachloride	56-23-5	5	**0.4**	0.5	0.134
Chlorobenzene	108-90-7	5	5	2.5	0.7
Chloroethane	75-00-3	5	5	2.5	0.7
Chloroform	67-66-3	7	7	2.5	0.7
Chloromethane	74-87-3	5	5	2.5	0.7
cis-1,2-Dichloroethene	156-59-2	5	5	2.5	0.7
cis-1,3-Dichloropropene	10061-01-5	**0.4**	**0.4**	0.5	0.144
Dibromochloromethane	124-48-1	50	50	0.5	0.149
Dibromomethane	74-95-3	5	5	5	1
Ethylbenzene	100-41-4	5	5	2.5	0.7
Methylene chloride	75-09-2	5	5	2.5	0.7
Styrene	100-42-5	5	5	2.5	0.7
Tetrachloroethene	127-18-4	5	0.7	0.5	0.181
Toluene	108-88-3	5	5	2.5	0.7
trans-1,2-Dichloroethene	156-60-5	5	5	2.5	0.7
trans-1,3-Dichloropropene	10061-02-6	**0.4**	**0.4**	0.5	0.164
trans-1,4-Dichloro-2-butene	110-57-6	5	5	2.5	0.7
Trichloroethene	79-01-6	5	5	0.5	0.175
Trichlorofluoromethane	75-69-4	5	5	2.5	0.7
Vinyl acetate	108-05-4	NS	NS	5	1
Vinyl chloride	75-01-4	2	**0.3**	1	0.0699
p/m-Xylene	179601-23-1	5	5	2.5	0.7
o-Xylene	95-47-6	5	5	2.5	0.7

Quality Assurance Project Plan Worksheet #15-1 Reference Limits and Evaluation (Groundwater and Surface Water)

Analyte	CAS Number	Groundwater Screening Criteria[1]	Surface Water Screening Criteria[2]	Water Reference Limits[3]	
				Laboratory Reporting Limit	Laboratory Method Detection Limit
Metals (SW-846 6010/6020/7470) (ug/L)					
Aluminum	7429-90-5	NS	100	10	2
Antimony	7440-36-0	3	3	0.5	0.1
Arsenic	7440-38-2	25	50	0.5	0.2
Barium	7440-39-3	1,000	1,000	0.5	0.1
Beryllium	7440-41-7	3	3	0.5	0.1
Cadmium	7440-43-9	5	5	0.2	0.05
Chromium	7440-47-3	50	50	1	0.2
Cobalt	7440-48-4	NS	5	0.2	0.1
Copper	7440-50-8	200	200	1	0.1
Iron	7439-89-6	300	300	50	13
Lead	7439-92-1	25	50	1	0.2
Manganese	7439-96-5	300	300	0.5	0.1
Nickel	7440-02-0	100	100	0.5	0.1
Potassium	7440-09-7	NS	NS	100	27
Selenium	7782-49-2	10	10	5	0.3
Silver	7440-22-4	50	50	0.25	0.1
Sodium	7440-23-5	20,000	NS	100	15
Thallium	7440-28-0	0.5	0.5	0.2	0.03
Vanadium	7440-62-2	NS	14	5	0.1
Zinc	7440-66-6	2,000	2,000	10	1.2
Boron	7440-42-8	1,000	10,000	30	7
Calcium	7440-70-2	NS	NS	100	30
Magnesium	7439-95-4	35,000	35,000	100	10
Mercury	7439-97-6	0.7	0.7	0.2	0.066
Wet Chemistry (mg/L)					
Color (SM2120B)	NA	NS	NS	5 A.P.C.U	NA
Total Kjeldahl Nitrogen (EPA 351.3)	NA	NS	NS	0.3	0.093
Alkalinity (SM2320B)	471-34-1	NS	NS	2	NA
Ammonia (EPA 350.1)	7664-41-7	2	2	0.075	0.021
Chemical Oxygen Demand (EPA 410.4)	NA	NS	NS	10	3.52
Hexavalent Chromium (SW-846 7196A)	18540-29-9	0.05	0.011	0.01	0.0035
Total Dissolved Solids (SM2540C)	NA	NS	NS	10	3.561
Biochemical Oxygen Demand (SM5210B)	NA	NS	NS	2	NA
Nitrate (EPA 353.2)	14797-55-8	10	10	0.1	0.0188
Phenolics (EPA 420.1)	NA	**0.001**	**0.001**	0.03	0.005
Total Organic Carbon (SM5310C)	7440-44-0	NS	NS	0.5	0.114
Cyanide (SW-846 9012)	57-12-5	0.2	0.2	0.005	0.001276
Sulfate (EPA 300.0)	14808-79-8	250	250	1	0.0518
Chloride (EPA 300.0)	16887-00-6	250	250	0.5	0.0541
Bromide (EPA 300.0)	24959-67-9	2	2	0.05	0.0103
Hardness (SM2340B)	NA	NS	NS	0.66	NA

Abbreviations:

mg/L = milligrams per liter

ug/L = micrograms per liter

NA = not applicable

NS = not specified

Notes:

1. Groundwater screening criteria correspond to the NYSDEC's Division of Water, Ambient Water Quality Standards and Guidance Values, Class GA Standards. Bold typeface indicates that the laboratory RL and/or MDL is greater than the applicable standard.
2. Surface water screening criteria correspond to the NYSDEC's Division of Water, Ambient Water Quality Standards and Guidance Values, Class A Standards. Bold typeface indicates that the laboratory RL and/or MDL is greater than the applicable standard.
3. Concentrations detected less than the RL but greater than the MDL must be reported with the appropriate qualifier.

Quality Assurance Project Plan Worksheet #15-2 Reference Limits and Evaluation (Sediment)

Analyte	CAS Number	Sediment Screening Criteria[1]					Sediment Reference Limits[2]	
		NYSDEC Lowest Effect Level	NYSDEC Severe Effect Level	NYSDEC Screening - Class A	NYSDEC Screening - Class B	NYSDEC Screening - Class C	Laboratory Reporting Limit	Laboratory Method Detection Limit
Metals (6010/7471) (mg/kg)								
Aluminum	7429-90-5	NS	NS	NS	NS	NS	4	0.8
Antimony	7440-36-0	2	25	NS	NS	NS	2	0.32
Arsenic	7440-38-2	6	33	< 10	10 - 33	> 33	0.4	0.08
Barium	7440-39-3	NS	NS	NS	NS	NS	0.4	0.12
Beryllium	7440-41-7	NS	NS	NS	NS	NS	0.2	0.04
Cadmium	7440-43-9	0.6	9	< 1	1 - 5	> 5	0.4	0.028
Calcium	7440-70-2	NS	NS	NS	NS	NS	4	1.2
Chromium	7440-47-3	26	110	<43	43 - 110	>110	0.4	0.08
Cobalt	7440-48-4	NS	NS	NS	NS	NS	0.8	0.2
Copper	7440-50-8	16	110	<32	32 - 150	>150	0.4	0.08
Iron	7439-89-6	20,000	40,000	NS	NS	NS	2	0.8
Lead	7439-92-1	31	110	<36	36 - 130	>130	2	0.08
Magnesium	7439-95-4	NS	NS	NS	NS	NS	4	0.4
Manganese	7439-96-5	460	1,100	NS	NS	NS	0.4	0.08
Nickel	7440-02-0	16	50	<23	23 - 49	>49	1	0.16
Potassium	9/7/7440	NS	NS	NS	NS	NS	100	16
Selenium	7782-49-2	NS	NS	NS	NS	NS	0.8	0.12
Silver	7440-22-4	1	2.2	<1	1 - 2.2	>2.2	0.4	0.08
Sodium	7440-23-5	NS	NS	NS	NS	NS	80	12
Thallium	7440-62-2	NS	NS	NS	NS	NS	0.8	0.16
Vanadium	7440-62-2	NS	NS	NS	NS	NS	0.4	0.04
Zinc	7440-66-6	120	270	<120	120 - 460	>460	2	0.28
Mercury	7439-97-6	0.15	1.3	<0.2	0.2 - 1	>1	0.08	0.016896
Wet Chemistry (mg/kg)								
Total Organic Carbon (Lloyd Kahn)	NA	NS	NS	NS	NS	NS	0.05	NA

Abbreviations:

mg/kg = milligrams per kilogram
NA = not applicable
NS = not specified

Notes:

1. Sediment screening criteria reflect NYSDEC Screening and Assessment of Contaminated Sediment.
2. Concentrations detected less than the RL but greater than the MDL must be reported with the appropriate qualifier.

Quality Assurance Project Plan Worksheet #16 – Project Schedule/Timeline

Activities	Organization	Anticipated Date of Initiation[1]	Anticipated Date of Completion[1]	Deliverable	Deliverable Due Date
Semi-Annual Surface Water Sampling	ARCADIS	2nd and 4th Quarters	Not applicable (NA)	Yes	Preliminary laboratory results: 10 days Laboratory analytical data report: Electronic 30 days
Annual Groundwater and Sediment Sampling	ARCADIS	2nd Quarter	NA	Yes	Preliminary laboratory results: 10 days Laboratory analytical data report: Electronic 30 days
Quarterly Landfill Inspections	ARCADIS	Quarterly	NA	No	NA
Quarterly Landfill Inspection Reports	ARCADIS	Quarterly	NA	Yes	Quarterly
Periodic Review Report	ARCADIS	Every Fifth Year	4th Quarter	Yes	Submit in the 1st Quarter of Calendar Year Following each Five-Year Review Period
Environmental Monitoring Report	ARCADIS	Annually	4th Quarter	Yes	4th Quarter

Note:

[1] Anticipated dates of initiation and completion are subject to change.

Quality Assurance Project Plan Worksheet #17 – Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Groundwater Monitoring. The network of monitoring wells has been installed to monitor both upgradient and downgradient groundwater conditions at the Site. Wells were installed either in the upper, intermediate, or lower water bearing unit as summarized below:

Hydrogeologic Unit	Well ID
Upper Water-Bearing Unit	2S 3S 6S 7S 9S 15S
Intermediate Water-Bearing Unit	2M 3M 6M
Lower Water-Bearing Unit	2D 3D 7D 9D 15D

Groundwater samples will be collected from the Site monitoring wells following EPA-approved low-flow sampling procedures using a dedicated low-flow bladder pump. Prior to collecting groundwater samples, field measurements will be made for pH, conductivity, turbidity, dissolved oxygen (DO), temperature, and oxidation-reduction potential (REDOX) using a water quality meter. Samples will be collected on an annual basis and will be analyzed for 6 NYCRR Part 360 baseline parameters. The groundwater levels will be measured prior to sampling. The sampling frequency may be modified with the approval of the NYSDEC.

If biofouling or silt accumulation occurs in the monitoring wells, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced if the well is rendered unusable. Repairs and/or replacement of wells in the monitoring well network will be performed as needed based on assessments of structural integrity and overall performance.

Surface Water Sampling. Surface water monitoring will be conducted in Mathew Creek at locations SW-1, SW-2, and SW-3 on a semi-annual schedule and will be analyzed for 6 NYCRR Part 360 baseline parameters during one event, and 6 NYCRR Part 360 routine parameters during the other event. Samples will

Quality Assurance Project Plan Worksheet #17 – Sampling Design and Rationale

be collected by slowly submerging sample containers into the surface water body. In the event that the containers cannot be completely submerged, water will be collected in clean glass beakers and poured into the sample bottles. Prior to collecting surface water samples, field measurements will be made for pH, conductivity, turbidity, DO, temperature, and REDOX using a water quality meter.

Sediment Sampling. Sediment samples will be collected on an annual basis to determine if the landfill contaminants are affecting sediments associated with Mathew Creek. Sediment sample locations SED-1 through SED-9 will be sampled. The sediment samples will be collected from 0 to 0.5 feet below the sediment surface and analyzed for target analyte list (TAL) metals and total organic carbon (TOC). Samples will be collected with a stainless steel trowel (or equivalent disposable equipment), homogenized in a clean ziplock-style bag, and then placed into laboratory-provided sample jars. Samples will be collected from the most downstream sampling location (SED-9) to the most upstream sampling location (SED-1).

Site-Wide Inspections. Site-wide inspections will be performed on a quarterly schedule. Site-wide inspections will be also be performed after any severe weather conditions that may affect Engineering Controls (ECs) or monitoring devices. An inspection form will be completed, and will compile sufficient information to assess the following:

- Compliance with all Institutional Controls (ICs), including Site usage;
- Evaluation of the condition and continued effectiveness of ECs;
- General Site conditions at the time of the inspection;
- Site management activities being conducted, including, where appropriate, confirmation sampling and a health and safety inspection;
- Compliance with permits and schedules included in the SMP, as applicable; and
- Confirmation that Site records are up to date.

Quality Assurance Project Plan Worksheet #18 – Sampling Locations and Methods/Standard Operating Procedure Requirements

Sampling Location/ID Number	Matrix	Sample Type and Number	Analytical Group	Concentration Level	Number of Samples (plus field duplicates)[1]	Sampling Standard Operating Procedure (SOP) Reference Number[2]	Rationale for Sampling Location
Monitoring Well Network: MW-2S, MW-2M, MW-2D, MW-3S, MW-3M, MW-3D, MW-6S, MW-6M, MW-7S, MW-7D, MW-9S, MW-9D, MW-15S, MW-15D	Groundwater	One grab sample from existing monitoring wells using low-flow techniques	6 NYCRR Part 360 Baseline Parameters: alkalinity, ammonia, biochemical oxygen demand (BOD), bromide, chemical oxygen demand (COD), chloride, color, hardness, nitrate, sulfate, total Kjeldahl nitrogen (TKN), cyanide, total organic carbon (TOC), total dissolved solids (TDS), phenolics, metals[3], hexavalent chromium, mercury, and volatile organic compounds (VOCs)	All	14 + 1 field duplicate	F-05	Monitor both the upgradient and down-gradient groundwater conditions at the Site to assess the performance of the remedy and progress of natural attenuation processes

Quality Assurance Project Plan Worksheet #18 – Sampling Locations and Methods/Standard Operating Procedure Requirements

Sampling Location/ID Number	Matrix	Sample Type and Number	Analytical Group	Concentration Level	Number of Samples (plus field duplicates)[1]	Sampling Standard Operating Procedure (SOP) Reference Number[2]	Rationale for Sampling Location
Surface Water: SW-1, SW-2, SW-3	Surface Water	One grab sample from surface water body (Mathew Creek)	6 NYCRR Part 360 Baseline Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, color, hardness, nitrate, sulfate, TKN, cyanide, TOC, TDS, phenolics, metals[3], hexavalent chromium, mercury, and VOCs 6 NYCRR Part 360 Routine Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, hardness, nitrate, sulfate, TKN, TOC, TDS, phneolics, and metals[4]	All	3 + 1 field duplicate	F-08	Assess if landfill contaminants are affecting the water quality of Mathew Creek
Sediment: SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED-7, SED-8, SED-9	Sediment	One grab sample from creek sediment (Mathew Creek)	Target analyte list (TAL) metals[5] and TOC	All	9 + 1 field duplicate	F-07	Assess if landfill contaminants are affecting sediment associated with Mathew Creek

Notes:

[1] One blind duplicate sample will be collected for every 20 samples, or at a minimum of one per sampling event. The number of samples provided is per sampling event.

[2] Sampling SOP reference number from QAPP Worksheet #21.

[3] 6 NYCRR Part 360 Baseline metals include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[4] 6 NYCRR Part 360 Routine metals include: cadmium, calcium, chromium, iron, lead, magnesium, manganese, potassium, and sodium.

[5] TAL metals include: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #19 - Analytical Standard Operating Procedure Requirements (Sample Containers, Preservation and Holding Times)

Parameter	Analytical and Preparation Method/SOP Reference	Bottle Type	Preservation	Holding Time [1]
Groundwater and Surface Water				
Alkalinity	SM2320B / L-01	1 x 250ml plastic	No headspace; Cool < 6°C	14 days to analysis
Ammonia	EPA 350.1 / L-02	1 x 500ml plastic	H2SO4, pH < 2; Cool < 6°C	28 days to analysis
Biochemical Oxygen Demand (BOD)	SM5210B / L-03	1 x 1L plastic	Cool < 6°C	48 hours to analysis
Bromide, Chloride, and Sulfate	EPA 300.0 / L-04	1 x 500ml plastic	Cool < 6°C	28 days to analysis
Chemical Oxygen Demand (COD)	EPA 410.4 / L-05	1 x 125ml plastic	H2SO4, pH < 2; Cool < 6°C	28 days to analysis
Color	SM2120B / L-06	1 x 500ml amber glass	Cool < 6°C	48 hours to analysis
Hardness	SM2340B / L-13	1 x 500ml plastic	HNO3, pH <2; Cool < 6°C	180 days to analysis
Nitrate	EPA 353.2 / L-07	1 x 250ml plastic	Cool < 6°C	48 hours to analysis
Total Kjeldahl Nitrogen (TKN)	EPA 351.1 / L-08	1 x 500ml plastic	H2SO4, pH < 2; Cool < 6°C	28 days to analysis
Cyanide	SW846 9012 / L-09	1 x 250ml plastic	NaOH, pH > 12; Cool < 6°C	14 days to analysis
Total Organic Carbon (TOC)	SM5310C / L-10	2 x 40mL amber glass vials with Teflon septa	No headspace; H2SO4, pH < 2; Cool < 6°C	28 days to analysis
Total Dissolved Solids (TDS)	SM2540C / L-11	1 x 500ml plastic	Cool < 6°C	7 days to analysis
Total Phenol	EPA 420.1 / L-12	1 x 1L amber glass	H2SO4, pH < 2; Cool < 6°C	28 days to analysis
Metals	SW846 6010 / L-13	1 x 500ml plastic	HNO3, pH <2; Cool < 6°C	180 days to analysis
Metals	SW846 6020 / L-14	1 x 500ml plastic	HNO3, pH <2; Cool < 6°C	180 days to analysis
Hexavalent Chromium	SW846 7196A / L-15	1 x 500ml plastic	Cool < 6°C	24 hours to analysis
Mercury	SW846 7470A / L-17	1 x 500ml plastic	HNO3, pH <2; Cool < 6°C	28 days to analysis
Volatile Organic Comounds (VOCs)	SW846 8260C / L-16	3 x 40mL amber glass vials with Teflon septa	No headspace; HCl, pH < 2; Cool < 6°C	14 days to analysis
Sediment				
Metals	SW846 6010 / L-13	1 x 8oz glass	Cool < 6°C	180 days to analysis
Mercury	SW846 7470A / L-18	1 x 8oz glass	Cool < 6°C	28 days to analysis
TOC	Lloyd Kahn / L-19	1 x 8oz glass	Cool < 6°C	28 days to analysis

Abbreviations:
°C = degree Celsius
HCl = hydrochloric acid
NaOH = sodium hydroxide
H2SO4 = sulfuric acid
L = liter
ml = milliliter
oz = ounce

Notes:
1. All holding times are measured from date of collection.

Quality Assurance Project Plan Worksheet #20 - Sample Quantities and Control Frequencies

Matrix/Analysis	Laboratory[1]	Analytical and Preparation SOP[2]	Estimated Sample Quantity[3]	Field QC Analyses						Laboratory QC Sample						Total
				Trip Blank		Field Blank[4]		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
				Freq.	No.	Freq.	No.	Freq.	No.	Freq. [5]	No.	Freq. [5]	No.	Freq. [5]	No.	
Groundwater: 6 NYCRR Part 360 Baseline Parameters																
Alkalinity (SM 2320B)	Alpha Analytical	L-01	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Ammonia (EPA 350.1)	Alpha Analytical	L-02	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Biochemical Oxygen Demand (BOD) (SM 5210B)	Alpha Analytical	L-03	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Bromide, Chloride, and Sulfate (EPA 300.0)	Alpha Analytical	L-04	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Chemical Oxygen Demand (COD) (EPA 410.4)	Alpha Analytical	L-05	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Color (SM 2120B)	Alpha Analytical	L-06	14	NA	--	1/event	1	1/event	1	NA	--	NA	--	NA	--	16
Hardness (SM 2340B)	Alpha Analytical	L-13	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Nitrate (EPA 353.2)	Alpha Analytical	L-07	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Total Kjehdahl Nitrogen (TKN) (EPA 351.1)	Alpha Analytical	L-08	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Cyanide (SW846 9012)	Alpha Analytical	L-09	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Total Organic Carbon (TOC) (SM 5310C)	Alpha Analytical	L-10	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Total Dissolved Solids (TDS) (SM 2540C)	Alpha Analytical	L-11	14	NA	--	1/event	1	1/event	1	1/event	--	1/event	--	1/event	1	17
Phenolics (EPA 420.1)	Alpha Analytical	L-12	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Metals (SW846 6010, 6020)[6]	Alpha Analytical	L-13/L-14	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Hexavalent Chromium (SW846 7196A)	Alpha Analytical	L-15	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Mercury (SW846 7470A)	Alpha Analytical	L-17	14	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	18
Volatile Organic Compounds (VOCs) (SW846 8260)	Alpha Analytical	L-16	14	1/cooler	2	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	20
Surface Water: 6 NYCRR Part 360 Baseline Parameters																
Alkalinity (SM 2320B)	Alpha Analytical	L-01	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Ammonia (EPA 350.1)	Alpha Analytical	L-02	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
BOD (SM 5210B)	Alpha Analytical	L-03	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Bromide, Chloride, and Sulfate (EPA 300.0)	Alpha Analytical	L-04	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
COD (EPA 410.4)	Alpha Analytical	L-05	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Color (SM 2120B)	Alpha Analytical	L-06	3	NA	--	1/event	1	1/event	1	NA	--	NA	--	NA	--	5
Hardness (SM 2340B)	Alpha Analytical	L-13	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Nitrate (EPA 353.2)	Alpha Analytical	L-07	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TKN (EPA 351.1)	Alpha Analytical	L-08	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Cyanide (SW846 9012)	Alpha Analytical	L-09	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TOC (SM 5310C)	Alpha Analytical	L-10	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TDS (SM 2540C)	Alpha Analytical	L-11	3	NA	--	1/event	1	1/event	1	NA	--	NA	--	1/event	1	6
Phenolics (EPA 420.1)	Alpha Analytical	L-12	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Metals (SW846 6010, 6020)[6]	Alpha Analytical	L-13/L-14	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Hexavalent Chromium (SW846 7196A)	Alpha Analytical	L-15	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Mercury (SW846 7470A)	Alpha Analytical	L-17	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
VOCs (SW846 8260)	Alpha Analytical	L-16	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Surface Water: 6 NYCRR Part 360 Routine Parameters																
Alkalinity (SM 2320B)	Alpha Analytical	L-01	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Ammonia (EPA 350.1)	Alpha Analytical	L-02	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
BOD (SM 5210B)	Alpha Analytical	L-03	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Bromide, Chloride, and Sulfate (EPA 300.0)	Alpha Analytical	L-04	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
COD (EPA 410.4)	Alpha Analytical	L-05	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Hardness (SM 2340B)	Alpha Analytical	L-13	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Nitrate (EPA 353.2)	Alpha Analytical	L-07	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TKN (EPA 351.1)	Alpha Analytical	L-08	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TOC (SM 5310C)	Alpha Analytical	L-10	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
TDS (SM 2540C)	Alpha Analytical	L-11	3	NA	--	1/event	1	1/event	1	NA	--	NA	--	1/event	1	6
Phenolics (EPA 420.1)	Alpha Analytical	L-12	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7
Metals (SW846 6010, 6020)[7]	Alpha Analytical	L-13/L-14	3	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	7

Quality Assurance Project Plan Worksheet #20 - Sample Quantities and Control Frequencies

Matrix/Analysis	Laboratory[1]	Analytical and Preparation SOP[2]	Estimated Sample Quantity[3]	Field QC Analyses						Laboratory QC Sample						Total
				Trip Blank		Field Blank[4]		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
				Freq.	No.	Freq.	No.	Freq.	No.	Freq. [5]	No.	Freq. [5]	No.	Freq. [5]	No.	
Sediment																
Metals (SW846 6010)[8]	Alpha Analytical	L-13	9	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	13
Mercury (SW846 7471B)	Alpha Analytical	L-18	9	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	13
TOC (Lloyd Kahn)	Alpha Analytical	L-19	9	NA	--	1/event	1	1/event	1	1/event	1	1/event	1	NA	--	13

Abbreviations:
Freq. = frequency
NA = not applicable
No. = number of samples
QC = quality control

Notes:
1. See Worksheet #30 for contact information.
2. See Worksheet #23 for SOP title, revision number, and date details.
3. Sample quantities are provided per calendar year.
4. Field blanks are only required when non-dedicated and/or non-disposable sampling equipment is utilized.
5. Frequency for Matrix Spike, Matrix Spike Duplicate and Laboratory Dupicate samples is 1 per 20 field samples, not including field blanks and field duplicates.
6. Metals to include aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc by SW-846 6020; and boron, calcium, and magnesium by SW-846 6010.
7. Metals to include cadmium, chromium, iron, lead, manganese, potassium, and sodium by SW-846 6020; and calcium and magnesium by SW-846 6010.
8. Metals to include aluminum, antimony, arsenic,barium, beryllium, cadmium,calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #21 – Field Sampling Standard Operating Procedure References

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Yes/No)	Comments
F-01	Chain of Custody, Handling, Packaging and Shipping, Revision 2, March 2009	ARCADIS	See SOP for specific equipment needs	No	Describes field sample custody, handling, packaging and shipping procedures
F-02	Field Equipment Decontamination, Revision 3, April 2010	ARCADIS	See SOP for specific equipment needs	No	Describes the procedure for field equipment cleaning and decontamination
F-03	Measuring Basic Water Quality Parameters In-Situ, Revision 1, March 2004	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for measurement of water quality parameters and the required equipment
F-04	Field Log Book Entries, Revision 0, August 2009	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for entries needed in a field log book for environmental investigations
F-05	Low-Flow Groundwater Purging and Sampling for Monitoring Wells, Revision 4, February 2011	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for groundwater sampling and the required equipment
F-06	Multiple Gas Air Monitoring and Field Screening, Revision 0, July 2003	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for field screening with a one-to-five sensor instrument
F-07	Sediment Sampling, Revision 0, July 2003	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for collection of sediment samples
F-08	Surface Water Sampling, Revision 0, June 2013	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for collection of surface water samples
F-09	Investigation-Derived Waste Handling and Storage, Revision 2, March 2009	ARCADIS	See SOP for specific equipment needs	No	Describes the procedures for managing investigation-derived wastes generated during site activities

Quality Assurance Project Plan Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection

Field Equipment	Calibration Activity/ Frequency	Maintenance Activity	Testing Activity	Inspection Activity	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference[1]
Combination Water Quality Meter	As required by manufacturer specifications	As required by manufacturer specifications; a replacement meter and probes will be available onsite or ready for overnight shipment, as necessary	Groundwater and surface water sampling: temperature, conductivity, pH, turbidity, REDOX, dissolved oxygen	Check all membranes and sensors, and check battery charge	As required by manufacturer specifications	As required by manufacturer specifications	Field personnel	F-03
Multi-Gas Meter	As required by manufacturer specifications	As required by manufacturer specifications; a replacement meter will be available onsite or ready for overnight shipment, as necessary	Landfill gas monitoring: carbon monoxide, hydrogen sulfide, oxygen, combustible gas	Check alarm setting, check filters and gas inlet adaptor, clean sensor modules, check battery charge	As required by manufacturer specifications	As required by manufacturer specifications	Field personnel	F-06

Note:
[1] SOP reference numbers correspond to the field sampling SOPs in Worksheet #21.

Quality Assurance Project Plan Worksheet #23 – Analytical Standard Operating Procedure References

SOP Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
L-01	Alkalinity, Titration Method, Revision 5, 10/16/2014	Definitive	Water / Alkalinity	Titrator	Alpha Analytical	No
L-02	Nitrogen, Ammonia, Revision 5, 11/20/2014	Definitive	Water / Ammonia	Ion Analyzer	Alpha Analytical	No
L-03	Biochemical Oxygen Demand (BOD), 5-Day, Revision 6, 10/26/2014	Definitive	Water / BOD	Dissolved Oxygen Meter	Alpha Analytical	No
L-04	Determination of Inorganic Anions by Ion Chromatography, Revision 4, 12/4/2014	Definitive	Water / Bromide, Chloride, and Sulfate	Ion Chromatograph	Alpha Analytical	No
L-05	Chemical Oxygen Demand (COD), Revision 9, 1/21/2015	Definitive	Water / COD	Spectrophotometer	Alpha Analytical	No
L-06	True and Apparent Color – Visual Comparison Method, Revision 3, 11/20/2012	Definitive	Water / Color	Not applicable	Alpha Analytical	No
L-07	Nitrate, Nitrite, and Nitrate/Nitrite Nitrogen, Revision 7, 4/24/2015	Definitive	Water / Nitrate	Ion Analyzer	Alpha Analytical	No
L-08	Nitrogen, Total Kjeldahl, Revision 4, 11/20/2014	Definitive	Water / Total Kjeldahl Nitrogen	Ion Analyzer	Alpha Analytical	No
L-09	Total Cyanide, Revision 6, 7/24/2014	Definitive	Water / Cyanide	Lachat Flow Analyzer	Alpha Analytical	No
L-10	Total Organic Carbon (TOC), Revision 5, 11/7/2014	Definitive	Water / TOC	TOC Analyzer	Alpha Analytical	No
L-11	Total Dissolved Solids (TDS) Dried at 180ºC, Revision 8, 5/8/2014	Definitive	Water / TDS	Analytical Balance	Alpha Analytical	No
L-12	Total Phenol – SEAL Method, Revision 1, 5/28/2013	Definitive	Water / Total Phenol	Spectrophotometer	Alpha Analytical	No
L-13	Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES), Revision 7, 11/20/2014	Definitive	Water and Sediment / Metals and Hardness	ICP-AES	Alpha Analytical	No
L-14	Inductively Coupled Plasma – Mass Spectrometry (ICP-MS), Revision 5, 2/3/2014	Definitive	Water / Metals	ICP-MS	Alpha Analytical	No

Quality Assurance Project Plan Worksheet #23 – Analytical Standard Operating Procedure References

SOP Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
L-15	Chromium, Hexavalent, Revision 5, 4/13/2015	Definitive	Water / Hexavalent Chromium	Spectrophotometer	Alpha Analytical	No
L-16	Volatile Organic Compounds (VOCs) by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 15, 3/19/2015	Definitive	Water / VOCs	GC/MS	Alpha Analytical	No
L-17	Mercury in Liquid Waste, Revision 4, 11/26/2013	Definitive	Water / Mercury	Cold Vapor Atomic Absorption (CVAA)	Alpha Analytical	No
L-18	Mercury in Solid or Semisolid Waste, Revision 6, 11/26/2013	Definitive	Sediment / Mercury	CVAA	Alpha Analytical	No
L-19	Total Organic Carbon and Soot in Soil, Sediment, Revision 18, 5/21/2015	Definitive	Sediment / TOC	TOC Analyzer	Alpha Analytical	No

Quality Assurance Project Plan Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gas chromatography/mass spectrometry (GC/MS)	Instrument performance check (tune).	Prior to initial and continuing calibration.	As per method.	Retune instrument.	Analyst	L-16
	Initial calibration — prior to sample analysis, a minimum of five concentration levels for all compounds.	Prior to sample analysis five points for all compounds. Yearly.	Each compound relative response factor (RRF) RSD ≤ 15% for all compounds or linear $r^2 \geq 0.99$ and RRF ≥ 0.05.	Inspect system, correct problem, rerun calibration and affected samples if RSD > 50% or linear $r^2 \geq 0.99$.		
	Continuing calibration — before sample analysis, one standard (midpoint).	Before sample analysis and every 12 hours.	Each compound percent difference ≤ 20% for all compounds or linear and response factor (RF) ≥0.05.	Inspect system, correct problem, rerun calibration and affected samples if %D > 80%.		
Inductively coupled plasma-atomic emission spectrometry (ICP-AES) Inductively-coupled plasma-mass spectrometry (ICP-MS)	Minimum two calibration standards and calibration blank, one standard (midpoint).	Daily/continuing.	Initial calibration — coefficient of variation ≥ 0.995. Continuing calibration — +/- 10% difference. Low-level check (CRI) continuing calibration — +/- 30% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-13, L-14
Cold vapor atomic absorption (CVAA)	Initial calibration — five concentration levels. Continuing calibration — one standard.	Daily, or on continuing calibration failure. Continuing, every 10 samples.	Initial calibration - ≥ 0.995 coefficient of variation. Continuing calibration — +/- 20% difference. Low-level check (CRI) continuing calibration — +/- 30% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-17, L-18
Lachat Autoanalyzer Ion chromatograph Spectrophotometer TOC Analyzer	Initial calibration — six concentration levels. Continuing calibration — one standard.	Daily, or on continuing calibration failure. Continuing, every 10 samples.	Initial calibration — coefficient of variation ≥ 0.995. Continuing calibration — +/- 10% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-02, L-04, L-05, L-07, L-08, L-09, L-10, L-12, L-15, L-19

Quality Assurance Project Plan Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Dissolved oxygen meter	Autocalibration	Daily.	Compare calibration against Winkler titration.	Perform a manual calibration per the manufacturer's instructions.	Analyst	L-03
pH Meter	Initial calibration with 3 buffers (normally pH 4, 7, and 10).	Daily.	Buffers should be within 0.05 pH units of true value.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-01

Note:
[1] SOP reference numbers correspond to the analytical SOPs in Worksheet #23.

Quality Assurance Project Plan Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Gas Chromatography/Mass Spectrometry (GC/MS)	• Replace GC septa • Periodic rinsing or replacement of purge and trap tubes and sparge needles • Periodic cleaning of mass spectrometer ion source • Replacement of injector ports and seals • Clip several inches off of the front of the GC column • Replacement of GC column	VOCs	Check connections, bake out instrument, leak test	See L-16	See L-16	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-16
Inductively coupled plasma-atomic emission spectrometry (ICP-AES) Inductively-coupled plasma-mass spectrometry (ICP-MS)	• Change capillary and pump tubing • Check liquid argon tank • Replace and realign plasma torch • Clean nebulizer and spray chamber	All metals except mercury	Check connections, replace worn equipment	See L-13, L-14	See L-13, L-14	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-13, L-14

Quality Assurance Project Plan Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Cold vapor atomic absorption (CVAA)	• Clean tubing and quartz cell as needed • Clean aspirator as necessary • Check level of mercury scrubber solution • Replace lamps • Check that gas supply and delivery pressures are adequate	Mercury	Check connections, replace worn equipment	See L-17, L-18	See L-17, L-18	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-17, L-18
Lachat autoanalyzer	• Change tubing • Change O-ring • Flush lines at end of each run	Ammonia, nitrate, total Kjehdahl nitrogen, cyanide	Check connections, replace worn equipment	See L-02, L-07, L-08, L-09	See L-02, L-07, L-08, L-09	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-02, L-07, L-08, L-09
TOC analyzer	• Inspect tubing, copper/tin scrubber, and autosampler syringe	Total organic carbon	Check connections, replace worn equipment	See L-10, L-19	See L-10, L-19	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-10, L-19
Spectrophotometer	• Calibration	Chemical oxygen demand, total phenol, hexavalent chromium	Check connections, replace worn equipment	See L-05, L-12, L-15	See L-05, L-12, L-15	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-05, L-12, L-15

Quality Assurance Project Plan Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Ion chromatograph	• Refill eluent reservoir • Empty waste container • Check fluid lines • Check junctions between pump heads and pump casting • Check filter	Bromide, chloride, and sulfate	Check connections, replace worn equipment	See L-04	See L-04	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-04
Dissolved oxygen meter	• Change membrane	Biochemical oxygen demand	Inspect probe for debris	See L-03	See L-03	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-03
pH Meter	• Change buffer fluid • Clean electrodes • Rinse electrodes • Replace electrodes as necessary	Alkalinity	Inspect probe for debris	See L-01	See L-01	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-01

Note:
[1] SOP reference numbers correspond to analytical SOPs in Worksheet #23.

Quality Assurance Project Plan Worksheet #26 – Sample Handling System

Sample Collection, Packaging and Shipment
Sample Collection (Personnel/Organization): Field Personnel/ARCADIS
Sample Packaging (Personnel/Organization): Field Personnel/ARCADIS
Coordination of Shipment (Personnel/Organization): Field Personnel/ARCADIS
Type of Shipment/Carrier: Federal Express to Alpha Analytical
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Sample Custodian/Alpha Analytical
Sample Custody and Storage (Personnel/Organization): Sample Custodian/Alpha Analytical
Sample Preparation (Personnel/Organization): Lab Analyst/Alpha Analytical
Sample Determinative Analysis (Personnel/Organization): Lab Analyst/Alpha Analytical
Sample Archiving
Field Sample Storage: 30 days from submittal of laboratory final report
Sample Extract/Digestate Storage (number of days from extraction/digestion): 60 days
Sample Disposal
Personnel/Organization: Sample Custodian/Alpha Analytical
Number of Days from Analysis: 30-day minimum from submittal of laboratory final report

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

Sample Handling and Custody Requirements

At all times, field and laboratory personnel will be aware of the need to maintain all samples, whether in the field or in the laboratory, under strict chain-of-custody and in a manner to retain physical properties and chemical composition. This Worksheet details sample handling and custody requirements from collection to ultimate disposal.

Sample Handling (Sample Packaging, Shipping Containers and Sample Shipment, Sample Custody)

Sample packaging and shipment procedures are designed so that the samples will arrive at the laboratory, with the chain-of-custody, intact.

Samples will be packaged for shipment as outlined below:

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- If necessary, wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the chain-of-custody form with the required sampling information and confirm that the recorded information matches the sample labels. Note: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.
- Using duct tape, secure the outside and inside drain plug at the bottom of the cooler.
- Please a new large heavy duty plastic garbage bag inside the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers upright in the cooler.
- Place ice in large re-sealable plastic bags. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain-of-custody forms in a large re-sealable plastic bag. Tape the bag to the inside of the cooler lid.

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

- Close the lid of the cooler, lock and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the shipping address and return address, affix “Fragile” labels and draw (or affix) arrows indicating “this side up.” Cover the labels with clear plastic tape.
- Place a signed custody seal over the front and back of the cooler lid.

Samples will be packaged by field personnel and transported as low-concentration environmental samples. Samples will be hand delivered or delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the chain-of-custody form identifying the contents.

The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain-of-custody form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Additional procedures for packing, handling and shipping environmental samples are presented in the SOP F-01 Chain-of-Custody, Handling, Packing and Shipping, a copy of which is included in Appendix A.

Field Custody Procedures

The objective of field sample custody is to protect samples from tampering from the time of sample collection through time of transport to the analytical laboratory. Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain-of-custody forms.

Field logbooks will provide the means of recording the field data collection activities that are performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned
- logbook number
- project name
- project start date
- end date

Entries in the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protective equipment being used, and signature of the person making the entry will be provided. The names of visitors to the site, as well as the purpose of their visit, will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with one strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the Site Management Plan and applicable SOPs (Appendix A). The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

Sample Labels

Preprinted sample labels (supplied by the laboratory) will be affixed to sample bottles prior to delivery to the sampling site. The following information is required on each sample label:

- project name
- date collected
- time collected
- location
- name of sampler
- analysis to be performed
- preservative
- sample number

Chain-of-Custody Record

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be initiated by the sampling crew in the field. The chain-of-custody forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody will be made prior to shipment (or multiple copy forms will be used) for field documentation. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Whenever samples are split with a government agency or other party, a separate chain-of-custody will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, note this in the "Received By" space.

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

Laboratory Custody Procedures
Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of-custody form will accompany all samples requiring laboratory analysis. The laboratory will use chain-of-custody guidelines described in the EPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity. Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler and compare the contents against the field chain-of-custody. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, ARCADIS will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds [VOCs] in Water)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8260/ L-16	**No. of Sample Locations**	Groundwater: 14/year Surface water: 6/year
Analytical Group	VOCs	**Sampler's Name**	To be determined		
Concentration Level	All	**Field Sampling Organization**	ARCADIS		
Sampling Standard Operating Procedure (SOP)	F-05, F-08	**Analytical Organization**	Alpha Analytical		

Quality Control (QC) Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field duplicate	One per sampling event	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Surrogates	Three per sample	Percent recovery (%R): 70-130%	Reanalyze sample	Lab personnel	Accuracy/bias	%R: 70-130%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalyze batch	Lab personnel	Accuracy/bias contamination	< RL
Trip blanks	One per cooler containing VOC samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per sampling event	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per batch	%R: Laboratory-specific limits	Qualify data as needed or reanalyze batch	Lab personnel	Precision	%R: Laboratory-specific limits
Instrument check: bromofluorobenzene (BFB)	One per calibration	% Relative abundance	Reanalyze batch	Lab personnel	Accuracy/bias	% Relative abundance
Internal standard	At least three per sample	Area response and retention times, see analytical SOP	Reanalyze sample	Lab personnel	Precision	Area response and retention times, see analytical SOP
Matrix spike (MS)	One per batch	%R: Laboratory-specific limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: Laboratory-specific limits
Matrix spike duplicate (MSD)	One per batch	%R: Laboratory-specific limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: Laboratory-specific limits

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds [VOCs] in Water)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8260/ L-16	**No. of Sample Locations**	Groundwater: 14/year Surface water: 6/year	
Analytical Group	VOCs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling Standard Operating Procedure (SOP)	F-05, F-08	**Analytical Organization**	Alpha Analytical			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MS/MSD and LCS/LCS[2]	One per batch	RPD < 20%	Qualify data as needed	Lab and/or Data Validator	Precision	RPD < 20%

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (General Chemistry Parameters in Water)

Matrix	Water	**Analytical Method/SOP Reference**	SM2320B/L-01 EPA 350.1/L-02 SM5210B/L-03 EPA 300.0/L-04 EPA 410.4/L-05 SM2120B/L-06 SM2340B/L-13 EPA 353.2/L-07 EPA 351.3/L-08 SW846 9012/L-09 SM5310C/L-10 SM2540C/L-11 EPA 420.1/L-12 SW846 7196A/L-15	**No. of Sample Locations**	Groundwater: 14/year Surface water: 6/year
Analytical Group	Wet Chemistry	**Sampler's Name**	Not Available		
Concentration Level	All	**Field Sampling Organization**	ARCADIS		
Sampling Standard Operating Procedure (SOP)	F-05, F-08	**Analytical Organization**	Alpha Analytical		

Quality Control (QC) Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field duplicate	One per sampling event	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per sampling event	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards (if applicable)	Numerous	Percent recovery (%R): 90-110%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	%R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias	%R: 80-120%

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (General Chemistry Parameters in Water)

Matrix	Water	**Analytical Method/SOP Reference**	SM2320B/L-01 EPA 350.1/L-02 SM5210B/L-03 EPA 300.0/L-04 EPA 410.4/L-05 SM2120B/L-06 SM2340B/L-13 EPA 353.2/L-07 EPA 351.3/L-08 SW846 9012/L-09 SM5310C/L-10 SM2540C/L-11 EPA 420.1/L-12 SW846 7196A/L-15	**No. of Sample Locations**	Groundwater: 14/year Surface water: 6/year	
Analytical Group	Wet Chemistry	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling Standard Operating Procedure (SOP)	F-05, F-08	**Analytical Organization**	Alpha Analytical			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per 20 field samples of similar matrix	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%
Laboratory duplicate or MS/MSD or LCS/LCSD[2]	One per 20 field samples of similar matrix	RPD < 20%	Qualify data as needed	Data Validator	Precision – overall	RPD < 20%

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Metals in Water)

Matrix	Water	**Analytical Method/ SOP Reference**	SW-846 6010/6020/7470/ L-13/ L-14/L-17	**No. of Sample Locations**	Groundwater: 14/year Surface Water: 6/year	
Analytical Group	Metals	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling SOP	F-05, F-08	**Analytical Organization**	Alpha Analytical			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per sampling event	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	Numerous	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per sampling event	< RL	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards	Numerous	Percent recovery (%R): 90-110%; Mercury (Hg) %R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%; Hg %R: 80-120%
Reporting limit standard (CRI)	Two per run	%R: 70-130%	Qualify data as needed or reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 70-130%
Interference check sample (A and AB)	Two per run	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab personnel	Precision – lab	%R: 80-120%
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per batch	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias	%R: 80-120%
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Metals in Water)

Matrix	Water	**Analytical Method/ SOP Reference**	SW-846 6010/6020/7470/ L-13/ L-14/L-17	**No. of Sample Locations**	Groundwater: 14/year Surface Water: 6/year	
Analytical Group	Metals	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling SOP	F-05, F-08	**Analytical Organization**	Alpha Analytical			
Quality Control (QC) Sample	**Frequency/Number**[1]	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MS/MSD or LCS/LCSD[2]	One per batch	RPD < 20%	Qualify data as needed	Lab and/or Data Validator	Precision – overall	RPD < 20%
Post-digestion spike	One per batch	%R: 75-125%	Qualify data as needed	Lab personnel	Accuracy/bias	%R: 75-125%
Serial dilution[3]	One per batch	Percent difference (%D): < 10%	Qualify data as needed	Lab personnel	Precision	%D: < 10%

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] LCS/LCSD used when MS/MSD are not client-supplied.

[3] Performed as needed only for analytes with concentration > 50 times the method detection limit.

Quality Assurance Project Plan Worksheet #28-4 – Quality Control Samples (General Chemistry Parameters in Sediment)

Matrix	Sediment	**Analytical Method/ SOP Reference**	Lloyd Kahn/L-19	**No. of Sample Locations**	9/year	
Analytical Group	Wet Chemistry	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling Standard Operating Procedure (SOP)	F-07	**Analytical Organization**	Alpha Analytical			

Quality Control (QC) Sample	**Frequency/Number**[1]	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per sampling event	Relative percent difference (RPD) < 50%	Qualify data as needed	Data Validator	Precision – overall	RPD < 50%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per sampling event	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards (if applicable)	Numerous	Percent recovery (%R): 90-110%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	%R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias	%R: 80-120%
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per 20 field samples of similar matrix	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%
Laboratory duplicate or MS/MSD or LCS/LCSD[2]	One per 20 field samples of similar matrix	RPD < 20%	Qualify data as needed	Data Validator	Precision – overall	RPD < 20%

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals in Sediment)

Matrix	Sediment	**Analytical Method/ SOP Reference**	SW-846 6010/7471/L-13/ L-18	**No. of Sample Locations**	9/year
Analytical Group	Metals	**Sampler's Name**	Not Available		
Concentration Level	All	**Field Sampling Organization**	ARCADIS		
Sampling SOP	F-07	**Analytical Organization**	Alpha Analytical		

Quality Control (QC) Sample	Frequency/Number[1]	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field duplicate	One per sampling event	Relative percent difference (RPD) < 50%	Qualify data as needed	Data Validator	Precision – overall	RPD < 50%
Method blanks	Numerous	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per sampling event	< RL	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards	Numerous	Percent recovery (%R): 90-110%; Mercury (Hg) %R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%; Hg %R: 80-120%
Reporting limit standard (CRI)	Two per run	%R: 70-130%	Qualify data as needed or reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 70-130%
Interference check sample (A and AB)	Two per run	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab personnel	Precision – lab	%R: 80-120%
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per batch	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias	%R: 80-120%
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%
MS/MSD or LCS/LCSD[2]	One per batch	RPD < 20%	Qualify data as needed	Lab and/or Data Validator	Precision – overall	RPD < 20%

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals in Sediment)

Matrix	Sediment	**Analytical Method/ SOP Reference**	SW-846 6010/7471/L-13/ L-18	**No. of Sample Locations**	9/year	
Analytical Group	Metals	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS			
Sampling SOP	F-07	**Analytical Organization**	Alpha Analytical			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Post-digestion spike	One per batch	%R: 75-125%	Qualify data as needed	Lab personnel	Accuracy/bias	%R: 75-125%
Serial dilution[3]	One per batch	%D: < 10%	Qualify data as needed	Lab personnel	Precision	%D: < 10%

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] LCS/LCSD used when MS/MSD are not client-supplied.

[3] Performed as needed only for analytes with concentration > 50 times the method detection limit.

Quality Assurance Project Plan Worksheet #29 – Project Documents and Records

Sample Collection Documents and Records	On-Site Analysis Documents and Records[1]	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field notes - Pre- and post-sampling memos, as needed - Sampling logs - Chain-of-custody records - Air bills - Custody seals - Field sampling standard operating procedures - Site inspection forms	- Equipment calibration logs - Field data records - Field instrument maintenance logs	- Sample receipt, custody and tracking records - Analysis standard operating procedures - Standard traceability logs - Equipment calibration logs - Sample prep logs - Run logs - Equipment maintenance, testing and inspection logs - Corrective action forms - Reported field sample results - Reported results for standards, QC checks and QC samples - Instrument printouts (raw data) for field samples, standards, QC checks and QC samples - Data package completeness checklists - Sample disposal records - Extraction/cleanup records - Raw data (stored on disk or CD-R) - Analytical reports to ARCADIS	- Data validation checklists - Data quality assessments - Data usability summary reports	- Site Management Plan - Health and Safety Plan - Periodic Review Report - Environmental Monitoring Report

Note:

[1] Records and logs from the project will be stored in ARCADIS' Clifton Park, New York office.

Quality Assurance Project Plan Worksheet #30 – Analytical Services

Matrix	Analytical Group	Concentration Level	Analytical Standard Operating Procedure (SOP)	Data Package Turnaround Time (business days)	Laboratory/ Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Groundwater	6 NYCRR Part 360 Baseline Parameters: alkalinity, ammonia, biochemical oxygen demand (BOD), bromide, chemical oxygen demand (COD), chloride, color, hardness, nitrate, sulfate, total Kjeldahl nitrogen (TKN), cyanide, total organic carbon (TOC), total dissolved solids (TDS), phenolics, metals[1], hexavalent chromium, mercury, and volatile organic compounds (VOCs)	All	See Worksheet #23	Preliminary report: 10 business days Final report and electronic data deliverable (EDD): 30 calendar days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 508.898.9220 Contact: Candace Fox	NA
Surface Water	6 NYCRR Part 360 Baseline Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, color, hardness, nitrate, sulfate, TKN, cyanide, TOC, TDS, phenolics, metals[1], hexavalent chromium, mercury, and VOCs 6 NYCRR Part 360 Routine Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, hardness, nitrate, sulfate, TKN, TOC, TDS, phenolics, and metals[2]	All	See Worksheet #23	Preliminary report: 10 business days Final report and EDD: 30 calendar days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 508.898.9220 Contact: Candace Fox	NA

Quality Assurance Project Plan Worksheet #30 – Analytical Services

Matrix	Analytical Group	Concentration Level	Analytical Standard Operating Procedure (SOP)	Data Package Turnaround Time (business days)	Laboratory/ Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Sediment	Target analyte list (TAL) metals[3] and TOC	All	See Worksheet #23	Preliminary report: 10 business days Final report and EDD: 30 calendar days	Alpha Analytical 8 Walkup Drive Westborough, MA 01581 508.898.9220 Contact: Candace Fox	NA

Notes:

[1] 6 NYCRR Part 360 Baseline metals include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[2] 6 NYCRR Part 360 Routine metals include: cadmium, calcium, chromium, iron, lead, magnesium, manganese, potassium, and sodium.

[3] TAL metals include: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #31 – Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CAs) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Laboratory Audit of Alpha Analytical	Per Laboratory Quality Assurance (QA) Program	Internal	Alpha Analytical	James Todaro Laboratory QA Manager, Alpha Analytical	Candace Fox Laboratory Project Manager, Alpha Analytical	Candace Fox Laboratory Project Manager, Alpha Analytical	Dennis Capria QA Coordinator, ARCADIS
Field Sampling/Health and Safety Inspections	Annually	Internal	ARCADIS	Katie Bidwell Task Manager/Field Team Leader, ARCADIS	Doug Weeks Project Manager, ARCADIS Chuck Webster Health and Safety Manager, ARCADIS	Doug Weeks Project Manager, ARCADIS Chuck Webster Health and Safety Manager, ARCADIS	Katie Bidwell Task Manager/Field Team Leader, ARCADIS

Quality Assurance Project Plan Worksheet #32 – Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Contract Laboratory Technical Audit (external)	Written Audit Report	Candace Fox Project Manager, Alpha Analytical Doug Weeks Project Manager, ARCADIS Dennis Capria Quality Assurance (QA) Coordinator, ARCADIS	1 week after audit	Memorandum	James Todaro QA Officer, Alpha Analytical	48 hours after notification
Field Sampling/Health and Safety Inspection	Memorandum	Doug Weeks Project Manager, ARCADIS Chuck Webster Health and Safety Manager, ARCADIS	2 days	Memorandum	Katie Bidwell Task Manager/Field Team Leader, ARCADIS	48 hours after notification
Contract Laboratory Technical Audit (internal)	Memorandum	Candace Fox Project Manager, Alpha Analytical Doug Weeks Project Manager, ARCADIS Dennis Capria QA Coordinator, ARCADIS	2 days	Memorandum	James Todaro QA Officer, Alpha Analytical	48 hours after notification

Quality Assurance Project Plan Worksheet #33 – Quality Assurance Management Reports

Type of Report	Frequency (e.g., daily, weekly monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Field Sampling/Health and Safety Inspection Report	One per year	NA	Katie Bidwell Task Manager/Field Team Leader, ARCADIS	Doug Weeks Project Manager, ARCADIS Chuck Webster Health and Safety Manager, ARCADIS
Contract Laboratory Technical Audit Report	As necessary during project	NA	Dennis Capria Quality Assurance (QA) Coordinator, ARCADIS	Doug Weeks Project Manager, ARCADIS
Data Validation Reports	10% of the ASP Category B laboratory data packages will be validated	As generated throughout project	Dennis Capria QA Coordinator, ARCADIS	Doug Weeks Project Manager, ARCADIS Katie Bidwell Task Manager/Field Team Leader, ARCADIS

Quality Assurance Project Plan Worksheet #34 – Verification (Step I) Process

Verification Input	Description	Internal/External	Responsible for Verification (name, organization)
Chain-of-custody and shipping forms	Chain-of-custody forms and shipping documentation will be reviewed by the laboratory upon receipt of samples for verification against the sample coolers they represent. Chain-of-custody form will be signed by all parties that had custody of samples, with the exception of commercial carriers.	External	Alpha Analytical
Field notes and sampling logs	All field notes and sampling logs will be reviewed internally and placed in the project file.	Internal	Katie Bidwell Task Manager/Field Team Leader, ARCADIS
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal to ARCADIS.	Internal	Alpha Analytical
Laboratory data	All final data packages will be verified for content upon receipt.	External	Dennis Capria Quality Assurance (QA) Coordinator, ARCADIS

Quality Assurance Project Plan Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIa	Sampling methods and procedures	Establish that required sampling methods were used and that any deviations were noted. Provide that the sampling procedures and field measurements met performance criteria and that any deviations were documented.	Katie Bidwell Task Manager/Field Team Leader, ARCADIS
Step IIa	Analytical method and procedures	Establish that required analytical methods were used and that any deviations were noted. The laboratory will provide that QC samples met performance criteria and that any deviations were documented in the report narrative.	Alpha Analytical Dennis Capria Quality Assurance (QA) Coordinator, ARCADIS
Step IIa Modified	Analytical method and procedures	Review associated blanks for potential contamination and verify that all preparations and analyses have been performed within applicable holding times.	Dennis Capria QA Coordinator, ARCADIS
Step IIb	Documentation of QAPP QC sample results	Establish that all QAPP-required QC samples were collected and analyzed.	Dennis Capria QA Coordinator, ARCADIS

Quality Assurance Project Plan Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIb	Project quantitation limits	Determine that the project quantitation limits were achieved, as outlined in the QAPP.	Dennis Capria QA Coordinator, ARCADIS
Step IIb	Performance criteria	Evaluate QC data associated with the samples designated for intended uses stated in Worksheet #36 against project-specific performance criteria in the QAPP, laboratory Quality Assurance Manual and control criteria.	Dennis Capria QA Coordinator, ARCADIS
Step IIb	Validation Report	Summarize data verification and validation components included in the Performance Review. Include qualified data and explanation of all qualifiers.	Dennis Capria QA Coordinator, ARCADIS

Quality Assurance Project Plan Worksheet #36 – Validation (Steps IIa and IIb) Summary

Steps IIa and IIb	Matrix	Analytical Group	Data Purpose	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)[2]
IIa and IIb	Groundwater	6 NYCRR Part 360 Baseline Parameters: alkalinity, ammonia, biochemical oxygen demand (BOD), bromide, chemical oxygen demand (COD), chloride, color, hardness, nitrate, sulfate, total Kjeldahl nitrogen (TKN), cyanide, total organic carbon (TOC), total dissolved solids (TDS), phenolics, metals[3], hexavalent chromium, mercury, and volatile organic compounds (VOCs)	Monitor groundwater conditions and assess performance of the remedy	Low	*USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, October 2004; method criteria; laboratory control limits; QAPP criteria; and professional judgment	Dennis Capria QA Coordinator, ARCADIS

Quality Assurance Project Plan Worksheet #36 – Validation (Steps IIa and IIb) Summary

Steps IIa and IIb	Matrix	Analytical Group	Data Purpose	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)[2]
IIa and IIb	Surface Water	6 NYCRR Part 360 Baseline Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, color, hardness, nitrate, sulfate, TKN, cyanide, TOC, TDS, phenolics, metals[3], hexavalent chromium, mercury, and VOCs 6 NYCRR Part 360 Routine Parameters (one event per year): alkalinity, ammonia, BOD, bromide, COD, chloride, hardness, nitrate, sulfate, TKN, TOC, TDS, phneolics, and metals[4]	Monitor surface water conditions in Mathew Creek	All	*USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, October 2004; method criteria; laboratory control limits; QAPP criteria; and professional judgment	Dennis Capria QA Coordinator, ARCADIS

Quality Assurance Project Plan Worksheet #36 – Validation (Steps IIa and IIb) Summary

Steps IIa and IIb	Matrix	Analytical Group	Data Purpose	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)[2]
IIa and IIb	Sediment	Target analyte list (TAL) metals[5] and TOC	Monitor sediment conditions in Mathew Creek	All	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, October 2004; method criteria; laboratory control limits; QAPP criteria; and professional judgment	Dennis Capria QA Coordinator, ARCADIS

Note:

[1] The October 1999 Organics National Functional Guidelines (NFG) and October 2004 Inorganics NFG will be used to validate the data since the Organic Low-Medium (OLM) and Inorganic Low-Medium (ILM) analytical methods referenced in these documents most closely parallel the data quality indicator requirements of the SW846 organic and inorganic methods. There are many differences in the Inorganic Superfund Methods (ISM) and Superfund Organic Methods (SOM) analytical methods referenced in the newer NFG which are not applicable to the SW846 methods.

[2] Data validation will be performed by a third party data validator. The ARCADIS QA Coordinator will oversee the data validator and review the Data Usability Summary Report.

[3] 6 NYCRR Part 360 Baseline metals include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[4] 6 NYCRR Part 360 Routine metals include: cadmium, calcium, chromium, iron, lead, magnesium, manganese, potassium, and sodium.

[5] TAL metals include: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The Data Usability Assessment will be performed by ARCADIS for data associated with the Site Management Plan at the Johnstown Landfill. Documentation generated during the Data Usability Assessment will consist of data validation checklists with a brief summary of overall data usability.

The Data Usability Assessment process involves data verification and validation. Data verification is the process by which laboratory results are checked to provide that the proper QC steps were performed and key items have met QC objectives (both analytical and contractual). Key steps of an ARCADIS data verification include:

- identifying sample collection, handling and analysis procedures
- documenting handling and analysis activities (e.g., QC checklist)
- verifying (internally, at the data generator level) all sampling, handling, on-site analytical laboratory data
- verifying laboratory data (e.g., laboratory-qualified data)
- verifying sampling, on-site analytical laboratory data
- verifying data package deliverable completeness
- reviewing the case narrative
- presenting all analytical results
- summarizing QC sample data
- evaluating applicable raw data

All required data deliverables must be present in the data package in order to proceed to the next step of data validation.

Data validation entails a review of the sample collection, handling, QC data, and the raw data to verify that the laboratory was operating within required limits, analytical results were correctly transcribed from the instrument read-outs and which (if any) environmental samples were related to out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The data quality indicators (DQIs) used to evaluate conformance with the project data quality objectives (DQOs) are presented below.

DQIs are generally defined in terms of six parameters:

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this QAPP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP, established QA/QC procedures and use of appropriately trained personnel.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QAPP. Checks for analytical precision will include the analysis of MS/MSDs, laboratory duplicates and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the RPD by the following equation:

$$\text{RPD} = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements.
B = Analytical result from the second measurement.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard.
X = Value measured in original sample.
B = True value of amount added to sample or true value of standard.

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated method detection limits (MDLs) can satisfy the project requirements as they relate to the project action limits. MDLs are updated annually by the laboratory. The current MDLs for the analytical laboratories are presented in Worksheet #15.

Data Validation and Usability

Laboratory analytical data will be validated using the USEPA's National Functional Guidelines (Organics October 1999 and Inorganics July 2002) as guidance, where appropriate. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits and procedures. Data validation will consist of data screening, checking, reviewing, editing and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from those specified in this QAPP will be detailed on COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package.
- Verify that field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the methods specified.
- Review QA/QC data (i.e., confirm that duplicates, blanks and spikes were analyzed on the required number of samples, as specified in the method and verify that duplicate and MS recoveries are acceptable).
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate.
- If data appear suspect, investigate the specific data of concern. Calculations will be traced back to raw data. If calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each method:

- assessment of the data package
- description of any protocol deviations

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

- failures to reconcile reported and/or raw data
- assessment of any compromised data
- overall appraisal of the analytical data
- table of site name, sample quantities, matrix and fractions analyzed

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without QC qualifiers. Qualified data can provide useful information.

During the review process, laboratory qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted or modified by the data reviewer. Results will be qualified with the following codes in accordance with the USEPA National Functional Guidelines:

Concentration (C) qualifiers:

U	The analyte/compound was analyzed for, but not detected. The associated value is the compound quantitation limit.
J	The reported value was obtained from a reading less than the required RL, but greater than or equal to the method detection limit.

Quantitation (Q) qualifiers:

Inorganics:

E	The reported value is estimated due to the presence of interference.
N	Spiked sample recovery not within control limits.
*	Duplicate analysis not within control limits.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Organics:

B	The compound has been found in the sample as well as its associated blank; its presence in the sample may be suspect.
N	The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification.
P	The lower of the two values is reported when the percent difference between the results of two GC columns is greater than 40 percent.
E	The compound was quantitated above the calibration range.
D	Concentration is based on a diluted sample analysis.
C	Identification confirmed by GC/MS.

Validation qualifiers:

J	Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.
U	The analyte was analyzed for, but was not detected above the level of the associated reported quantitation limit.
UB	Blank contamination: The analyte was found in an associated blank above one half the reporting limit, as well as in the sample.
UJ	The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.
R	The data are rejected due to deficiencies in meeting QC criteria and may not be used for decision making.

Two facts will be noted to all data users. First, the "R" flag means that the associated value is unusable. In other words, due to significant QC problems, the analysis is invalid and provides no information as to whether the compound is present or not. Analytes with "R" values should not appear on data tables because they cannot be relied upon for any reason. The second fact is that no compound concentration, even if it has passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

reanalysis may be made by the QA Manager at this point.

Validation Reports

The data validation reports will identify all deficiencies and the potential impact on the results. The ARCADIS QA Manager or designee will amend qualifiers generated during the validation process to the database. The validation checklists and the database will be the primary location of all applicable data qualifiers. Qualifiers will not be applied to the hard copy analytical reports.

Field Data Review

Field data are generated from in-field measurement, which may include a geophysical survey, well development and groundwater sampling. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including aqueous pH, conductivity, temperature, turbidity and dissolved oxygen, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed by ARCADIS Field Managers with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections.

Reconciliation with Data Usability Requirements

Data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Data that has been rejected will not be used. Data that has been qualified but not rejected will be considered useable (i.e., qualified as estimated) and definitive data. If there is an instance where further limitations must be placed on qualified data, the data will be additionally qualified with “X.” This would indicate that the associated data is nondefinitive data and should be used for screening purposes only.

Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results or inconsistent data may include any or all of the following:

- retrieval of missing information

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken:

- additional sample collection and analysis

APPENDIX A – FIELD SAMPLING SOPs

Chain-of-Custody, Handling, Packing and Shipping

Rev. #: 2

Rev Date: March 6, 2009

Approval Signatures

Prepared by: Caron Koll Date: 3/6/09
Caron Koll

Reviewed by: Date: 3/6/09
Jane Kennedy(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the chain-of-custody, handling, packing, and shipping procedures for the management of samples to decrease the potential for cross-contamination, tampering, mis-identification, and breakage, and to insure that samples are maintained in a controlled environment from the time of collection until receipt by the analytical laboratory.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, Department of Transportation (DOT) training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following list provides materials that may be required for each project. Project documents and sample collection requirements should be reviewed prior to initiating field operations:

- indelible ink pens (black or blue);
- polyethylene bags (resealable-type);
- clear packing tape, strapping tape, duct tape;
- chain of custody
- DOT shipping forms, as applicable
- custody seals or tape;
- appropriate sample containers and labels,;
- insulated coolers of adequate size for samples and sufficient ice to maintain 4°C during collection and transfer of samples;
- wet ice;
- cushioning and absorbent material (i.e., bubble wrap or bags);

- temperature blank
- sample return shipping papers and addresses; and
- field notebook.

IV. Cautions

Review project requirements and select appropriate supplies prior to field mobilization.

Insure that appropriate sample containers with applicable preservatives, coolers, and packing material have been supplied by the laboratory.

Understand the offsite transfer requirements for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation. Prior to using air transportation, confirm air shipment is acceptable under DOT and International Air Transport Association (IATA) regulation

Schedule pick-up time for laboratory courier or know location of laboratory/service center and hours of operation.

Understand DOT and IATA shipping requirements and evaluate dangerous goods shipping regulations relative to the samples being collected (i.e. complete an ARCADIS shipping determination). Review the ARCADIS SOPs for shipping, packaging and labeling of dangerous goods. Potential samples requiring compliance with this DOT regulation include:

- Methanol preservation for Volatile Organic Compounds in soil samples
- Non-aqueous phase liquids (NAPL)

V. Health and Safety Considerations

Follow health and safety procedures outlined in the project/site Health and Safety Plan (HASP).

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

Some sample containers contain preservatives.

- The preservatives must be retained in the sample container and should in no instance be rinsed out.
- Preservatives may be corrosive and standard care should be exercised to reduce potential contact to personnel skin or clothing. Follow project safety procedures if spillage is observed.
- If sample container caps are broken discard the bottle. Do not use for sample collection.

VI. Procedure

Chain-of-Custody Procedures

1. Prior to collecting samples, complete the chain-of-custody record header information by filling in the project number, project name, and the name(s) of the sampling technician(s) and other relevant project information. Attachment 1 provides an example chain-o- custody record

2. Chain-of-custody information MUST be printed legibly using indelible ink (black or blue).

3. After sample collection, enter the individual sample information on the chain-of-custody:

   a. Sample Identification indicates the well number or soil location that the sample was collected from. Appropriate values for this field include well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain-of-custody form. DO NOT use the apostrophe or quotes in the sample ID. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively. NOTE: The sample nomenclature may be dictated by the project database and require unique identification for each sample collected for the project. Consult the project data management plan for additional information regarding sample identification.

b. List the date of sample collection. The date format to be followed should be mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).

c. List the time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. The composite field should be checked if the sample is a composite over a period of time or from several different locations and mixed prior to placing in sample containers.

e. The "Grab". field should be marked with an "X" if the sample was collected as an individual grab sample. (e.g. monitoring well sample or soil interval).

f. Any sample preservation should be noted.

g. The analytical parameters that the samples are being analyzed for should be written legibly on the diagonal lines. As much detail as possible should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering "PCBs" or "Method 8082." Multiple methods and/or analytical parameters may be combined for each column (e.g., PCBs/VOCs/SVOCs or 8082/8260/8270). These columns should also be used to present project-specific parameter lists (e.g., Appendix IX+3 target analyte list. Each sample that requires a particular parameter analysis will be identified by placing the number of containers in the appropriate analytical parameter column. For metals in particular, indicate which metals are required.

h. Number of containers for each method requested. This information may be included under the parameter or as a total for the sample based on the chain of custody form used.

i. Note which samples should be used for site specific matrix spikes.

j. Indicate any special project requirements.

k. Indicate turnaround time required.

l. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory.

m. If available attach the Laboratory Task Order or Work Authorization forms

n. The remarks field should be used to communicate special analytical requirements to the laboratory. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG). Reporting requirements that should be specified in the remarks column include: 1) turnaround time; 2) contact and address where data reports should be sent; 3) name of laboratory project manager; and 4) type of sample preservation used.

o. The “Relinquished By” field should contain the signature of the sampling technician who relinquished custody of the samples to the shipping courier or the analytical laboratory.

p. The “Date” field following the signature block indicates the date the samples were relinquished. The date format should be mm/dd/yyyy (e.g., 03/07/2005).

q. The “Time” field following the signature block indicates the time that the samples were relinquished. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

r. The “Received By” section is signed by sample courier or laboratory representative who received the samples from the sampling technician or it is signed upon laboratory receipt from the overnight courier service.

3. Complete as many chain-of-custody forms as necessary to properly document the collection and transfer of the samples to the analytical laboratory.

4. Upon completing the chain-of-custody forms, forward two copies to the analytical laboratory and retain one copy for the field records.

5. If electronic chain-of-custody forms are utilized, sign the form and make 1 copy for ARCADIS internal records and forward the original with the samples to the laboratory.

Handling Procedures

1. After completing the sample collection procedures, record the following information in the field notebook with indelible ink:
    - project number and site name;
    - sample identification code and other sample identification information, if appropriate;
    - sampling method;
    - date;
    - name of sampler(s);
    - time;
    - location (project reference);
    - location of field duplicates and both sample identifications;
    - locations that field QC samples were collected including equipment blanks, field blanks and additional sample volume for matrix spikes; and
    - any comments.
2. Complete the sample label with the following information in indelible ink:
    - sample type (e.g., surface water);
    - sample identification code and other sample identification information, if applicable;
    - analysis required;
    - date;
    - time sampled; and
    - initials of sampling personnel;

- sample matrix; and
- preservative added, if applicable.

3. Cover the label with clear packing tape to secure the label onto the container and to protect the label from liquid.

4. Confirm that all caps on the sample containers are secure and tightly closed.

5. In some instances it may be necessary to wrap the sample container cap with clear packing tape to prevent it from becoming loose.

6. For some projects individual custody seals may be required. Custody seal evidence tape may be placed on the shipping container or they may be placed on each sample container such that the cooler or cap cannot be opened without breaking the custody seal. The custody seal should be initialed and dated prior to relinquishing the samples.

Packing Procedures

Following collection, samples must be placed on wet ice to initiate cooling to 4°C immediately. Retain samples on ice until ready to pack for shipment to the laboratory.

1. Secure the outside and inside of the drain plug at the bottom of the cooler being used for sample transport with “Duct” tape.

2. Place a new large heavy duty plastic garbage bag inside each cooler

3. Place each sample bottle wrapped in bubble wrap inside the garbage bag. VOC vials may be grouped by sample in individual resealable plastic bags). If a cooler temperature blank is supplied by the laboratory, it should be packaged following the same procedures as the samples. If the laboratory did not include a temperature blank, do not add one. Place 1 to 2 inches of cushioning material (i.e., vermiculite) at the bottom of the cooler.

4. Place the sealed sample containers upright in the cooler.

5. Package ice in large resealable plastic bags and place inside the large garbage bag in the cooler. Samples placed on ice will be cooled to and maintained at a temperature of approximately 4°C.

6. Fill the remaining space in the cooler with cushioning material such as bubble wrap. The cooler must be securely packed and cushioned in an upright position and be surrounded (Note: to comply with 49 CFR 173.4, filled cooler must not exceed 64 pounds).

7. Place the completed chain-of-custody record(s) in a large resealable bag and tape the bag to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with packing tape.

9. Wrap strapping tape around both ends of the cooler.

10. Mark the cooler on the outside with the following information: shipping address, return address, “Fragile, Handle with Care” labels on the top and on one side, and arrows indicating “This Side Up” on two adjacent sides.

11. Place custody seal evidence tape over front right and back left of the cooler lid, initial and date, then cover with clear plastic tape.

Note: Procedure numbers 2, 3, 5, and 6 may be modified in cases where laboratories provide customized shipping coolers. These cooler types are designed so the sample bottles and ice packs fit snugly within preformed styrofoam cushioning and insulating packing material.

Shipping Procedures

1. All samples will be delivered by an express carrier within 48 hours of sample collection. Alternatively, samples may be delivered directly to the laboratory or laboratory service center or a laboratory courier may be used for sample pickup.

2. If parameters with short holding times are required (e.g., VOCs [EnCore™ Sampler], nitrate, nitrite, ortho-phosphate and BOD), sampling personnel will take precautions to ship or deliver samples to the laboratory so that the holding times will not be exceeded.

3. Samples must be maintained at 4°C±2°C until shipment and through receipt at the laboratory

4. All shipments must be in accordance with DOT regulations and ARCADIS dangerous goods shipping SOPs.

5. When the samples are received by the laboratory, laboratory personnel will complete the chain-of-custody by recording the date and time of receipt of samples, measuring and recording the internal temperature of the shipping container, and checking the sample identification numbers on the containers to ensure they correspond with the chain-of-custody forms.

Any deviations between the chain-of-custody and the sample containers, broken containers, or temperature excursions will be communicated to ARCADIS immediately by the laboratory.

VII. Waste Management

Not applicable

VIII. Data Recording and Management

Chain-of-custody records will be transmitted to the ARCADIS PM or designee at the end of each day unless otherwise directed by the ARCADIS PM. The sampling team leader retains copies of the chain-of-custody forms for filing in . the project file. Record retention shall be in accordance with project requirements.

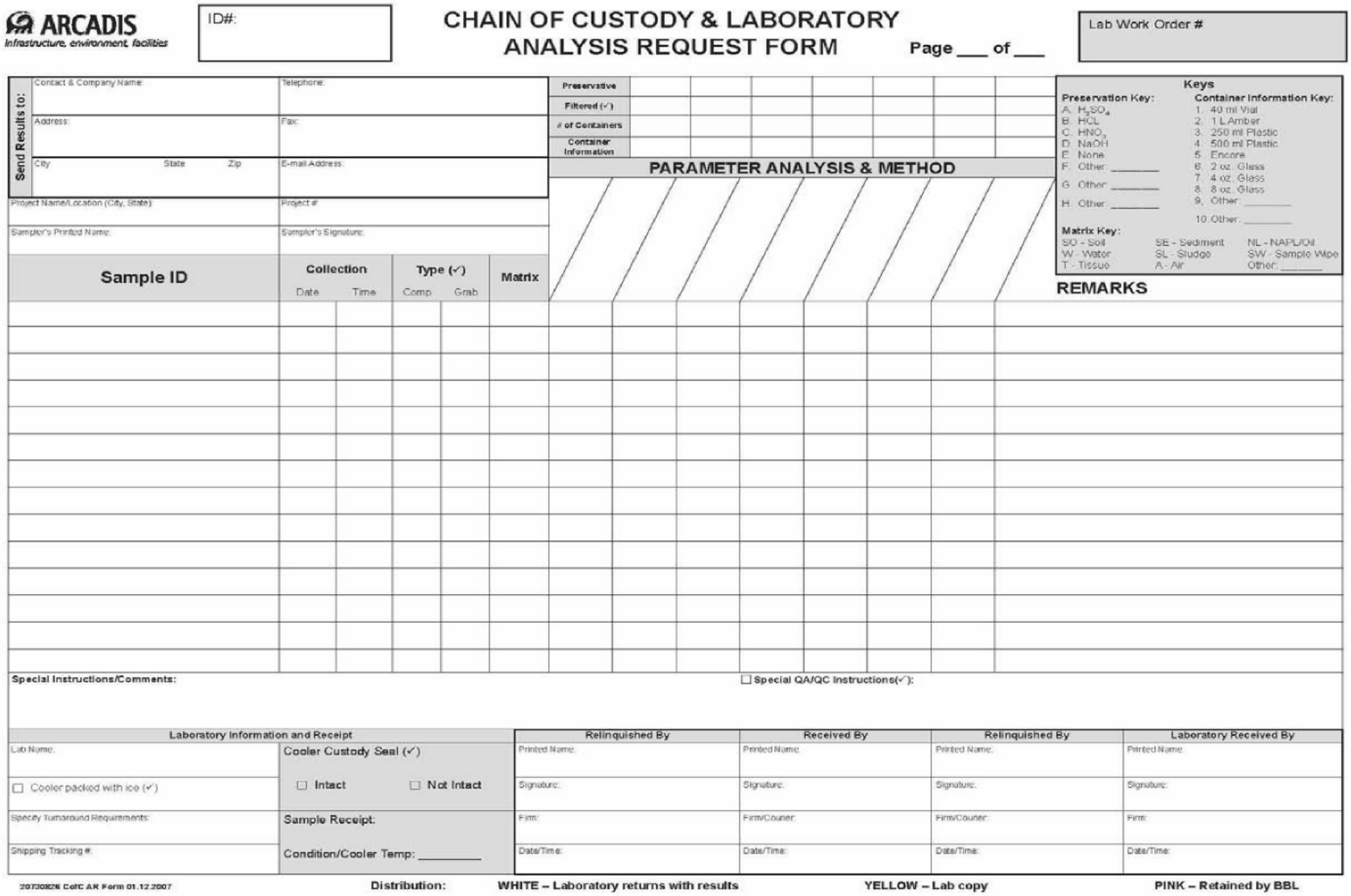
IX. Quality Assurance

Chain-of-custody forms will be legibly completed in accordance with the applicable project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents. A copy of the completed chain-of-custody form will be sent to the ARCADIS Project Manager or designee for review.

X. References

Not Applicable

Attachment 1



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ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name:	Telephone:
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ________
G. Other: ________
H. Other: ________

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ________
10. Other: ________

Matrix Key:

SO - Soil	SE - Sediment	NL - NAPL/Oil
W - Water	SL - Sludge	SW - Sample Wipe
T - Tissue	A - Air	Other: ______

Sample ID	Collection		Type (✓)		Matrix								REMARKS
	Date	Time	Comp	Grab									

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _________	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20070826 CofC AR Form 01.12.2007 **Distribution:** **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by BBL**

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Field Equipment Decontamination

Rev. #: 3

Rev Date: April 26, 2010

Approval Signatures

Prepared by: Keith Shepherd Date: 4/26/2010

Keith Shepherd

Reviewed by: Date: 4/26/2010

Richard Murphy (Technical Expert)

I. Scope and Application

Equipment decontamination is performed to ensure that sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that would interfere with laboratory analysis for analytes of interest. Equipment must be cleaned prior to use for sampling or contact with environmental media to be sampled, and prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling tools which will be conducted at an established equipment decontamination area (EDA) on site (as appropriate). Equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between sampling events, and prior to leaving the site. Cleaning procedures for sampling equipment will be monitored by collecting equipment blank samples as specified in the applicable work plan or field sampling plan. Dedicated and/or disposable (not to be re-used) sampling equipment will not require decontamination.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired fieldwork. The project HASP and other documents will identify any other training requirements such as site specific safety training or access control requirements.

III. Equipment List

- health and safety equipment, as required in the site Health and Safety Plan (HASP)
- distilled water

- Non-phosphate detergent such as Alconox or, if sampling for phosphorus phosphorus-containing compounds, Luminox (or equivalent).
- tap water
- rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan or field sampling plan (if decontamination waste is to be shipped for disposal)
- brushes
- large heavy-duty garbage bags
- spray bottles
- (Optional) – Isoprophyl alcohol (free of ketones) or methanol
- Ziploc-type bags
- plastic sheeting

IV. Cautions

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts.

If equipment is damaged to the extent that decontamination is uncertain due to cracks or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination will be performed by a DOT-trained individual for cleaning materials shipped by ARCADIS.

V. Health and Safety Considerations

Review the material safety data sheets (MSDS) for the cleaning materials used in decontamination. If solvent is used during decontamination, work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers. Follow health and safety procedures outlined in the HASP.

VI. Procedure

A designated area will be established to clean sampling equipment in the field prior to sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location exposed to combustion engine exhaust. Detergent solutions will be prepared in clean containers for use in equipment decontamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.

2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.

3. If equipment is very dirty, precleaning with a brush and tap water may be necessary.

4. (Optional) – Flush with isopropyl alcohol (free of ketones) or with methanol. This step is optional but should be considered when sampling in highly impacted media such as non-aqueous phase liquids or if equipment blanks from previous sampling events showed the potential for cross contamination of organics.

5. Rinse with distilled/deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps will be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another contained filled with potable water. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock. Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

VII. Waste Management

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

VIII. Data Recording and Management

Equipment cleaning and decontamination will be noted in the field notebook. Information will include the type of equipment cleaned, the decontamination location and any deviations from this SOP. Specific factors that should be noted include solvent used (if any), and source of water.

Any unusual field conditions should be noted if there is potential to impact the efficiency of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the files. Records will be maintained for any solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

IX. Quality Assurance

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water over the clean and dry tools and collecting the deionized water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

X. References

USEPA Region 9, Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

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Measuring Basic Water Quality Parameters In-Situ

Rev. #: 01

Rev Date: March 17, 2004

Approval Signatures

Prepared by: ______________________________ Date: ________________________

Reviewed by: ______________________________ Date: ________________________

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating a water quality meter. Temperature, pH, specific conductivity, dissolved oxygen, ORP, and turbidity of groundwater and surface water will be measured in-situ with a combination water quality meter (Horiba U22 or equivalent). This SOP describes equipment, field procedures, materials, and documentation procedures. Groundwater quality parameters will be measured in-situ during the collection of groundwater quality samples. This SOP should be followed in conjunction with the *Groundwater Monitoring Well Sampling Procedures* SOP.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the work plans or reports.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available during field measurement of water quality:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan

- Equipment decontamination supplies (See *Field Sampling Equipment Decontamination Procedures* SOP)

- Water quality meter, Horiba U22 or equivalent

- Replacement parts for the meter, including dissolved oxygen membrane

- Extra batteries

- Calibration/maintenance log(s)
- Calibration solutions
- Thermometer
- Distilled water
- Disposable plastic beakers
- Fine-end screw driver
- Field logbook.

IV. Cautions

Monitoring probes should not be placed in sample shipping containers to reduce the risk of contaminating a sample. A representative sub-sample should be used to measure the field water quality parameters.

Calibration standards must be stored properly. Check and replace all calibration standards per manufacturer suggestions to ensure accurate meter readings.

V. Health and Safety Considerations

Calibration solutions may contain hazardous chemicals. An MSDS should accompany all calibration solutions.

VI. Procedure

Calibration Procedures

The meter will be calibrated following the manufacturer’s instructions. Calibration information will be recorded in the field logbook and a calibration log will be completed.

Operation Procedures

The meter will be operated following the manufacturer’s instructions. Readings will be recorded in the field logbook.

Maintenance Procedures

The meter will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field notebook. A replacement meter and probes will be available on-site or ready for overnight shipment, as necessary.

VII. Waste Management

Rinse water, PPE, and other residual material generated during the equipment decontamination will be placed in appropriate containers. Containerized waste and calibration solutions will be disposed of consistent with appropriate procedures as outlined in the *Handling and Storage of Investigation-Derived Waste* SOP.

VIII. Data Recording and Management

Field parameters will be recorded on the Low Flow Groundwater Monitoring Purge Log and in the field logbook for three-volume groundwater sampling in accordance with the specifications outlined in the *Quality Assurance Project Plan*.

All readings taken, calibration procedures, calibration checks, and adjustments will be documented in the field logbook. In addition, a calibration log will be completed for each day in which these procedures were conducted. These logs will be filed in the Laboratory Calibration Log Book.

All readings taken and adjustments made during calibrations and calibration checks will be recorded in the field notebook, along with the date and time at which the procedure was completed. The serial number of the meter and calibration solutions shall be recorded if applicable.

IX. Quality Assurance

Groundwater quality parameters should be measured prior to sample collection. If down-hole water quality meters are used, they will be decontaminated as specified in the *Field Sampling Equipment Decontamination Procedures* SOP (CalEPA, 1995).

X. References

California Environmental Protection Agency (CalEPA). 1995. *Representative Sampling of Groundwater for Hazardous Substances.* Guidance Manual for Ground Water Investigations. July 1995.

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Field Log Book Entries

Rev. #: 0

Rev Date: 11 August 2009

Approval Signatures

Prepared by: Andrew Kanik Date: 8/11/09

Reviewed by: Michael J Gefell Date: 8/11/09
(Technical Expert)

I. Scope and Application

This ARCADIS Standard Operating Procedure covers the entries needed in a field log book for environmental investigations.

This SOP does not address all of the entries that may be needed for a specific project, and does not address health and safety, equipment decontamination, field parameter measurements, sample preservation, chain-of-custody, or laboratory analysis. For direction on requirements in these areas, refer to other ARCADIS SOPs, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan, as appropriate.

II. Personnel Qualifications

ARCADIS personnel participating in fieldwork and making entries into the field log book should have a minimum of one (1) year of field experience (or be under the supervision and accompanied in the field by someone who does) and current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. Field personnel will also be compliant with client-specific training requirements. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

- Field Log Book
- Ball point (medium point) pen with blue or black ink (black preferred). A fine point Sharpie pen may be used if the ink does not bleed through the page and become visible on back side of the page. If weather conditions prevent the use of a pen, indicate so in the log and use an alternate writing instrument .
- Zip-lock baggie or other weather-proof container to protect the field log book from the elements.

IV. Cautions

All entries in the field log must be legible and archivable. Do not leave the field log book exposed to the elements or other conditions that might moisten the pages and smear/dissolve the entries. When not in the field, the log book should be stored in a location that is easily accessible to field crews.

V. Health and Safety Considerations

ARCADIS field personnel will be familiar and compliant with Client-specific health and safety requirements.

VI. Procedure

- Print legibly. Do not use cursive writing.

- The name of the project, project number and project location should be written in indelible ink on the outside of the field log book.

- On the inside of the front cover, write “If Found, Please Return to ARCADIS” and include the appropriate address and phone number, the name of the person to which the book is assigned, and the name of the project manager.

- Reserve the first page of the book for a Table of Contents.

- Reserve the last five (5) pages of the book for important contacts, notes, reminders, etc.

- Each day of field work, the following should be recorded in the field log book as applicable:

  a) Project Name

  b) Date and time arrived

  c) Work Site Location

  d) Names of people on-site related to the project including ARCADIS employees, visitors, subcontractor employees, agency personnel, client representative, etc.

  e) Describe the work to be performed briefly, and list the equipment on-site

  f) Indicate the health and safety (H&S) level to be used

  g) Record instrument calibrations and checks

  h) Record time and general content of H&S briefing

  i) Describe the weather conditions, including temperature, precipitation, and wind speed and direction

  j) List periodic time entries in the far left hand column of each page

  k) Minimize unused space on each page

- The tailgate meeting must be recorded in the log book and the tailgate form completed. If H&S monitoring is performed, record the time and results of initial and followup monitoring.

- Note factual observations including collection of QA/QC samples, delays, well damage, accidents, work plan deviations, instrument problems, and problem resolutions.

- Describe work performed and how documented such as photographs, sample core logs, water sampling logs, etc.

- Describe bases for field decisions including pertinent conversations with visitors, regulators, or project personnel.

- Note final instrument calibrations and checks.

- Sign the log book at the end of each day at a minimum. Draw a line to the end of the page to indicate no further entries on that page. Sign the bottom of each page if possible.

- If an entry to the log book is changed, strike out the deleted text or item with a single line such that the entry remains legible, and initial and date the change. Such changes should only be made by the same person that made the initial entry.

- Field log book entries must be made in the field at the site, not at a later time at a different location. Supplemental entries to the log book may be made at a later date. The supplemental entry must be clearly identified as such and the entry must be signed and dated as described in this SOP.

- Problems noted in the field log book must be brought to the attention of the project manager and task manager in a timely fashion. Problems may be reported in person, on the telephone, or in a written daily log form. If daily logs are prepared and you will not be able to personally give the daily log to the project manager, send the daily log via FAX or overnight courier to the project manager and task manager.

VII. Waste Management

Investigation-derived waste will be managed as described in the Investigation-Derived Waste Handling and Storage SOP. A drum/waste inventory should be maintained on a pre-designated page in the field log book.

VIII. Data Recording and Management

Each page of the field log book should be scanned for electronic/digital archiving at periodic intervals. This will ensure that copies of the field notes are available in the event the field book is lost or damaged, and that field data can be easily disseminated to others without the risk of physically sending the field log book. Field log books that are full should be archived with the project files, and readily retrievable.

IX. Quality Assurance

Be mindful that the field log book may be produced in court. All entries should be legible (as discussed above). Entries should also be in English, unless working in a country where English is not the predominant language or you are directed otherwise by the project manager.

X. References

<u>Not Applicable</u>

Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells

Rev. #: 4

Rev Date: February 2, 2011

Approval Signatures

Prepared by: David S. Lipson Date: 2/2/2011

Reviewed by: Michael J Gefell Date: 2/2/2011
(Technical Expert)

I. Scope and Application

Groundwater samples will be collected from monitoring wells to evaluate groundwater quality. The protocol presented in this standard operating procedure (SOP) describes the procedures to be used to purge monitoring wells and collect groundwater samples. This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA SOP No. GW0001; July 30, 1996). Both filtered and unfiltered groundwater samples may be collected using this low-flow sampling method. Filtered samples will be obtained using a 0.45-micron disposable filter. No wells will be sampled until well development has been performed in accordance with the procedures presented in the SOP titled Monitoring Well Development, unless that well has been sampled or developed within the prior 1-year time period. Groundwater samples will not be collected within 1 week following well development.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading groundwater sample collection activities should have a minimum of 2 years of previous groundwater sampling experience. ARCADIS personnel providing assistance to groundwater sample collection and associated activities should have a minimum of 6 months of related experience or an advanced degree in environmental sciences, engineering, hydrogeology, or geology.

The supervisor of the groundwater sampling team will have at least 1 year of previous supervised groundwater sampling experience.

Prior to mobilizing to the field, the groundwater sampling team should review and be thoroughly familiar with relevant site-specific documents including but not limited to the site work plan, field sampling plan, QAPP, HASP, and historical information. Additionally, the groundwater sampling team should review and be thoroughly familiar with documentation provided by equipment manufacturers for all equipment that will be used in the field prior to mobilization.

III. Equipment List

Specific to this activity, the following materials (or equivalent) will be available:

- Health and safety equipment (as required in the site Health and Safety Plan [HASP]).

- Site Plan, well construction records, prior groundwater sampling records (if available).
- Sampling pump, which may consist of one or more of the following:
    - submersible pump (e.g., Grundfos Redi-Flo 2);
    - peristaltic pump (e.g., ISCO Model 150); and/or
    - bladder pump (e.g., Marschalk System 1, QED Well Wizard, Geotech, etc.).
- Appropriate controller and power source for pump:
    - Submersible and peristaltic pumps require electric power from either a generator or a deep cell battery.
    - Submersible pumps such as Grundfos require a pump controller to run the pump
    - Bladder pumps require a pump controller and a gas source (e.g., air compressor or compressed N_2 or CO_2 gas cylinders).
- Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used. For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will also be used through the pump apparatus.
- Water-level probe (e.g., Solinist Model 101).
- Water-quality (temperature/pH/specific conductivity/ORP/turbidity/dissolved oxygen) meter and flow-through measurement cell. Several brands may be used, including:
    - YSI 6-Series Multi-Parameter Instrument;
    - Hydrolab Series 3 or Series 4a Multiprobe and Display; and/or
    - Horiba U-10 or U-22 Water Quality Monitoring System.
- Supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020). Turbidity measurements collected with multi-parameter meters have been shown to sometimes be unreliable due to fouling of the optic lens of the

turbidity meter within the flow-through cell. A supplemental turbidity meter will be used to verify turbidity data during purging if such fouling is suspected. Note that industry improvements may eliminate the need for these supplemental measurements in the future.

- Appropriate water sample containers (supplied by the laboratory).
- Appropriate blanks (trip blank supplied by the laboratory).
- 0.45-micron disposable filters (if field filtering is required).
- Large glass mixing container (if sampling with a bailer).
- Teflon® stirring rod (if sampling with a bailer).
- Cleaning equipment.
- Groundwater sampling log (attached) or bound field logbook.

Note that in the future, the client may acquire different makes/models of some of this equipment if the listed makes/models are no longer available, or as a result of general upgrades or additional equipment acquisitions. In the event that the client uses a different make/model of the equipment listed, the client will use an equivalent type of equipment (e.g., pumps, flow-through analytical cells) and note the specific make/model of the equipment used during a sampling event on the groundwater sampling log. In addition, should the client desire to change to a markedly different sampling methodology (e.g., discrete interval samplers, passive diffusion bags, or a yet to be developed technique), the client will submit a proposed SOP for the new methodology for USEPA approval prior to implementing such a change.

The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment will be serviced by a qualified technician.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area and monitoring well can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate groundwater samples.

Do not use permanent marker or felt-tip pens for labels on sample container or sample coolers – use indelible ink. The permanent markers could introduce volatile constituents into the samples.

It may be necessary to field filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to impacted based on previous analytical data. If no analytical data are available, samples are collected in order of upgradient, then furthest downgradient to source area locations.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over-tightening can cause the glass to shatter or impair the integrity of the Teflon seal.

V. Health and Safety Considerations

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting.

Use caution when removing well caps as well may be under pressure, cap can dislodge forcefully and cause injury.

Use caution when opening protective casing on stickup wells as wasps frequently nest inside the tops of the covers. Also watch for fire ant mounds near well pads when sampling in the south or western U.S.

VI. Procedure

Groundwater will be purged from the wells using an appropriate pump. Peristaltic pumps will initially be used to purge and sample all wells when applicable. If the depth to water is below the sampling range of a peristaltic pump (approximately 25 feet), submersible pumps or bladder pumps will be used provided the well is constructed with a casing diameter greater than or equal to 2 inches (the minimum well diameter capable of accommodating such pumps). Bladder pumps are preferred over peristaltic and submersible pumps if sampling of VOCs is required to prevent volatilization. For smaller diameter wells where the depth to water is below the sampling range of a peristaltic pump, alternative sampling methods (i.e., bailing or small diameter bladder pumps) will be used to purge and sample the groundwater. Purge water will be collected and containerized.

1. Calibrate field instruments according to manufacturer procedures for calibration.

2. Measure initial depth to groundwater prior to placement of pumps.

3. Prepare and install pump in well: For submersible and non-dedicated bladder pumps, decontaminate pump according to site decontamination procedures. Non-dedicated bladder pumps will require a new Teflon® bladder and attachment of an air line, sample discharge line, and safety cable prior to placement in the well. Attach the air line tubing to the air port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Care should be taken not to reverse the air and discharge tubing lines during bladder pump set-up as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on pump model used). Slowly lower pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Take care to avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering pump into well; twisted and tangled lines could result in the pump becoming stuck in the well casing. Also, make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well as this could lead to well contamination. If a peristaltic pump is being used, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

4. If using a bladder pump, connect the air line to the pump controller output port. The pump controller should then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Take care to tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon tape may be used on the threads of the cylinder to provide a tighter seal. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow. Turn on the pump controller if an on/off switch is present and verify that all batteries are charged and fully operating before beginning to pump.

5. Connect the pump discharge water line to the bottom inlet port on the flow-through cell connected to the water quality meter.

6. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters (mL) per minute (or at lower site-specific rate if specified). The pump rate should be adjusted to cause little or no water level drawdown in the well (less than 0.3 feet below the initial static depth to water measurement) and the water level should stabilize. The water level should be monitored every 3 to 5 minutes (or as appropriate, lower flow rates may require longer time between readings) during pumping if the well diameter is of sufficient size to allow such monitoring. Care should be taken not to break pump suction or cause entrainment of air in the sample. Record pumping rate adjustments and depths to water. If necessary, pumping rates should be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to stabilize indicator parameters. A steady flow rate should be maintained to the extent practicable. Groundwater sampling records from previous sampling events (if available) should be reviewed prior to mobilization to estimate the optimum pumping rate and anticipated drawdown for the well in order to more efficiently reach a stabilized pumping condition.

   If the recharge rate of the well is very low, alternative purging techniques should be used, which will vary based on the well construction and screen position. For wells screened across the water table, the well should be pumped dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should be pumped until a stabilized level (which may be below the maximum displacement goal of 0.3 feet) can be maintained and monitoring for stabilization of field indicator parameters can commence. If a lower stabilization level cannot be maintained, the well should be pumped until the drawdown is at a level slightly higher than the bentonite seal above the well screen. Sampling should commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples.

   During purging, monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, pH, etc.) every 3 to 5 minutes (or as appropriate). Field indicator parameters will be measured using a flow-through analytical cell or a clean container such as a glass beaker. Record field indicator parameters on the groundwater sampling log. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain within 3%, ORP readings remain within ± 10 mV and pH remains within 0.1 units for three consecutive readings collected at 3- to 5-minute intervals (or other appropriate interval, alternate stabilization goals may exist in different geographic regions, consult the site-specific Work Plan for stabilization criteria). If the field indicator parameters do not stabilize within 1 hour of the start of purging, but the groundwater turbidity is below the goal of 50 NTU and the values for all other parameters are within 10%, the well can be sampled. If the parameters have stabilized but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to a minimum rate of 100 mL/min to reduce turbidity levels as low as possible. Dissolved oxygen is extremely susceptible to various external influences (including temperature or the presence of bubbles on the DO meter); care should be taken to minimize the agitation or other disturbance of water within the flow-through cell while collecting these measurements. If air bubbles are present on the DO probe or in the discharge tubing, remove them before taking a measurement. If dissolved oxygen values are not within acceptable range for the temperature of groundwater (Attachment 1), then again check for and remove air bubbles on probe before re-measuring. If the dissolved oxygen value is 0.00 or less, then the meter should be serviced and re-calibrated. If the dissolved oxygen values are above possible results, then the meter should be serviced and re-calibrated.

During extreme weather conditions, stabilization of field indicator parameters may be difficult to obtain. Modifications to the sampling procedures to alleviate these conditions (e.g., measuring the water temperature in the well adjacent to the pump intake) will be documented in the field notes. If other field conditions exist that preclude stabilization of certain parameters, an explanation of why the parameters did not stabilize will also be documented in the field logbook.

7. Complete the sample label(s) and cover the label(s) with clear packing tape to secure the label onto the container.

8. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container. If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell. When the container is full, tightly screw on the cap. Samples should be collected in the following order: VOCs, TOC, SVOCs, metals and cyanide, and others (or other order as defined in the site-specific Work Plan).

9. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Install an in-line, disposable 0.45-micron particle filter on the discharge tubing after the appropriate unfiltered groundwater sample has been collected. Continue to run the pump until an initial volume of “flush” water has been run through the filter in accordance with the manufacturer’s directions (generally 100 to 300 mL). Collect filtered groundwater sample by diverting flow

out of the filter into the appropriately labeled sample container. When the container is full, tightly screw on the cap.

10. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

11. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the stabilized field indicator parameters as measured during the final reading during purging (Attachment 2 – Example Sampling Log).

12. Turn off the pump and air compressor or close the gas cylinder valve if using a bladder pump set-up. Slowly remove the pump, tubing, lines, and safety cable from the well. Do not allow the tubing or lines to touch the ground or any other surfaces which could contaminate them. .

13. If tubing is to be dedicated to a well, it should be folded to a length that will allow the well to be capped and also facilitate retrieval of the tubing during later sampling events. A length of rope or string should be used to tie the tubing to the well cap. Alternatively, if tubing and safety line are to be saved and reused for sampling the well at a later date they may be coiled neatly and placed in a clean plastic bag that is clearly labeled with the well ID. Make sure the bag is tightly sealed before placing it in storage.

14. Secure the well and properly dispose of personal protective equipment (PPE) and disposable equipment.

15. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

16. Complete decontamination procedures for flow-through analytical cell and submersible or bladder pump, as appropriate.

17. At the end of the day, perform calibration check of field instruments.

If it is not technically feasible to use the low-flow sampling method, purging and sampling of monitoring wells may be conducted using the bailer method as outlined below:

1. Don appropriate PPE (as required by the HASP).

2. Place plastic sheeting around the well.

3. Clean sampling equipment.

4. Open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field log. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the breathing zone reading is less than 5 PID units, proceed. If the PID reading in the breathing zone is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings. For wells that are part of the regular weekly monitoring program and prior PID measurements have not resulted in a breathing zone reading above 5 PID units, PID measurements will be taken monthly.

5. Measure the depth to water and determine depth of well by examining drilling log data or by direct measurement. Calculate the volume of water in the well (in gallons) by using the length of the water column (in feet), multiplying by 0.163 for a 2-inch well or by 0.653 for a 4-inch well. For other well diameters, use the formula:

   Volume (in gallons) = π TIMES well radius (in feet) squared TIMES length of water column (in feet) TIMES 7.481 (gallons per cubic foot)

6. Measure a length of rope or twine at least 10 feet greater than the total depth of the well. Secure one end of the rope to the well casing and secure the other end to the bailer. Test the knots and make sure the rope will not loosen. Check bailers so that all parts are intact and will not be lost in the well.

7. Lower bailer into well and remove one well volume of water. Contain all water in appropriate containers.

8. Monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, and pH). Measure field indicator parameters using a clean container such as a glass beaker or sampling cups provided with the instrument. Record field indicator parameters on the groundwater sampling log.

9. Repeat Steps 7 and 8 until three or four well volumes have been removed. Examine the field indicator parameter data to determine if the parameters have stabilized. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain

within 3%, and pH remains within 0.1 units for three consecutive readings collected once per well volume removed.

10. If the field indicator parameters have not stabilized, remove a maximum of five well volumes prior to sample collection. Alternatively, five well volumes may be removed without measuring the field indicator parameters.

11. If the recharge rate of the well is very low, wells screened across the water table may be bailed dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should only be bailed down to a level slightly higher than the bentonite seal above the well screen. The well should not be bailed completely dry, to maintain the integrity of the seal. Sampling should commence as soon as the well volume has recovered sufficiently to permit sample collection.

12. Following purging, allow water level in well to recharge to a sufficient level to permit sample collection.

13. Complete the sample label and cover the label with clear packing tape to secure the label onto the container.

14. Slowly lower the bailer into the screened portion of the well and carefully retrieve a filled bailer from the well causing minimal disturbance to the water and any sediment in the well.

15. The sample collection order (as appropriate) will be as follows:

    a. VOCs;

    b TOC;

    c. SVOCs;

    d. metals and cyanide; and

    e. others.

16. When sampling for volatiles, collect water samples directly from the bailer into 40-mL vials with Teflon®-lined septa.

17. For other analytical samples, remove the cap from the large glass mixing container and slowly empty the bailer into the large glass mixing container. The

sample for dissolved metals and/or filtered PCBs should either be placed directly from the bailer into a pressure filter apparatus or pumped directly from the bailer with a peristaltic pump, through an in-line filter, into the pre-preserved sample bottle.

18. Continue collecting samples until the mixing container contains a sufficient volume for all laboratory samples.

19. Mix the entire sample volume with the Teflon® stirring rod and transfer the appropriate volume into the laboratory jar(s). Secure the sample jar cap(s) tightly.

20. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Sample filtration for the filtered sample will be performed in the field using a peristaltic pump prior to preservation. Install new medical-grade silicone tubing in the pump head. Place new Teflon® tubing into the sample mixing container and attach to the intake side of pump tubing. Attach (clamp) a new 0.45-micron filter (note the filter flow direction). Turn the pump on and dispense the filtered liquid directly into the laboratory sample bottles.

21. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

22. After sample containers have been filled, remove one additional volume of groundwater. Measure the pH, temperature, turbidity, and conductivity. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the field indicator parameters.

23. Remove bailer from well, secure well, and properly dispose of PPE and disposable equipment.

24. If a bailer is to be dedicated to a well, it should be secured inside the well above the water table, if possible. Dedicated bailers should be tied to the well cap so that inadvertent loss of the bailer will not occur when the well is opened.

25. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

VII. Waste Management

Materials generated during groundwater sampling activities, including disposable equipment, will be placed in appropriate containers. Containerized waste will be disposed of by the client consistent with the procedures identified in the HASP.

VIII. Data Recording and Management

Initial field logs and chain-of-custody records will be transmitted to the ARCADIS PM at the end of each day unless otherwise directed by the PM. The groundwater team leader retains copies of the groundwater sampling logs.

IX. Quality Assurance

In addition to the quality control samples to be collected in accordance with this SOP, the following quality control procedures should be observed in the field:

- Collect samples from monitoring wells in order of increasing concentration, to the extent known based on review of historical site information if available.

- Equipment blanks should include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well).

- Collect equipment blanks after wells with higher concentrations (if known) have been sampled.

- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.

- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well using procedures for equipment decontamination.

X. References

United States Environmental Protection Agency (USEPA). 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (September 1986).

USEPA Region II. 1998. *Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling*.

USEPA. 1991. Handbook Groundwater, Volume II Methodology, Office of Research and Development, Washington, DC. USEPN62S, /6-90/016b (July, 1991).

U.S. Geological Survey (USGS). 1977. National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination. Reston, Virginia.

Attachment 1

Groundwater Sampling Log

Attachment 2

Oxygen Solubility in Fresh Water

Temperature (degrees C)	**Dissolved Oxygen** (mg/L)
0	14.6
1	14.19
2	13.81
3	13.44
4	13.09
5	12.75
6	12.43
7	12.12
8	11.83
9	11.55
10	11.27
11	11.01
12	10.76
13	10.52
14	10.29
15	10.07
16	9.85
17	9.65
18	9.45
19	9.26
20	9.07
21	8.9
22	8.72
23	8.56
24	8.4
25	8.24
26	8.09
27	7.95
28	7.81
29	7.67
30	7.54
31	7.41
32	7.28
33	7.16
34	7.05
35	6.93

Reference: Vesilind, P.A., *Introduction to Environmental Engineering*, PWS Publishing Company, Boston, 468 pages (1996).

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Multiple Gas Air Monitoring and Field Screening

Rev. #: 0

Rev Date: July 20, 2003

Approval Signatures

Prepared by: ______________________________ Date: ________________________

Reviewed by: ______________________________ Date: ________________________
(Technical Expert)

Reviewed by: ______________________________ Date: ________________________
(Project Manager)

I. Scope and Application

Field screening with a one-to-five sensor instrument, such as a MultiRAE, is a procedure to measure relative concentrations of volatile organic compounds (VOCs), carbon monoxide, hydrogen sulfide, oxygen, and combustible gas, as well as other compounds. Characteristics of the MultiRAE are presented in Attachment 1. Field screening will be conducted on the following:

- Work area air to assess exposure to on-site workers of air contaminants via the air pathway;
- Well headspaces as a precautionary measure each time the well cover is opened; and
- Measuring ports of landfill gas monitoring locations.

II. Personnel Qualifications

User personnel should be familiar with monitor operation and read through the operation manual that is provided with the instrument in order to properly calibrate and operate the monitor.

III. Equipment List

The following materials, as required, shall be available while performing MultiRAE field screening:

- personal protective equipment (PPE), as required by the site Health and Safety Plan (HASP);
- MultiRAE Plus and operating manual;
- calibration canisters for the MultiRAE;
- sample jars;
- aluminum foil; and
- field notebook.

IV. Cautions

Alarm levels for the MultiRAE are as follows:

High - 3 beeps and flashes per second;

Low - 2 beeps and flashes per second; and

STEL and TWA - 1 beep and flash per second.

V. Health and Safety Considerations

Care should be taken when handling calibration gas cylinders as contents may be under pressure.

VI. Procedure

MultiRAE Calibration

MultiRAE field instruments contain an integrated photoionization detector (PID) which will be calibrated and operated to yield “total organic vapor” in parts per million (ppm) (v/v). Operation, maintenance, and calibration shall be performed in accordance with the manufacturer’s instructions and entered on the PID Calibration and Maintenance Log (Attachment 2).

1. Don PPE, as required by the HASP.

2. Hold the “Mode” key to turn on. Alarm will beep once. Warm-up will take approximately 90 seconds.

3. After the 90 second warm-up, the MultiRAE should display all of the installed sensors. If there is no alarm and the sensor readings are in the correct range, then the MultiRAE is ready for use. If the readings are outside the correct range, then perform a “Fresh air calibration.”

4. To calibrate the MultiRAE, hold the “Mode” and “N/-” keys for 5 seconds to get into the programming mode. Press “Y” or “N” at appropriate intervals and follow instructions on screen. When performing the “Fresh air calibration,” make sure that the air is clean.

5. To perform the “Multiple Sensor Calibration,” press “Y/+” at the appropriate screen. Attach the calibration gas regulator to the mixed gas cylinder and

attach calibration hose to MultiRAE. Turn on calibration gas. Follow instructions on screen. Disconnect regulator from gas cylinder when calibration is complete.

6. VOC can only be calibrated individually. At “Single Sensor Calibration,” press the “Y/+” key. Use “Mode” key to select VOC. Attach calibration gas regulator to VOC (isobutylene) cylinder. Attach calibration hose to MultiRAE and make sure it is tight. With cursor on VOC, press “Y/+” key. Turn on calibration gas. Follow instructions on screen. Repeat if necessary for other gases. Disconnect regulator.

7. Set the alarms at desired levels by pressing “Y/+” to accept default or “N/-” to move on. Press “Mode” to escape.

8. To power off, hold the “Mode” key for full 5 seconds. Leave MultiRAE on charger when not in use.

Work Area Air Monitoring Procedures

1. Measure and record the background PID and other gas readings.

2. Measure and record the breathing space readings.

Well Headspace Screening Procedures

1. Measure and record the background PID and other gas readings.

2. Unlock and open the well cover while standing upwind of the well.

3. Remove the well cap.

4. Place the MultiRAE probe approximately 6 inches above the top of the casing.

5. Record all MultiRAE readings and proceed in accordance with the HASP.

VII. Waste Management

To be completed by Preparer and reviewed by Technical Expert.

VIII. Data Recording and Management

The MultiRAE has datalogging capabilities. Up to 20,000 points can be downloaded to a PC with the serial number of unit, user ID, site number, and calibration date. The datalogging interval is programmable from 1 to 3,600 seconds. Direct readings can also be taken.

IX. Quality Assurance

After each use, the readout unit should be wiped down with a clean cloth or paper towel.

The external pre-filter should always be used. Replace when it looks very dirty or when the MultiRAE is in pump alarm with the filter on; and you can clear the pump alarm with the filter off.

X. References

RAE Systems MultiRAE Plus Data Sheet, revised 1-10/00.

RAE Systems “Using the MultiRAE Personal Multigas Monitor” training materials PowerPoint presentation, undated.

ATTACHMENT 1

Characteristics of the MultiRAE PID and Personal Multigas Monitor

I. Introduction

PIDs are used in the field to detect a variety of compounds in air. PIDs can be used to detect leaks of volatile substances in drums and tanks, to determine the presence of volatile compounds in soil and water, and to make ambient air surveys. If personnel are thoroughly trained to operate the instrument and to interpret the data, these PID instruments can be a valuable tool. Its use can help in deciding the level of protection to be worn, assist in determining the implementation of other safety procedures, and in determining subsequent monitoring or sampling locations. The MultiRAE serves as a PID as well as explosimeter, which detects Lower Explosive Limits (LEL), as well as other specified gases.

Portable MultiRAEs detect the concentration of organic gases, as well as percent oxygen, hydrogen sulfide, carbon monoxide, and others. The basis for detection is the ionization of gaseous species. The incoming gas molecules are subjected to UV radiation, which ionizes molecules that have an ionization potential (IP) less than or equal to that rated for the UV source. Every molecule has a characteristic IP, which is the energy required to remove an electron from the molecule, thus yielding a positively charged ion and the free electron. These ions are attracted to an oppositely charged electrode, causing a current and an electric signal to the LED display. Compounds are measured on a ppm volume basis, except for oxygen and LEL. Oxygen is measured as percentage by volume and combustible gas as percentage of LEL toxic gases.

II. MultiRAE or Equivalent PID

The integrated PID detects the concentration of organic gases, as well as a few inorganic gases. The basis for detection is the ionization of gaseous species. The incoming gas molecules are subjected to UV radiation, which is energetic enough to ionize many gaseous compounds. Each molecule is transformed into charged ion pairs, creating a current between two electrodes. Every molecule has a characteristic IP, which is the energy required to remove an electron from the molecule, yielding a positively charged ion and the free electron.

The PID probe consists of a 10.6 eV lamp standard. This probe detects many aromatic and large-molecule hydrocarbons. In addition, the 10.6 eV lamp detects some smaller organic molecules and some halogenated hydrocarbons. The primary PID calibration gas is isobutylene.

A protected catalytic bead is used for combustible gases. Interchangeable electrochemical sensors are used for oxygen and toxic gases.

III. Limitations

The MultiRAE instrument can monitor several vapors and gases in air. Unlike a single PID monitor, the MultiRAE can measure up to five different gases, thus providing a broader range of toxic gas detection.

The integrated PID instrument of the MultiRAE is generally not specific, and its response to different compounds is relative to the calibration gases. Instrument readings may be higher or lower than the true concentration. This effect can be observed when monitoring total contaminant concentrations if several different compounds are being detected at once. In addition, the response of these instruments is not linear over the entire detection range. Therefore, care must be taken when interpreting the data. Concentrations should be reported in terms of the calibration gas and span potentiometer.

MultiRAE monitors are small, portable instruments and may not yield results as accurate as laboratory instruments. They are relatively easy to use and interpret when detecting total concentrations of known contaminants in air, but interpretation becomes more difficult when trying to identify the individual components of a mixture. This instrument can be used as an indicator for combustible gases or oxygen deficiency.

ATTACHMENT 2

PID CALIBRATION AND MAINTENANCE LOG

Instrument Model Number

Instrument Serial Number

Calibration Gas

ppm

Date/Time	Initials	Battery Check	Calibration			
			Background Value	True Gas Value	Measured Gas Value	Adjust

COMMENTS:

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Sediment Sampling

Rev. #: 0

Rev Date: July 29, 2003

Approval Signatures

Prepared by: ______________________________ Date: ________________________

Reviewed by: ______________________________ Date: ________________________
(Technical Expert)

Reviewed by: ______________________________ Date: ________________________
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) sets forth the field procedures for collection of sediment via Lexan tubing and grab samples using a hand-held dredge.

II. Personnel Qualifications

To be completed by Preparer and reviewed by Technical Expert.

III. Equipment List

The following materials will be available, as required, during sediment sampling:

- health and safety equipment (as required by the site Health and Safety Plan [HASP]);
- cleaning equipment;
- disposable aluminum pans;
- disposable spatulas;
- appropriate sample containers and forms;
- coolers with ice;
- field notebook;
- anchor;
- boat and motor;
- rope;
- survey's rod;
- duct tape;
- Lexan tubing with end caps;
- push rod;

- hacksaw;
- steel core driver;
- vacuum pump;
- piston sampler/check valve push core device; and
- 6-foot rule.

IV. Cautions

To be completed by Preparer and reviewed by Technical Expert.

V. Health and Safety Considerations

To be completed by Preparer and reviewed by Technical Expert.

VI. Procedures

The following procedures will be used to collect sediment samples:

1. Don health and safety equipment (as required in the HASP).
2. Clean reusable sampling equipment as follows: non-phosphate detergent and distilled water wash; distilled water rinse; rinse equipment with solvent (hexane); distilled water rinse; allow to air dry and wrap in aluminum foil.
3. Use GPS surveying techniques to locate the proposed sample location and position the boat with anchors.
4. Identify the proposed sample location in the field notebook, along with other appropriate information collected during sediment sampling activities.
5. Measure the total depth of the water using a surveyor’s rod to the nearest 0.1 foot.
6. At each sample location, lower a section of Lexan tube until it just reaches the top of the sediment (sections of Lexan tube may need to be spliced together or the Lexan tube may be attached to a check valve core device).

7. Push the Lexan tube with a straight vertical entry into the sediment so as to secure a reliably representative core sample. Measure the depth of sediment.

8. Drive the tube several inches more using a steel core drive and measure the additional distance. (This procedure is performed to obtain a "plug" at the bottom of the core and prevent the loose sediment from escaping.)

9. Place a vacuum pump on the top end of the Lexan tube and create a vacuum to prevent the sediment from escaping (note this is not needed if using a check valve core device).

10. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

11. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

12. Keeping the tube upright, wipe the bottom end dry and seal the end with duct tape and label. Measure the length of sediment recovered and evaluate the integrity of the core. If additional cores are necessary to obtain a sufficient sample, repeat the coring procedure at the location adjacent to the previous one sampled.

13. While keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 1 inch above the sediment.

14. Recap the cut end of the tube, seal the cap with duct tape, and mark this end as "top."

15. Wipe the tube dry.

16. If sample sectioning is required, slice tube open or push sediment from tube and slice according to appropriate segmenting scheme (i.e., every 2 inches in cap material and 0 to 3 inches in native sediment).

17. Homogenize samples in a disposable aluminum pan.

18. Place homogenized sample in appropriate sample containers and cap.

19. Label all sample containers.

20. Place filled sample containers on ice in a cooler.

21. Follow procedures for packing, handling, and shipping with associated chain-of-custody procedures.

22. Record required information on the appropriate forms and/or field notebook.

23. Field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples will be obtained for every 20 sediment samples collected.

24. As an alternative sampling method, Steps 6 through 15 may be replaced with Steps a through g, as follows:

    a. At each sample location, drop open dredge from side of boat making sure that the end of the rope is maintained at all times.

    b. Once the dredge has been allowed to settle into the bottom sediment, a hard pull on the rope will close the sediment inside the dredge.

    c. Retrieve the dredge into the boat.

    d. Open the dredge to allow the sediment to empty onto a stainless steel tray or bowl.

    e. Multiple casts will be made and composited at each location until sufficient sample volume is obtained.

    f. Observe the sample and record descriptions in the field notebook.

    g. If chemical laboratory analyses are being performed, rinse blanks will be obtained by pouring deionized water through a cleaned stainless steel dredge onto a cleaned stainless steel tray. From the tray, the appropriate sample containers will be filled. Rinse blanks should be collected at the start and finish of sampling activities.

VII. Data Recording and Project Management

To be completed by Preparer and reviewed by Technical Expert.

VIII. Quality Assurance

To be completed by Preparer and reviewed by Technical Expert.

IX. References

To be completed by Preparer and reviewed by Technical Expert.

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Surface Water Sampling
Standard Operating Procedure

Rev. #: 0

Date: June 3, 2013

Approval Signatures

Prepared by: ______________________ Date: June 3, 2013
Jesse Starr

Reviewed by: Shannon Dunn Date: June 3, 2013
Shannon Dunn
(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the collection of surface water samples using a grab method, discrete depth sampler or peristaltic pump. This SOP should be followed whenever collecting surface water samples.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Manager.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field personnel will be versed in the relevant SOPs and will possess the skills and experience necessary to successfully complete the desired field work. The project Health and Safety Plan (HASP) and other documents will identify any other training requirements such as site-specific safety training or access control requirements.

III. Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required in the project Health and Safety Plan (HASP)
- project Quality Assurance Project Plan (QAPP)
- Sampling and Analysis Plan (SAP)
- indelible ink pens
- appropriate sample containers, labels, and forms
- decontamination supplies including bucket, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern.
- sample packing and shipping materials

- water-quality (temperature/pH/specific conductivity/ORP/turbidity/dissolved oxygen) meter and flow-through measurement cell. Several brands may be used, including:
  - YSI 6-Series Multi-Parameter Instrument
  - Hydrolab Series 3 or Series 4a Multiprobe and Display
  - Horiba U-10 or U-22 Water Quality Monitoring System
- for grab sampling method: pole with polyethylene and/or stainless steel dipper, if applicable
- for discrete depth sampling method: discrete depth samplers (e.g., Kemmerer or Van Dorn samplers)
- for peristaltic pump sampling method: peristaltic pump with appropriate power source, Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used. For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will also be used through the pump apparatus.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate surface water samples.

Do not use permanent marker or felt-tip pens for labels on sample container or sample coolers – use indelible ink. The permanent markers could introduce volatile constituents into the samples.

It may be necessary to field-filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over tightening can cause the glass to shatter or impair the integrity of the Teflon seal.

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

The ability to safely access the surface water sampling locations should be verified prior to sampling.

Field activities will be performed in accordance with a project-specific HASP, a copy of which will be present onsite during such activities.

Safety hazards associated with sampling surface water include fast-moving water, deep water, and steep slopes close to sampling sites. Extreme caution should be used when approaching sampling sites. Work will be performed in accordance with the project-specific HASP.

V. Procedure

Sampling Method

Surface water samples will be collected from sampling locations sequentially from downstream to upstream to prevent cross-contamination associated with sediment disturbance. Surface water samples will be collected prior to sediment sample collection.

Grab Sample Collection

Personnel conducting surface water sampling using grab sample collection techniques should perform the following:

1. Collect appropriate equipment, cleaned and decontaminated.

2. Obtain appropriate sampling containers.

3. Mobilize to surface water sampling location in accordance with the work plan or SAP.

4. Collect sample by directly lowering the laboratory-supplied sample container into the water and allowing the bottle to partially fill with water. The sampler will hold the bottle immediately below the water surface and allows the bottle to fill with sample. Field personnel will handle only the portions of the sample containers that do not come in contact with the sample, to avoid contamination. Additionally, care will be taken to avoid exposing samples and sample containers to atmospheric inputs such as dirt or dust.

5. Measure water quality parameters.

6. Transfer surface water samples into laboratory-supplied sample containers to complete the scope described in the SAP. Avoid overfilling sample containers to prevent preservatives, if present, in sample container from being lost.

Sample Collection Using a Discrete Depth Sampler (e.g., Kemmerer or Van Dorn)

Personnel conducting surface water sampling using grab sample collection techniques should perform the following:

1. Collect appropriate equipment, cleaned and decontaminated.
2. Obtain appropriate sampling containers.
3. Mobilize to surface water sampling location in accordance with the work plan or SAP.
4. Carefully set the sampling device so that water is allowed to pass through the tube.
5. Lower the pre-set sampling device to the predetermined depth using marked rope or line attached to the device.
6. When at desired depth; send down the messenger, closing the device. Avoid disturbing the bottom.
7. Retrieve sampler and discharge the first 10-20 mL to clear any potential cross-contamination.
8. Measure water quality parameters
9. Transfer surface water samples into laboratory-supplied sample containers to complete the scope described in the SAP. Avoid overfilling sample containers to prevent preservatives, if present, in sample container from being lost.
10. Pack and store samples appropriately for transport to laboratory.

Sample Collection Using Peristaltic Pump

Personnel conducting surface water sampling using peristaltic pump collection techniques should perform the following:

1. Surface water will be collected using a peristaltic pump if flow is slow and conventional sampling procedures are impossible without collecting excess

suspended sediment in the sample. Note any observations such as color or odors and determine the depth of water. Record the information in the field log book or field log forms.

2. Personnel should be aware that contact with peristaltic pump apparatus (e.g., control knobs) can serve as a source of metals contamination in dissolved metals analyses. Operation of pump controls should be conducted with gloves that do not come into contact with the sample or with materials that contact the sample.

3. Attach tubing to pump and configure tubing such that intake in positioned at the desired sample depth within the water column and discharge is into desired sample container.

4. Turn the pump on and adjust the flow rate as necessary to avoid splashing or overfilling.

5. Measure water quality parameters on a volume of sample that will not be shipped to the laboratory to avoid cross-contamination in the sample to be analyzed.

6. Collect surface water samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container.

- If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to surface water sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell.
- When the sample container is full, tightly screw on the cap.
- Samples should be collected in the following order: VOCs, TOC, SVOCs, metals and cyanide, and others (or other order as defined in the Sampling and Analysis Plan (SAP)).

7. Pack and store samples appropriately for transport to laboratory.

VI. Waste Management

Liquid investigation-derived wastes (IDWs), such decontamination liquids or excess surface water, will be collected into 55-gallon drums and may be transferred into large-volume polyethylene tanks with secondary containment pending treatment and/or disposal.

Non-aqueous liquid wastes, if generated (e.g., hexane, non-aqueous phase liquid [NAPL]), will be segregated and stored in appropriately sized buckets with secondary containment pending disposal.

PPE, soiled disposable items, and other trash will be stored in 55-gallon drums and stored on site pending disposal.

IDWs will be collected and stored on site in United States Department of Transportation (DOT)-compliant 55-gallon drums and/or large-volume tanks with secondary containment. Fifty-five-gallon drums and tanks will be labeled with DOT-compliant labels with the following information: drum contents, generator contact information, and date container was filled. IDWs known to be hazardous will be segregated and stored separately from non-hazardous IDWs. Solid IDWs will be segregated and stored separately from liquid IDWs.

IDWs will be sampled as needed for disposal characterization and stored on site pending treatment and/or disposal. IDWs may be managed in conjunction with remedial activities.

All IDWs will be stored in a secure onsite location pending treatment and disposal and/or discharge.

VII. Data Recording and Management

Record field data in field notebook and/or on field log sheets.

VIII. Quality Assurance

Sample quality will be achieved by complying with the procedures outlined in this SOP. Cross-contamination will be prevented by following standard decontamination protocols. Field activities will be supervised by appropriate experienced field supervisors. Additional quality assurance information is presented in the project-specific Quality Assurance Project Plan.

Investigation-Derived Waste Handling and Storage

Rev. #: 2

Rev Date: March 6, 2009

Approval Signatures

Prepared by: Andrew Karnik Date: 3/6/09

Reviewed by: Liz Marsh Date: 3/6/09
(Technical Expert)

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and non-hazardous, generated during site activities, which may include, but are not limited to - drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. Please note that this SOP is intended for materials that have been deemed a solid waste as defined by 40 CFR § 261.2 (which may includes liquids, solids, and sludges). In some cases, field determinations will be made based on field screening or previous data that materials are not considered a solid waste. IDW may include soil, groundwater, drilling fluids, decontamination liquids, personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials that may have come in contact with potentially impacted materials. IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary storage area (discussed in further detail under Drum Storage) onsite pending characterization and disposal. Waste materials will be analyzed for constituents of concern to evaluate proper disposal methods. PPE and disposable sampling equipment will be placed in DOT-approved drums prior to disposal and typically does not require laboratory analysis. This SOP describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly disposed. The procedures for handling IDW are based on the United States Environmental Protection Agency's Guide to Management of Investigation Derived Wastes (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). The following Laws and Regulations on Hazardous Waste Management are potential ARAR for this site.

State Laws and Regulations

- To Be Determined Based on Location of Site and Location of Treatment, Storage, and/or Disposal Facility (TSDF) to be utilized

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 42 USC § 9601-9675

- Superfund Amendments and Reauthorization Act (SARA)
- Department of Transportation (DOT) Hazardous Materials Transportation

Pending characterization, IDW will be stored appropriately within each area of contamination (AOC). Under RCRA, “storage” is defined as the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere” (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Waste characterization can either be based on generator knowledge, such as using materials safety data sheets (MSDS’), or can be based upon analytical results. The laboratory used for waste characterization analysis must have the appropriate state and federal certifications and be approved by ARCADIS and Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Wastes judged to potentially meet the criteria for hazardous wastes shall be stored in DOT approved packaging. Waste material classified as RCRA non-hazardous may be handled and disposed of as an industrial waste.

Liquid wastes judged to potentially meet the criteria for hazardous wastes shall be stored in DOT approved 55 gallon drums or other approved containers that are compatible with the type of material stored therein. Solid materials deemed to potentially meet hazardous criteria will be drummed where practicable. Large quantities of potentially hazardous solid materials must be containerized (such as in a roll-off box) for up to a maximum of 90 or 180 days as described in the Excavated Solids Section. Waste material classified as non-hazardous may be handled and disposed of as an industrial waste and is not subject to the 90-day or 180-day on-site storage limitation.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the Project Manager and Client as soon as practicable and documented in the report.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. ARCADIS personnel may sign manifests on a case-to-case basis for clients, provided the appropriate agreement is in place between ARCADIS and the client documenting that ARCADIS is not the generator, but is acting as authorized representative for the generator. ARCADIS personnel who sign hazardous waste manifests will have the current DOT hazardous materials transportation training according to 49 CFR § 172.704. ARCADIS field personnel will also comply with client-specific training such as LPS. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available for IDW handling and storage:

Appropriate personal protective equipment as specified in the Site Health and Safety Plan

- 55-gallon steel drums, DOT 1A2 or equivalent
- ¾ -inch socket wrench
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self adhesive)
- Polyethylene storage tank
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as specified in the *Chain-of-Custody* SOP and *Field Sampling Handling, Packing, and Shipping* SOP.
- Indelible ink and/or permanent marking pens
- Plastic sheeting

- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook.

IV. Cautions

- Filled drums can be very heavy, always use appropriate moving techniques and equipment.
- Similar media will be stored in the same drums to aid in sample analysis and disposal.
- Drum lids must be secured to prevent rainwater from entering the drums.
- Drums containing solid material may not contain any free liquids.
- Waste containers stored for extended periods of time may be subject to deterioration. Drum over packs may be used as secondary containment.
- All drums must be in good condition to prevent potential leakage and facilitate subsequent disposal. Inspect the drums for dents and rust, and verify the drum has a secure lid prior to use.

V. Health and Safety Considerations

- Appropriate personal protective equipment must be worn by all field personnel within the designated work area.
- Air monitoring may be required during certain field activities as required in the Site Health and Safety Plan.

- If excavating in potentially hazardous areas is possible, contingency plans should be developed to address the potential for encountering gross contamination or non-aqueous phase liquids.

- ARCADIS field personnel will be familiar and compliant with Client-specific health and safety requirements such as Chevron's hand safety policy including the prohibition of fixed and/or folding blade knives.

VI. Procedure

Waste storage and handling procedures to be used depend upon the type of generated waste. For this reason, IDW should be stored in a secure location onsite in separate 55-gallon storage drums, solids can be stockpiled onsite (if non-hazardous), and purge water may be stored in polyethylene tanks. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the Project Manager during all phases of the project. Site managers may want to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that generate little waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring (EPA, 1993).

Drum Storage

Drums containing hazardous waste shall be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized on-site location that is readily accessible for vehicular pick-up. Drums confirmed as, or believed to contain hazardous waste will be stored over an impervious surface provided with secondary containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 days or less without a permit and without having interim status provided that such accumulation is in compliance with specifications in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 days or less without a permit or without having interim status subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. **NOTE**: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g. Rhode Island). **State-specific regulations must be reviewed and understood prior to the generation of hazardous waste.**

Satellite Accumulation of Hazardous Waste

Satellite accumulation (SAA) shall mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or “Testing in Progress” label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Testing In Progress, Hazardous, or Non-Hazardous)
- Waste generator's name (e.g., client name)
- Project name
- Name and telephone number of ARCADIS project manager
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date

- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Testing in Progress” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied. Containers with waste determined to be non-hazardous will be labeled with a green and white "Non-Hazardous Waste" label over the "Waste Container" label. Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label. The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition a DOT proper shipping name shall be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g. Boring-1, Test Pit 3, etc) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to soil, fill and construction and demolition debris. Excavated solids may be temporarily stockpiled onsite as long as the material is a RCRA non-hazardous waste and the solids will be treated onsite pursuant to a certified, authorized, or permitted treatment method, or properly disposed off-site. Stockpiled materials characterized as hazardous must be immediately containerized and removed from the site within 90 days of generation (except for soils using satellite accumulation). Excavated solids should be stockpiled and maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (EPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover. Excavated solids may also be placed in roll off containers and covered with a 6-mil PVC liner pending results for waste characterization.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in 55-gallon drums with bolt-sealed lids.

Disposable Equipment

Disposable equipment includes personal protective equipment (tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, disposable equipment will also be disposed of as a hazardous waste. These materials will be stored onsite in labeled 55-gallon drums pending analytical results for waste characterization.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert polyethylene materials.

The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are describe in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.

- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

VII. Waste Characterization Sampling and Shipping

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific federally regulated thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility.

Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with the Chain-of-Custody SOP and Field Sampling Handling, Packing, and Shipping SOP and Hazardous Materials Packaging and Shipping SOP.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please reference the following ARCADIS intranet team page for more information: http://team/sites/hazmat/default.aspx.

Preparing Waste Shipment Documentation (Hazardous and Non-Hazardous)

Waste profiles will be prepared by the ARCADIS PM and forwarded, along with laboratory analytical data to the Client PM for approval/signature. The Client PM will then return the profile to ARCADIS who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by ARCADIS prior to forwarding to the Client PM for approval. Upon approval of the manifest, the Client PM will return the original signed manifest directly to the waste contractor or to the ARCADIS PM for forwarding to the waste contractor.

Final drum labeling and pickup will be supervised by an ARCADIS representative who is experienced with waste labeling procedures. The ARCADIS representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. **When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums.** A copy of the ARCADIS drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

VIII. Data Recording and Management

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with the *Quality Assurance Project Plan*, if one exists. Copies of the chains-of-custody forms will be maintained in the project file.

Following waste characterization, IDW containers will be re-labeled with the appropriate waste hazardous or non-hazardous waste labels and the client will initiate disposal at the appropriate waste disposal facility.

IX. Quality Assurance

The chain-of-custody and sample labels for waste characterization samples will be filled out in accordance with the *Quality Assurance Project Plan*.

X. References

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

USEPA. 1991. *Guide to Discharging CERCLA Aqueous Wastes to Publicly Owned Treatment Works (POTWs)*. Office of Remedial and Emergency Response. Hazardous Site Control Division 0S-220W. March 1991.

APPENDIX B – LABORATORY SOPs and CERTIFICATIONS

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2016
Issued April 01, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MITCHELL OSTROWSKI
ALPHA ANALYTICAL
8 WALKUP DR
WESTBOROUGH, MA 01581-1019

NY Lab Id No: 11148

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Bacteriology	
Coliform, Total / E. coli (Qualitative)	SM 18-22 9223B (-97) (Colilert)
E. coli (Enumeration)	SM 18-22 9223B (-97) (Colilert)
Standard Plate Count	SM 18-22 9215B (-00)
Fuel Additives	
Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2
Metals I	
Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4

Metals II	
Aluminum, Total	EPA 200.7 Rev. 4.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4 EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Metals III	
Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4
Microextractibles	
1,2-Dibromo-3-chloropropane	EPA 504.1
1,2-Dibromoethane	EPA 504.1
Miscellaneous	
Organic Carbon, Total	SM 19-22 5310C (-00)
Perchlorate	EPA 332.0 Rev. 1
Turbidity	SM 18-22 2130 B (-01) EPA 180.1 Rev. 2.0
Non-Metals	
Alkalinity	SM 18-22 2320B (-97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 18-22 2120B (-01)

Serial No.: 52256

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2016
Issued April 01, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MITCHELL OSTROWSKI
ALPHA ANALYTICAL
8 WALKUP DR
WESTBOROUGH, MA 01581-1019

NY Lab Id No: 11148

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Non-Metals	
Cyanide	SM 18-22 4500-CN E (-99)
Fluoride, Total	EPA 300.0 Rev. 2.1
	SM 18-22 4500-F C (-97)
Nitrate (as N)	SM 18-22 4500-NO3 F (-00)
Nitrite (as N)	SM 18-22 4500-NO3 F (-00)
Solids, Total Dissolved	SM 18-22 2540C (-97)
Specific Conductance	SM 18-22 2510B (-97)
Sulfate (as SO4)	EPA 300.0 Rev. 2.1
Trihalomethanes	
Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2
Total Trihalomethanes	EPA 524.2
Volatile Aromatics	
1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2

Volatile Aromatics	
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2

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All approved analytes are listed below:

Volatile Halocarbons

2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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NELAP RECOGNIZED TNI ACCREDITATION BODY

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Acrylates	
Acrolein (Propenal)	EPA 8260C
	EPA 624
Acrylonitrile	EPA 8260C
	EPA 624
Ethyl methacrylate	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 625
	EPA 8270D
Pyridine	EPA 625
	EPA 8270D
Bacteriology	
Coliform, Fecal	SM 9221C,E-06
	SM 9222D-97
Coliform, Total	SM 9221B-06
	SM 9222B-97
Standard Plate Count	SM 18-21 9215B
Benzidines	
3,3'-Dichlorobenzidine	EPA 625

Benzidines	
3,3'-Dichlorobenzidine	EPA 8270D
Benzidine	EPA 625
	EPA 8270D
Chlorinated Hydrocarbon Pesticides	
4,4'-DDD	EPA 8081B
	EPA 608
4,4'-DDE	EPA 8081B
	EPA 608
4,4'-DDT	EPA 8081B
	EPA 608
Aldrin	EPA 8081B
	EPA 608
alpha-BHC	EPA 8081B
	EPA 608
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B
	EPA 608
Chlordane Total	EPA 8081B
	EPA 608
delta-BHC	EPA 8081B
	EPA 608
Dieldrin	EPA 8081B
	EPA 608
Endosulfan I	EPA 8081B
	EPA 608

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Chlorinated Hydrocarbon Pesticides

Endosulfan II	EPA 8081B
	EPA 608
Endosulfan sulfate	EPA 8081B
	EPA 608
Endrin	EPA 8081B
	EPA 608
Endrin aldehyde	EPA 8081B
	EPA 608
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
	EPA 608
Heptachlor epoxide	EPA 8081B
	EPA 608
Lindane	EPA 8081B
	EPA 608
Methoxychlor	EPA 8081B
	EPA 608
Toxaphene	EPA 8081B
	EPA 608

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 625
	EPA 8270D

Chlorinated Hydrocarbons

2-Chloronaphthalene	EPA 625
	EPA 8270D
Hexachlorobenzene	EPA 625
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270D
Hexachlorocyclopentadiene	EPA 625
	EPA 8270D
Hexachloroethane	EPA 625
	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dalapon	EPA 8151A
Dinoseb	EPA 8151A

Demand

Biochemical Oxygen Demand	SM 5210B-01,-11
Carbonaceous BOD	SM 5210B-01,-11
Chemical Oxygen Demand	EPA 410.4 Rev. 2.0
	SM 5220D-97,-11

Fuel Oxygenates

Di-isopropyl ether	EPA 8260C
Ethanol	EPA 8260C

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Fuel Oxygenates

Methyl tert-butyl ether	EPA 8260C
tert-amyl methyl ether (TAME)	EPA 8260C
tert-butyl alcohol	EPA 8260C
tert-butyl ethyl ether (ETBE)	EPA 8260C

Haloethers

4-Bromophenylphenyl ether	EPA 625 EPA 8270D
4-Chlorophenylphenyl ether	EPA 625 EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625 EPA 8270D
Bis(2-chloroethyl)ether	EPA 625 EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 625 EPA 8270D

Low Level Polynuclear Aromatics

Acenaphthene Low Level	EPA 8270D SIM
Acenaphthylene Low Level	EPA 8270D SIM
Anthracene Low Level	EPA 8270D SIM
Benzo(a)anthracene Low Level	EPA 8270D SIM
Benzo(a)pyrene Low Level	EPA 8270D SIM
Benzo(b)fluoranthene Low Level	EPA 8270D SIM
Benzo(g,h,i)perylene Low Level	EPA 8270D SIM
Benzo(k)fluoranthene Low Level	EPA 8270D SIM
Chrysene Low Level	EPA 8270D SIM

Low Level Polynuclear Aromatics

Dibenzo(a,h)anthracene Low Level	EPA 8270D SIM
Fluoranthene Low Level	EPA 8270D SIM
Fluorene Low Level	EPA 8270D SIM
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270D SIM
Naphthalene Low Level	EPA 8270D SIM
Phenanthrene Low Level	EPA 8270D SIM
Pyrene Low Level	EPA 8270D SIM

Metals I

Barium, Total	EPA 200.7 Rev. 4.4 EPA 6010C EPA 6020A EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4 EPA 6010C EPA 6020A EPA 200.8 Rev. 5.4
Calcium, Total	EPA 200.7 Rev. 4.4 EPA 6010C EPA 6020A
Chromium, Total	EPA 200.7 Rev. 4.4 EPA 6010C EPA 6020A EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4 EPA 6010C

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Metals I	
Copper, Total	EPA 6020A
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
Lead, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Magnesium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Potassium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A

Metals I	
Silver, Total	EPA 200.8 Rev. 5.4
Sodium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A

Metals II	
Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Chromium VI	EPA 7196A
	SM 3500-Cr B-09,-11
Mercury, Total	EPA 245.1 Rev. 3.0
	EPA 7470A

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Metals II

Selenium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

Metals III

Cobalt, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Molybdenum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

Metals III

Tin, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Titanium, Total	EPA 200.7 Rev. 4.4

Mineral

Acidity	SM 2310B-97,-11
Alkalinity	SM 2320B-97,-11
Chloride	EPA 300.0 Rev. 2.1
	SM 4500-Cl- E-97,-11
Fluoride, Total	EPA 300.0 Rev. 2.1
	SM 4500-F C-97,-11
Hardness, Total	EPA 200.7 Rev. 4.4
	SM 2340B-97,-11
Sulfate (as SO4)	EPA 300.0 Rev. 2.1
	SM 4500-SO4 E-97,-11

Miscellaneous

Boron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Color	SM 2120B-01,-11
Cyanide, Total	LACHAT QuikChem 10-204-00-
	SM 4500-CN E-99,-11
Formaldehyde	EPA 8315A
Oil and Grease Total Recoverable (HEM)	EPA 1664A
	EPA 1664B
Organic Carbon, Total	SM 5310C-00,-11
Phenols	EPA 420.1 Rev. 1978

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All approved analytes are listed below:

Miscellaneous	
Silica, Dissolved	EPA 200.7 Rev. 4.4
Specific Conductance	EPA 120.1 Rev. 1982 SM 2510B-97,-11
Sulfide (as S)	SM 4500-S2- D-00,-11
Surfactant (MBAS)	SM 5540C-00,-11
Total Petroleum Hydrocarbons	EPA 1664A EPA 1664B
Turbidity	SM 2130 B-01,-11 EPA 180.1 Rev. 2.0

Nitroaromatics and Isophorone	
1,3-Dinitrobenzene	EPA 8270D
2,4-Dinitrotoluene	EPA 625 EPA 8270D
2,6-Dinitrotoluene	EPA 625 EPA 8270D
Isophorone	EPA 625 EPA 8270D
Nitrobenzene	EPA 625 EPA 8270D

Nitrosoamines	
N-Nitrosodimethylamine	EPA 625 EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625 EPA 8270D
N-Nitrosodiphenylamine	EPA 625

Nitrosoamines	
N-Nitrosodiphenylamine	EPA 8270D

Nutrient	
Ammonia (as N)	SM 4500-NH3 H-97,-11 EPA 350.1 Rev. 2.0
Kjeldahl Nitrogen, Total	EPA 351.1 Rev. 1978 LACHAT 10-107-06-2
Nitrate (as N)	EPA 353.2 Rev. 2.0 EPA 300.0 Rev. 2.1 SM 4500-NO3 F-00,-11
Nitrate-Nitrite (as N)	EPA 353.2 Rev. 2.0 SM 4500-NO3 F-00,-11
Nitrite (as N)	EPA 353.2 Rev. 2.0 SM 4500-NO3 F-00,-11 SM 4500-NO2 B-00,-11
Orthophosphate (as P)	SM 4500-P E-99,-11
Phosphorus, Total	SM 4500-P E-99,-11

Organophosphate Pesticides	
Atrazine	EPA 8270D
Parathion ethyl	EPA 8270D
Thionazin	EPA 8270D

Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015C
Gasoline Range Organics	EPA 8015C

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All approved analytes are listed below:

Phthalate Esters	
Benzyl butyl phthalate	EPA 625
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625
	EPA 8270D
Diethyl phthalate	EPA 625
	EPA 8270D
Dimethyl phthalate	EPA 625
	EPA 8270D
Di-n-butyl phthalate	EPA 625
	EPA 8270D
Di-n-octyl phthalate	EPA 625
	EPA 8270D
Polychlorinated Biphenyls	
PCB-1016	EPA 8082A
	EPA 608
PCB-1221	EPA 8082A
	EPA 608
PCB-1232	EPA 8082A
	EPA 608
PCB-1242	EPA 8082A
	EPA 608
PCB-1248	EPA 8082A
	EPA 608
PCB-1254	EPA 8082A
	EPA 608

Polychlorinated Biphenyls	
PCB-1260	EPA 8082A
	EPA 608
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A
Polynuclear Aromatics	
Acenaphthene	EPA 625
	EPA 8270D
Acenaphthylene	EPA 625
	EPA 8270D
Anthracene	EPA 625
	EPA 8270D
Benzo(a)anthracene	EPA 625
	EPA 8270D
Benzo(a)pyrene	EPA 625
	EPA 8270D
Benzo(b)fluoranthene	EPA 625
	EPA 8270D
Benzo(ghi)perylene	EPA 625
	EPA 8270D
Benzo(k)fluoranthene	EPA 625
	EPA 8270D
Chrysene	EPA 625
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625
	EPA 8270D

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All approved analytes are listed below:

Polynuclear Aromatics

Fluoranthene	EPA 625
	EPA 8270D
Fluorene	EPA 625
	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 625
	EPA 8270D
Naphthalene	EPA 625
	EPA 8270D
Phenanthrene	EPA 625
	EPA 8270D
Pyrene	EPA 625
	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 625
	EPA 8270D
2,4,6-Trichlorophenol	EPA 625
	EPA 8270D
2,4-Dichlorophenol	EPA 625
	EPA 8270D
2,4-Dimethylphenol	EPA 625
	EPA 8270D
2,4-Dinitrophenol	EPA 625
	EPA 8270D
2-Chlorophenol	EPA 625

Priority Pollutant Phenols

2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625
	EPA 8270D
2-Methylphenol	EPA 625
	EPA 8270D
2-Nitrophenol	EPA 625
	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 625
	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 625
	EPA 8270D
Pentachlorophenol	EPA 625
	EPA 8270D
Phenol	EPA 625
	EPA 8270D

Residue

Solids, Total	SM 2540 B-97,-11
Solids, Total Dissolved	SM 2540 C-97,-11
Solids, Total Suspended	SM 2540 D-97,-11

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D

Serial No.: 52955

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2016
Issued April 01, 2015
Revised May 19, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MITCHELL OSTROWSKI
ALPHA ANALYTICAL
8 WALKUP DR
WESTBOROUGH, MA 01581-1019

NY Lab Id No: 11148

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Semi-Volatile Organics

1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 625
	EPA 8270D
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D
n-Decane	EPA 625
n-Octadecane	EPA 625

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
	EPA 624
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
	EPA 624
1,4-Dichlorobenzene	EPA 8260C
	EPA 624
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
	EPA 624

Volatile Aromatics

Chlorobenzene	EPA 8260C
	EPA 624
Ethyl benzene	EPA 8260C
	EPA 624
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
	EPA 624
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
	EPA 624
Total Xylenes	EPA 8260C
	EPA 624

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
	EPA 624
1,1,2,2-Tetrachloroethane	EPA 8260C
	EPA 624

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Volatile Halocarbons	
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
	EPA 624
1,1-Dichloroethane	EPA 8260C
	EPA 624
1,1-Dichloroethene	EPA 8260C
	EPA 624
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
	EPA 8011
1,2-Dibromoethane	EPA 8260C
	EPA 8011
1,2-Dichloroethane	EPA 8260C
	EPA 624
1,2-Dichloropropane	EPA 8260C
	EPA 624
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
	EPA 624
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
	EPA 624
Bromoform	EPA 8260C
	EPA 624

Volatile Halocarbons	
Bromomethane	EPA 8260C
	EPA 624
Carbon tetrachloride	EPA 8260C
	EPA 624
Chloroethane	EPA 8260C
	EPA 624
Chloroform	EPA 8260C
	EPA 624
Chloromethane	EPA 8260C
	EPA 624
cis-1,2-Dichloroethene	EPA 8260C
	EPA 624
cis-1,3-Dichloropropene	EPA 8260C
	EPA 624
Dibromochloromethane	EPA 8260C
	EPA 624
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
	EPA 624
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
	EPA 624
Tetrachloroethene	EPA 8260C
	EPA 624
trans-1,2-Dichloroethene	EPA 8260C
	EPA 624

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Volatile Halocarbons

trans-1,3-Dichloropropene	EPA 8260C
	EPA 624
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C
	EPA 624
Trichlorofluoromethane	EPA 8260C
	EPA 624
Vinyl chloride	EPA 8260C
	EPA 624

Volatiles Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Di-ethyl ether	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
n-Butanol	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

EPA 5030C
SM 4500-CN B or C-99,-11

Sample Preparation Methods

EPA 9030B
EPA 3005A
EPA 3510C
SM 4500-NH3 B-97,-11
EPA 9010C

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Acrylates	
Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C
Ethyl methacrylate	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Benzidines	
3,3'-Dichlorobenzidine	EPA 8270D
Benzidine	EPA 8270D
Characteristic Testing	
Corrosivity	EPA 9040C
	EPA 9045D
Ignitability	EPA 1030
	EPA 1010A
Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311
Chlorinated Hydrocarbon Pesticides	
4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B
alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
Atrazine	EPA 8270D
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Toxaphene	EPA 8081B
Chlorinated Hydrocarbons	
1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D

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All approved analytes are listed below:

Chlorinated Hydrocarbons

2-Chloronaphthalene	EPA 8270D
Hexachlorobenzene	EPA 8270D
Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dalapon	EPA 8151A
Dicamba	EPA 8151A
Dinoseb	EPA 8151A

Haloethers

4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 8270D

Low Level Polynuclear Aromatic Hydrocarbons

Acenaphthene Low Level	EPA 8270D SIM
Acenaphthylene Low Level	EPA 8270D SIM
Anthracene Low Level	EPA 8270D SIM
Benzo(a)anthracene Low Level	EPA 8270D SIM
Benzo(a)pyrene Low Level	EPA 8270D SIM

Low Level Polynuclear Aromatic Hydrocarbons

Benzo(b)fluoranthene Low Level	EPA 8270D SIM
Benzo(g,h,i)perylene Low Level	EPA 8270D SIM
Benzo(k)fluoranthene Low Level	EPA 8270D SIM
Chrysene Low Level	EPA 8270D SIM
Dibenzo(a,h)anthracene Low Level	EPA 8270D SIM
Fluoranthene Low Level	EPA 8270D SIM
Fluorene Low Level	EPA 8270D SIM
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270D SIM
Naphthalene Low Level	EPA 8270D SIM
Phenanthrene Low Level	EPA 8270D SIM
Pyrene Low Level	EPA 8270D SIM

Metals I

Barium, Total	EPA 6010C EPA 6020A
Cadmium, Total	EPA 6010C EPA 6020A
Calcium, Total	EPA 6010C EPA 6020A
Chromium, Total	EPA 6010C EPA 6020A
Copper, Total	EPA 6010C EPA 6020A
Iron, Total	EPA 6010C EPA 6020A
Lead, Total	EPA 6010C

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Metals I

Lead, Total	EPA 6020A
Magnesium, Total	EPA 6010C EPA 6020A
Manganese, Total	EPA 6010C EPA 6020A
Nickel, Total	EPA 6010C EPA 6020A
Potassium, Total	EPA 6010C EPA 6020A
Silver, Total	EPA 6010C EPA 6020A
Sodium, Total	EPA 6010C EPA 6020A

Metals II

Aluminum, Total	EPA 6010C EPA 6020A
Antimony, Total	EPA 6010C EPA 6020A
Arsenic, Total	EPA 6010C EPA 6020A
Beryllium, Total	EPA 6010C EPA 6020A
Chromium VI	EPA 7196A
Mercury, Total	EPA 7471B
Selenium, Total	EPA 6010C EPA 6020A
Vanadium, Total	EPA 6010C EPA 6020A
Zinc, Total	EPA 6010C EPA 6020A

Metals III

Cobalt, Total	EPA 6010C EPA 6020A
Molybdenum, Total	EPA 6010C EPA 6020A
Thallium, Total	EPA 6010C EPA 6020A
Tin, Total	EPA 6010C

Minerals

Chloride	EPA 9251
Sulfate (as SO4)	EPA 9038

Miscellaneous

Boron, Total	EPA 6010C
Cyanide, Total	EPA 9014 EPA 9012B
Phenols	EPA 9065
Specific Conductance	EPA 9050A

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 8270D

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Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 8330A
2,6-Dinitrotoluene	EPA 8270D
Isophorone	EPA 8270D
Nitrobenzene	EPA 8270D
Pyridine	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D

Organophosphate Pesticides

Parathion ethyl	EPA 8270D

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015C
Gasoline Range Organics	EPA 8015C

Phthalate Esters

Benzyl butyl phthalate	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270D
Diethyl phthalate	EPA 8270D
Dimethyl phthalate	EPA 8270D
Di-n-butyl phthalate	EPA 8270D
Di-n-octyl phthalate	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A

Polychlorinated Biphenyls

PCB-1221	EPA 8082A
PCB-1232	EPA 8082A
PCB-1242	EPA 8082A
PCB-1248	EPA 8082A
PCB-1254	EPA 8082A
PCB-1260	EPA 8082A
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270D
Acenaphthylene	EPA 8270D
Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D
Benzo(ghi)perylene	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270D
Fluoranthene	EPA 8270D
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D
Naphthalene	EPA 8270D
Phenanthrene	EPA 8270D
Pyrene	EPA 8270D

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NELAP RECOGNIZED ACCREDITATION BODY

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Priority Pollutant Phenols	
2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D
2,4-Dichlorophenol	EPA 8270D
2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 8270D
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 8270D
Phenol	EPA 8270D
Semi-Volatile Organics	
1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 8270D
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D

Semi-Volatile Organics	
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D
Volatile Aromatics	
1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C

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Volatile Aromatics

tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C
Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C

Volatile Halocarbons

Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C
Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C

Volatile Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C

Serial No.: 52258

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2016
Issued April 01, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MITCHELL OSTROWSKI
ALPHA ANALYTICAL
8 WALKUP DR
WESTBOROUGH, MA 01581-1019

NY Lab Id No: 11148

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Volatile Organics	
Di-ethyl ether	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
n-Butanol	EPA 8260C
tert-butyl alcohol	EPA 8260C
Vinyl acetate	EPA 8260C
Sample Preparation Methods	
	EPA 5035A-L
	EPA 5035A-H
	EPA 9030B
	EPA 3005A
	EPA 3050B
	EPA 3540C
	EPA 3546
	EPA 3060A
	EPA 9010C

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NELAP RECOGNIZED ACCREDITATION BODY

Statement of Qualifications

Westborough Facility

June 2012, Revision 8.0

ALPHA ANALYTICAL
World Class Chemistry

Alpha Analytical
8 Walkup Drive
Westborough, MA 01581
508-898-9220

Westborough, MA I Mansfield, MA I Mahwah, NJ I Albany, NY I Buffalo, NY

www.alphalab.com

CONTENTS

INTRODUCTION

Since 1985, Alpha Analytical has been performing some of the most sophisticated laboratory analysis in the industry, but our mission remains simple: To provide an accurate, high quality product in accordance with all applicable regulatory requirements in support of large projects on quick timeframes.

Although a lot has changed in the industry over the past 27 years, unfortunately, there are still a lot of "grey areas" in analytical methodologies and the enforcement of regulatory requirements as to what a laboratory "should do." There is a considerable variation in the level of effort laboratories expend in proportion to their expectation of regulatory scrutiny. There are no grey areas in the work Alpha Analytical does and our reputation supports that fact.

Alpha Analytical was founded with an absolute commitment to data integrity and the industry's highest ethical and professional standards. Continuing with Alpha's reputation of quality & reliability for over 25 years - we get it done right - no exceptions.

Alpha Analytical is a growing, financially secure, privately held company. Alpha invests over a million dollars annually in capital improvements and we have no pressure from venture capital firms or outside investors that could compromise our operations or plans.

Our two laboratory facilities located in Westborough and Mansfield, Massachusetts are comprised of over 50,000 square feet of smart, sophisticated 21st century systems. From our back-up generator systems to our LIMS system, ADEx and DataMerger data delivery tools and Fleetmatics GPS courier management system – Alpha Analytical has invested in making sure our clients' work is managed with intelligent efficiency.

Alpha Analytical is focused on being responsive to our clients. Responsive service ranging from our network of couriers, whose responsibility it is to be where you need them and when you need them, to our interactive login staff and front office personnel. Our senior staff is readily available to assist you with setting up your project, reviewing your regulatory requirements or helping you interpret your data. Alpha Analytical's staff is very experienced with the engineering and risk assessment applications of environmental data.

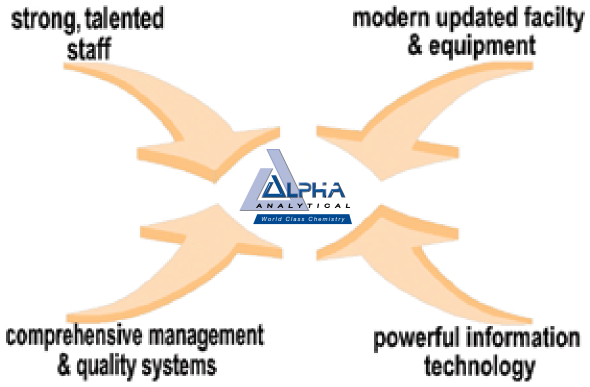
At your discretion, senior laboratory scientists can work together with your project staff on the project's data collection requirement – planning and logistics, sampling and analysis methodologies, data quality objectives, data interpretation and quality assurance. This unique team approach allows the sampling and analysis component to be completely integrated into the project as a whole, which assures that the work will be performed correctly and efficiently with no surprises.

Our laboratory clients include environmental and geotechnical engineering firms; major industrial/commercial facilities; government agencies; and municipalities.

Alpha Analytical Labs
Floor Plan 2012
Westborough, Massachusetts

ANALYTICAL SERVICES

At Alpha Analytical, we offer experienced scientific and technical staff and a wide range of risk-based, compliance-based and specialty analyses. Our capabilities include analyses on environmental matrices such as wastewater, water supply, aqueous, soil and air.



TURN AROUND TIME

Alpha Analytical is recognized for our high capacity standard analytical capabilities, with the ability to process large projects quickly and routinely. We have a strong commitment to getting you your data on time when you need it and when we committed it to you. A majority of our work is turned in 5 days, and in many instances less than that. We know that quick turn arounds help our clients be more effective.

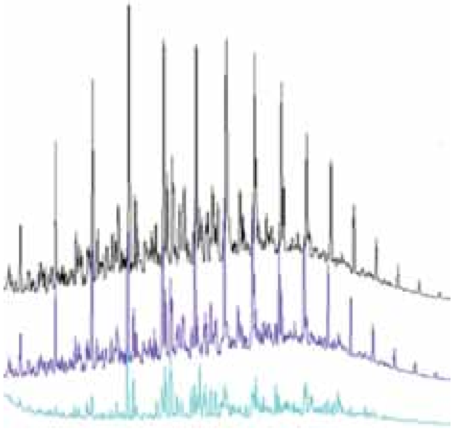
QUALITY

Alpha Analytical's quality philosophy that is second to none. We do it right and guarantee it and ensure our clients the peace of mind in the accuracy and quality of their data. We will always be in a position to defend our analytical work and data.

VOLATILE ANALYSES

Alpha performs analysis for volatile organic compounds (VOCs) in support of all major regulatory, engineering and industrial project applications. Analyses are performed utilizing state-of-the-art analytical instrumentation employing RCRA, CWA and SDWA methodologies. All VOC data is acquired utilizing standard chromatography software. The data is then uploaded via the Alpha local area network to the laboratory information management system (LIMS) for additional processing and reporting.

Alpha currently employs gas chromatographs/mass spectrometers (GC/MS) for the analysis of VOCs by EPA methods 8260B, 624 and 524.2. Alpha also performs EPA method 8260B analysis for soils sampled under EPA 5035 requirements. In fact, Alpha Analytical Labs was one of the first laboratories in New England to offer VOC analysis of soils by the low level, EPA 5035/8260 procedure. Our laboratory has considerable experience with the sample collection, preservation and analytical requirements associated with this method, as well as the high level, methanol preservation technique.



Alpha provides sampling syringes and containers, as well as field sampling SOPs and any associated training that is required.

Alpha has >20 gas chromatographs (GC) on line, with various detectors for the analysis of VOCs by EPA Methods 8021B, and for the analysis of volatile petroleum hydrocarbons (VPH) by the MA DEP method. Several GCs are specifically designated for VPH analysis.

EXTRACTABLE ORGANIC ANALYSES

Alpha performs a wide variety of extractable organics analysis. Many parameters, such as semivolatile or Acid/Base-Neutral analysis, are performed by Gas Chromatograph/ Mass Spectrometer (GC/MS). However, other analyses, such as PCBs Aroclors, Pesticides and Herbicides are performed by Gas Chromatograph (GC). All organics data is acquired utilizing standard chromatography software. The data is then uploaded via the Alpha local area network to the laboratory information management system (LIMS) for additional processing and reporting.

Alpha currently utilizes GC/MS instruments for the semivolatile organic analysis of samples by EPA methods 8270. The instruments are also employed for low-level analysis of polynuclear aromatic hydrocarbons (PAH) by modified EPA Method 8270 – selected ion monitoring (SIM). This technique allows Alpha to achieve the required levels of detection for Massachusetts Contingency Plan GW-1 compliance or any other risk-based regulatory criteria.

Alpha offers extractable and volatile petroleum hydrocarbons (EPH/VPH), extractable total petroleum hydrocarbons (ETPH), gasoline range and diesel range organics (GRO/DRO), and TPH by GC-FID to characterize soil and water samples. The laboratory has used these procedures with great success on a countless number of projects. Alpha has been using and evaluating the EPH/VPH procedures since they were released in 1995 and has actively participated in the public comment process as well as both round robin method evaluations. Alpha has also been active in the EPH/VPH Workgroup which was established by the MADEP to revise and improve the methods based on experience gained from working with the methods since they were released. Alpha has been issued a Record of Proficiency statement by the Massachusetts Department of Environmental Protection that states that laboratory is competent to perform EPH and VPH analysis on both water and soil sample matrices.

TRACE METALS

Alpha currently performs analysis for metals utilizing the most advanced analytical instrumentation. Alpha currently employs Inductively Coupled Plasma Spectrophotometer/Mass Spectrometer (ICP/MS), Inductively Coupled Plasma Spectrophotometers (ICP), Graphite Furnace Atomic Absorption Spectrophotometer (GFAA), and Cold Vapor Atomic Absorption Spectrophotometers (CVAA).

Alpha employs axial torch ICPs for routine trace metals analysis with instruments that are capable of quickly and reliably achieving levels of detection in the low ppb range.

The CVAA instruments are used for the analysis of mercury only. The Perkin-Elmer™ FIMS 100 automated analyzer is the primary instrument.

WET CHEMISTRY

Alpha boasts one of the largest wet chemistry laboratory spaces in the region for conventional wet chemistry analysis. Alpha performs a wide variety of wet chemical parameters including RCRA characterization, nutrients, anions, demand series, minerals, and solids. Alpha utilizes two Lachat FIA instruments for the analysis of nitrate, nitrate/nitrite, cyanide, ammonia-N, total Kjeldahl nitrogen and chloride. One of the Lachat instruments is also equipped with an ion chromatograph for anion analysis. Alpha's new total organic carbon (TOC) instrument, the Dohrmann Phoenix 8000 represents state of the art technology for the determination of low level TOC. Alpha can provide oil and grease analysis by EPA Method 1664.

Alpha has considerable experience with cyanide analysis, ranging from the total & amenable cyanide procedures to determinations for reactive, free, physiologically available (PAC), and weak and dissociable cyanides.

PERCHLORATE ANALYSIS

Alpha Analytical Labs offers the following methods for the analysis of Perchlorate:

EPA Method 314.0, incorporating all USEPA and MADEP method requirements. Method 314.0 is an ion chromatographic method for which Alpha Analytical Labs has a reporting limit of 1.0 ug/L in water and 40 ug/Kg in soil. Estimated concentrations can be reported to the method detection limit (MDL) of 0.20 ug/L for waters. Alpha Analytical Labs is approved for perchlorate by the USEPA under the UCMR Program and by the MADEP for low-level drinking water analysis.

EPA Method 331.0 (SW846 6850) LC/MS/MS and *EPA 332.0* (SW846 6860) IC/MS/MS for the determination of perchlorate in water and soil. Liquid Chromatography or Ion Chromatography coupled with MS/MS detection provides a technology that greatly increases the sensitivity of the analysis. Alpha has achieved reporting limits of 0.05 ug/ L in water and 0.5 ug/Kg in soil. This technology successfully removes interferences from other anions allowing for the identification of perchlorate in samples with conductivity levels greater than 30,000 µS/cm.

MICROBIOLOGICAL ANALYSES

Alpha currently performs analysis for standard drinking water bacteria. We provide testing for total and fecal coliform by both the membrane filtration and multiple tube fermentation (MPN) methods. We also employ Colilert® for the analysis of total coliform and E.Coli in drinking water. Alpha recognizes the logistical constraints associated with microbiological analyses and as such, employs a second shift to conduct all microbiological testing within the required holding times.

www.alphalab.com

Alpha's interactive website is a valuable resource for our clients. The site provides customer service and technical support functions as well as online project status and electronic data deliverable capability.

Sample containers and/or sample couriers can be ordered via the website, as well as generalized cost quotations. Laboratory data can also be viewed or downloaded directly from the site by using the optional Alpha Data Exchange (ADEx) service. The website is the online source of environmental laboratory technical support, reference materials, frequently asked questions and links to other important websites of environmental interest.

ALPHA DATA EXCHANGE (ADEx)

Alpha also has sophisticated electronic data deliverable capabilities. Using Alpha Data Exchange (ADEx), our online electronic deliverable service, allows you to check project status and download your data directly from our web site (www.alphalab.com) in a variety of formats including Excel, GIS Key, EquIS, and an Adobe Acrobat PDF file format of our summary report. These electronic data formats are automatically generated with no manual data entry or manipulation, which can dramatically minimize your office's data reduction and reporting level of effort with a zero tolerance for transcription errors.

ADEx clients have access to their data 24 x 7 via their firm's password protected ADEx account. Laboratory reports and electronic deliverable files are available to our clients via our website as soon as they are finalized (access is through a password and downloaded directly into client pre-specified report formats). Laboratory reports and data files are available online for a minimum of three years after they are generated. All client laboratory report files are archived for a period of ten years after report generation.

In addition, Alpha has developed new Excel "Criteria Checker" formats for Massachusetts MCP, Connecticut RSR and New York STARS regulatory standards that automatically highlight and summarize results that exceed the applicable criteria. Our website can also be used to order sample containers, schedule a pick up, request a quote as well as a source for additional information.

INFORMATION MANAGEMENT

The key to the seamless transmission of data at Alpha Analytical Labs is our Laboratory Information Management System or LIMS. Alpha is currently using a third generation LIMS system, taking advantage of a client/server technology and an Oracle database. The new LIMS system takes data entry and reporting to new levels of accuracy and productivity. Alpha's LIMS is completely compliant with the EPA's Good Automated Laboratory Procedures (GALP).

The LIMs eliminates the manual data entry issue, by downloading the data, including QC results, directly from the instrument for over 90% of the lab. Upon review and approval by analyst and managers, the data is directly downloaded, including calculations, into the database. This automated data acquisition capability eliminates transcription errors and allows for complete electronic central storage of raw data, calculations and results.

ELECTRONIC DELIVERABLES

Electronic data deliverable (EDD) formats can be generated automatically by the LIMS with no manual intervention. This allows the data files to be prepared with no additional special handling, which greatly reduces the potential for transcription errors and non-agreement between electronic and hardcopy reporting.

Alpha offers a wide array of standard EDD formats that are available as standard reporting options.

•Certificate of Analysis
•Excel Speadsheets
•ASCII, Quote Comma Delimited
•Data Management Formats
    - GIS-Key™
    - EQUiS™
    - EnvirodataT M
    - ERPIMS (AFCEE)
•"Criteria Checker"
    - MCP Method 1 standards
    - MCP Reportable
Concentration standards
    - Connecticut RSR standards
    - New York STARS and
NYSDEC standards
    - New Hampshire Method 1
      standards
    - Rhode Island regulatory criteria
    - EPA PRG's
    - Vermont Water Limits

Of particular interest are Alpha's Data Management and "Criteria Checker" formats.

Regarding the data management formats, Alpha has the standard file formats online for each product. However, many clients customize their databases with user defined fields (i.e. water levels, temperature, etc.) and Alpha can generate these custom formats as well, as long as an example file is provided as a reference.

Alpha's "Criteria Checker" formats are Excel workbooks with the data arranged in typical spreadsheet format – samples across the top in columns and the analytical parameters down the side in rows. The first column contains the regulatory standards. The "Criteria Checker" automatically bolds and highlights any result that exceeds the regulatory standard. Any reporting limit that exceeds the regulatory standard is highlighted in a different color. There is also a Summary Spreadsheet that only lists the parameters, result or reporting limit, that exceeded any particular regulatory standard.

COURIER SERVICE

It takes proper planning and a commitment to on-going technological investments to build the best laboratory courier service in the country. Our brand new Eco-line fleet of fuel-efficient vehicles coupled with the *Fleetmatics* vehicle management system, represents the Alpha Analytical standard of providing you with the highest quality in services and attention.

Alpha Analytical's sophisticated sample management system along with our professional logistical team has the ability to schedule and track sample container requests and sample pick-ups/drop offs. We know at all times where your samples are located and how we can best respond to your needs.

- Real-time GPS Vehicle Location
- Technically Trained Courier Staff
- Faster Response Time
- Increased Productivity
- Reliable Scheduling
- Peace Of Mind

SAMPLE CONTAINERS

Sample containers are provided by Alpha as a complementary service to our clients. The containers are provided pre-labeled for each specific analysis requested by our clients. If the analysis requires that the sample be preserved, as with soils in methanol for volatile organic analysis, or metals in water with acid, Alpha supplies the containers with the proper preservative(s). By pre-labeling the containers, Alpha eliminates the guesswork in the field as to which container is required. In addition, the labels are of a specific manufacture such that they can be written on (in pencil) even when wet and the labels are guaranteed not come off in water.

Typically, we request 24-hour notification of sample container requests, particularly for large sampling projects. This gives Alpha the opportunity to work with our clients to make sure the correct containers are supplied as well as to confirm the amount of field QC samples required and supply those containers as well. Sample containers can also be ordered online 24hours/ day via our website, although as with our couriers we cannot guarantee delivery before noon. The menu steps clients through the ordering process by requesting information concerning the number of samples required, the matrix, the analyses required, and the number and type of field QC samples needed.

SAMPLE STORAGE/DISPOSAL

As a service to our clients, Alpha typically stores samples for 30 days after the report is sent to the client. Arrangements can be made in advance for storage periods of up to six months, if required. In addition, Alpha is responsible for the disposal of samples, extracts and digestates according the appropriate regulatory requirements based on the analysis just completed and extract/digestate chemicals involved in the analysis. This service is offered at no charge to our clients. If, however, a client would like to have the raw sample returned, arrangements can be made to have the sample returned via the appropriate commercial carrier with the correct packaging for that sample(s).

Alpha has a comprehensive chemical safety and hygiene program including a SOP for the disposal of samples and waste.

QUALITY ASSURANCE PROGRAM

The Quality Systems Manual (QSM) of Alpha Analytical describes the quality program in use at the laboratory. This Quality Manual provides employees, clients and accrediting agencies with the necessary information to become familiar with how the quality system operates within Alpha Analytical

The quality program includes quality assurance, quality control, and the laboratory systems including feedback mechanisms for the automated continuous improvement of the laboratory operations to meet client needs. Implementation of the laboratory operations is by documenting procedures, training personnel and reviewing operations for improvement. Written procedures are maintained as Standard Operating Procedures (SOPs). The SOP's are available to the staff. Using QualTrax, our document management system. The provisions of the QSM are binding on all temporary and permanent personnel assigned responsibilities. All laboratory personnel must adhere strictly to the QSM and SOP's. The QSM sections provide overview descriptions of objectives, policies, services, operations and the program defined by the laboratory for quality assurance and quality control activities.

The QSM describes the requirements of the laboratory to demonstrate competency in the operations for performing environmental tests for inorganic, organic, and microbiological testing. The basis for the environmental tests is the methods found in documents published by the United States Environmental Protection Agency (EPA), ASTM, AOAC, APHA/AWWA/WEF and other procedures and techniques supplied by clients.

QUALITY CONTROL

The following general quality control principles apply to all procedures performed at Alpha Analytical. The manner implemented is dependent on the type of test performed. The laboratory SOP presents the specific quality control checks undertaken for assuring precision, accuracy and sensitivity of each test method.

All quality control measures are assessed and evaluated on an ongoing basis, and quality control acceptance limits are used to determine the usability of the data. Control charts monitor the long-term method performance by analyte, by instrument for water matrices. Routine evaluation and reporting of the control chart performance provides supervisors and management with additional performance measures to ensure data comparability. Control limits are recalculated when trends are observed or at least once per year.

The laboratory specifies in the SOP the acceptance/rejection criteria where no reference method or regulatory criteria exist. The test SOP specifies the QC samples performed per batch of samples. The quality control samples are categorized into the following:

- Method Blank
- Laboratory Duplicate
- Laboratory Control Sample
- Matrix Spike (MS)
- Matrix Spike Duplicate

SYSTEM AUDITS

Laboratory audits, both internal and external, review and examine the operations performed in the laboratory. Internal audits are self-reviews and external audits are reviews by external organizations to evaluate the ability of the laboratory to meet regulatory or project requirements. The QA Officer schedules internal process audits to assure the completion of the annual audit of each operational area. The process audits are a more detailed review of the operations. Representatives sent by clients and government or accrediting agencies often perform external audits. These audits are most often announced inspections, but sometimes are not announced. The Quality Assurance Officer accompanies the external audit team through the laboratory. The auditors receive a brief overview of company objectives, activities, and facilities. Interviews with essential supervisory staff and technical staff are arranged, along with retrieval of any documentation pertinent to the audit. Auditors usually provide a report on their findings shortly after the audit. The QA Officer receives the audit report. The QA Officer completes nonconformance action forms in response to any cited deficiencies.

PERFORMANCE AUDITS

Alpha Analytical participates in interlaboratory comparisons and proficiency test programs required by clients and certifying agencies. In addition, the laboratory participates in third party double-blind performance evaluation programs. The performance audits provide information on the data comparability of results generated by the laboratory. Test samples received by the laboratory are handled following routine laboratory procedures. Analysts demonstrate proficiency by analyzing an external proficiency test sample or an internally prepared blind test sample

CORRECTIVE ACTIONS

The corrective action program at Alpha Analytical uses the Nonconformance Report form to document and follow through the corrective action process. The mechanism for recording, reviewing and acting upon all quality problems is self-explanatory as the form is completed. The process ensures continuous improvement of company performance by preventing the recurrence of quality problems.

EXPERIENCES

Alpha Analytical is operated as a full service, environmental analytical support laboratory. Our staff is very experienced with the engineering and risk assessment applications of environmental data. The laboratory routinely coordinates and adapts its services to meet each client's individual application needs. Laboratory senior staff is available to work together with project staff on all aspects of the project's data collection requirements - planning and logistics, sampling and analysis methodologies, data quality objectives, data interpretation and quality assurance. This unique, team approach allows the sampling and analysis component to be completely integrated into the project as a whole, which assures that the work will be performed correctly and efficiently.

The laboratory has a wide range of experience working for a diverse group of clients in the areas of drinking water, wastewater and hazardous or solid waste projects. Laboratory clients include major industrial/commercial facilities and governmental agencies, as well as environmental and geotechnical engineering firms. Laboratory services range from the analysis of conventional water quality parameters to the determination of a full spectrum of priority pollutants and other contaminants of concern in water, soil, and wastes.

PERFORMANCE EVALUATION PROGRAMS

We participate in multiple Water Pollution (WP) Underground Storage Tank (UST) and Soil Proficiency Test Evaluations as well as NIST sponsored inter-calibration laboratory comparison studies each year. We achieved National Environmental Laboratory Accreditation Conference (NELAC) accreditation in 2001 and Depart of Defense accreditation in 2009.

ACOE (Army Corps of Engineers) validated ¾ Navy validated ¾ Air Force (AFCEE) ERPIMS capable Our ACOE and Navy validations include a broad range of methods including volatiles, semivolatiles, pesticides/PCB, metals, waste characterization and wet chemistry.

In 1997, we participated in the Massachusetts VPH/EPH Method Round Robin and received a Record of Proficiency for all four categories of VPH/EPH from the Massachusetts Department of Environmental Protection (MADEP).

Laboratory Certifications
We maintain certifications with the following states and organizations:

- Massachusetts DEP
- Connecticut DOH
- Louisiana DEQ
- New Hampshire DES
- New Jersey DEP
- New York DOH
- Rhode Island DOH
- State of Maine DES

For an up to date and complete listing of Alpha Analytical's certifications, please visit, www.alphalab.com.

CONSTRUCTION/DEMOLITION SUPPORT

Geotechnical and infrastructure related projects can turn into hazardous waste characterization projects whenever soil conditions exposed by construction activities requires special handling and disposal. Alpha has provided emergency analytical support whenever construction crews “encounter the unexpected”. The laboratory works closely with characterization and construction project staff to provide them with the information they need, when they need it. Alpha has supported numerous demolition-related projects and we have the experience necessary to deal with the difficult sample matrices and disposal issues associated with these projects.

COAL GASIFICATION SITE CHARACTERIZATION

Legacies of the "gaslight era", former manufactured gas plant (MGP) sites have a unique chemical contamination signature and, as they were often located along waterways in urban areas, can present a significant challenge to remediation. Alpha has a wide array of capabilities applicable to MGP residuals; however we wish to highlight these specific procedures which can be used to determine the concentration of contaminates of concern that could be considered bioavailable.

PAH ANALYSIS OF SEDIMENT PORE WATER BY SPME GC/MS SIM

Total PAH concentrations in sediment are generally recognized in the literature to be poor predictors of benthic invertebrate toxicity. Porewater analysis would provide a better indication, however the direct measurement of PAH concentrations in pore water has traditionally been very challenging. ASTM Method D7363, "*Determination of Parent and Alkyl Polycyclic Aromatics in Sediment Pore Water Using Solid-Phase Microextraction and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode*" is a viable option in that only minimal pore water volume is required for an aliquot to be obtained under representative conditions from a small amount of sediment. Other advantages of this analytical procedure are:

- Direct analysis of pore water for parent and alkylated PAH
- Can be used to predict benthic invertebrate toxicity
- High sensitivity with reporting limits as low as 0.06 ug/L

BLACK CARBON

It has been shown that organic carbon can influence the bioavailability of PAHs, with the anthropogenic black carbon being an important fraction of the total. Alpha can perform *Black carbon determinations* as part of our routine sediment characterization suite of methodologies used.

FREE CYANIDE ANALYSIS BY MICRODIFFUSION PREPARATION/ SPECTROPHOTOMETRY

The cyanide chemistry associated with MGP residuals in the environment is of particular interest because a wide range of cyanide species can be present, and there can be a significant difference in toxicity observed among the species. The application of risk-based approaches to characterizing cyanide requires reliable analytical procedures that can delineate the cyanide species into categories associated with their relative toxicities. Alpha offers Method 9016 for the analysis of free cyanide, which provides the selectivity required to isolate and quantify the most toxic cyanide species, which is also generally the lowest percentage of the total cyanides present. In addition, Alpha can also perform the Physiologically Available Cyanide method, which is a modification of the total cyanide methodology to allow for the determination of free cyanide and weakly complexed cyanide species up to, but not including the iron cyanide complexes.

Alpha Analytical has considerable qualifications and experience working on site characterization and remediation projects involving former MGP operations where the chemical analysis of aqueous, sediment, soil, and air/soil gas samples, as well as free product is required. We have the technical knowledge and experience required to generate the best possible results from difficult sample matrices and potentially highly contaminated samples.

TRANSPORTATION

Alpha is also very experienced with transportation projects, ranging from right-of-way clearance and fuel depot remediation to the characterization of highway sweeping materials

POWER COMPANY PROJECTS

Alpha is experienced with the unique analytical services of interest to utility companies. Alpha has the experience to analyze for dielectric fluids and cable oils in the presence of other interfering hydrocarbon products, which could be potentially present in an urban environment. Also, Alpha has considerable experience with the analysis of transformer and other refined oils for PCBs.

SOLID WASTE LANDFILLS

Alpha provides analytical testing services to communities and commercial operators directly as well as through engineering firm project managers for groundwater monitoring programs at active and closed solid waste landfill facilities in New England. Alpha Analytical's staff is familiar with applicable regulations (e.g. 310 CMR 19.132), required methods and data quality objectives associated with the monitoring of groundwater, surface waters, seeps and leachates from landfills.

For a large commercial solid waste landfill, Alpha played a crucial role in the investigation of the production of acetone from landfill cover material consisting of composited paper pulp material. Alpha also has experience with incinerator waste ash analysis and toxicity testing for disposal. The laboratory is also experienced with the data deliverable requirements of most data management software programs commonly used for solid waste applications.

WASTEWATER DISCHARGE PERMITS

Alpha Analytical has considerable experience with wastewater analysis and provides regular testing services in support of NPDES permit regulatory requirements. Testing includes metals, organics and general chemistry parameters. Alpha Analytical Labs also provides services to MWRA permit holders in support of their monitoring requirements. Alpha is by far the largest provider of testing services for MWRA permit-related applications and our staff is very familiar with sample collection procedures, method requirements and reporting (via MWRA SMART software) of data to the Authority. Alpha has several on-going projects for large manufacturing and health care facilities related to the point source identification and minimization of regulated chemical discharges.

HIGH TECHNOLOGY/ELECTRONICS MANUFACTURERS

Alpha Analytical provides analytical testing services to major industries for process control/design as well as environmental monitoring and clean-up. Alpha provides contracted analytical services to several of the largest manufacturing centers for telecommunications and electronics

MANUFACTURING FACILITIES

Alpha Analytical has considerable experience providing analytical services to manufacturing facilities in general. Analytical testing of products as well as waste streams for conventional, as well as non-conventional, parameters are routinely conducted. For producers of dairy products, gelatins, soaps and detergents in support of wastewater discharge limitation studies, Alpha analyzed samples where high levels of fats, oil & grease (FOG) as well as oxygen demand (BOD/COD) and TSS where primary concerns.

PUBLIC WATER SUPPLY MONITORING

Alpha also provides testing services to engineering and consulting firms in their work with various water supplies. These services include testing of raw and finished waters using EPA methods in accordance with primacy state regulations and the reporting of results in the required state format.

In our routine testing facility in Westborough, MA, Alpha processes on average about 100 projects per day. These projects contain the full gamut of matrices: water, soil, building materials, oils, wastewater and more. We process these samples for organic methods (volatiles, semivolatiles, Pesticides, Herbicides, PCBs, metals, wet chemistry and microbiology). Our standard turn around time for most projects is 5 business days and we have an average 95% on-time performance (OTP) for routine work and 98% OTP for rush work.

PRIVATE CLIENT

Alpha was selected for a large superfund site in Massachusetts to perform volatiles, metals and wet chemistry parameters under a site specific Quality Assurance Project Plan. The project involved several environmental consultants and was sampled weekly for close to a year generating over $200,000 of testing. Turn around time was 5 business days for most work with a full CLP-like deliverable following in 3-5 days. Project also involved method development for specific treatment issues that surfaced during the treatment phase.

FEDERAL CONTRACT

A six year contract was awarded to Alpha in 2006 to perform work at the Massachusetts Military Reservation (MMR) for a remediation phase involving testing for explosives and perchlorates. Over $600,000 analytical work has been processed against strict QA/QC criteria with full CLP-like data packages generated.

ARMY CORPS OF ENGINEERS (ACOE) PROJECT

Former Devens military installation cleanup project and building demolition required collection of over 5,000 soil samples over a 4 month period for pesticide analysis to be analyzed on ten day turn around time under specific QAPP driven criteria. Staged Environmental Data Deliverables (SEDD) was required. Alpha’s high capacity operation was able to handle this large project.

PRIVATE CLIENT

Industrial cleaner under a violation of their discharge permit needed to isolate which of their clients was soaking cleaning rags with a solvent which was causing the violation in their discharge water. Alpha developed a screening method in a matter of a few days to identify the solvent on these cleaning rags and analyzed approximately 100 per day for 8 days to isolate the culprits. Our client was able to talk to their client who was causing the violation and mitigate the problem.

EXPERIENCE

Alpha Analytical has extensive experience supporting site characterization and remediation support project applications. In fact, this was the very purpose Alpha Analytical was founded for back in 1984 out of a former relationship with Rizzo

In our routine testing facility in Westborough, MA, Alpha processes on average about 100 projects per day. These projects contain the full gamut of matrices: water, soil, building materials, oils, wastewater and more. We process these samples for organic methods (volatiles, semivolatiles, Pesticides, Herbicides, PCBs, metals, wet chemistry and microbiology). Our standard turn around time for most projects is 5 business days and we have an average 95% on-time performance (OTP) for routine work and 98% OTP for rush work.

PRIVATE CLIENT

Alpha was selected for a large superfund site in Massachusetts to perform volatiles, metals and wet chemistry parameters under a site specific Quality Assurance Project Plan. The project involved several environmental consultants and was sampled weekly for close to a year generating over $200,000 of testing. Turn around time was 5 business days for most work with a full CLP-like deliverable following in 3-5 days. Project also involved method development for specific treatment issues that surfaced during the treatment phase.

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EXPERIENCE

Alpha Analytical has extensive experience supporting site characterization and remediation support project applications. In fact, this was the very purpose Alpha Analytical was founded for back in 1984 out of a former relationship with Rizzo consulting engineering firms working on industrial and commercial real estate projects. A listing of three illustrative projects follows:

PROJECT NAME

Major Railroad Yard Site Characterization and Remediation

Scope Summary

Beginning in early 2010 and continuing to the present, Alpha Analytical processed a considerable amount of soil and groundwater samples in support of this project. Parameters included volatile organics, semi-volatile organics, pesticides, PCBs, and metals as well as the MassDEP procedures extractable petroleum hydrocarbons (EPH), volatile petroleum hydrocarbons (VPH) and physiologically available cyanide. All analyses were conducted and reported in strict accordance with the Massachusetts Contingency Plan's Compendium of Analytical Methods (CAM). Alpha provided on call rush analyses as well as Saturday/Sunday sample receiving and pickups on an as needed basis. Also, although soil samples were originally submitted for total metals only, Alpha was requested to perform hexavalent chromium analysis on any sample where the total chromium concentration exceeded the trigger value. In accordance with the CAM, Alpha must analyze all total metal soil samples for pH and oxidation-reduction potential within 24 hours if there is the potential for subsequent hexavalent chromium analysis. This requirement caused additional logistical demands on the project team, specifically regarding the week end work, which was successfully achieved. Signed chain of custodies and sample submittal receipts consisting of a summary listing of samples received and parameters logged in for analysis were sent the following morning for each sample submittal. All data was automatically incorporated into the client's Alpha Data Exchange (ADEx) account which allowed for on-going project status checks and the ability to download data in a wide variety of additional formats. The ADEx deliverable included the "Data Merger" tool, which has the capability to group multiple laboratory reports into one electronic file, and the "Criteria Checker" format which automatically summarizes and compares the data to up to 5 sets of the applicable regulatory criteria.

PROJECT NAME

Former Industrial Facility Site Assessment

Beginning in 2007 and continuing to the present, Alpha analyzed soil, groundwater, sediments, porewater, and tissue samples worth approximately $700,000 to date in support of this site characterization, ecological risk assessment and remediation

Associates (now Tetra Tech). The vast majority of Alpha's work is with consulting engineering firms working on industrial and commercial real estate projects. A listing of three illustrative projects follows:

PROJECT NAME

Major Railroad Yard Site Characterization and Remediation

Beginning in early 2010 and continuing to the present, Alpha Analytical processed a considerable amount of soil and groundwater samples in support of this project. Parameters included volatile organics, semi-volatile organics, pesticides, PCBs, and metals as well as the MassDEP procedures extractable petroleum hydrocarbons (EPH), volatile petroleum hydrocarbons (VPH) and physiologically available cyanide. All analyses were conducted and reported in strict accordance with the Massachusetts Contingency Plan's Compendium of Analytical Methods (CAM). Alpha provided on call rush analyses as well as Saturday/Sunday sample receiving and pickups on an as needed basis. Also, although soil samples were originally submitted for total metals only, Alpha was requested to perform hexavalent chromium analysis on any sample where the total chromium concentration exceeded the trigger value. In accordance with the CAM, Alpha must analyze all total metal soil samples for pH and oxidation-reduction potential within 24 hours if there is the potential for subsequent hexavalent chromium analysis. This requirement caused additional logistical demands on the project team, specifically regarding the week end work, which was successfully achieved. Signed chain of custodies and sample submittal receipts consisting of a summary listing of samples received and parameters logged in for analysis were sent the following morning for each sample submittal. All data was automatically incorporated into the client's Alpha Data Exchange (ADEx) account which allowed for on-going project status checks and the ability to download data in a wide variety of additional formats. The ADEx deliverable included the "Data Merger" tool, which has the capability to group multiple laboratory reports into one electronic file, and the "Criteria Checker" format which automatically summarizes and compares the data to up to 5 sets of the applicable regulatory criteria.

PROJECT NAME

Former Industrial Facility Site Assessment

Beginning in 2007 and continuing to the present, Alpha analyzed soil, groundwater, sediments, porewater, and tissue samples worth approximately $700,000 to date in support of this site characterization, ecological risk assessment and remediation support project. Parameters included volatile organics, semi-volatile organics, low level PAHs, pesticides, PCBs, and metals as well as a wide variety of water quality parameters.

Specialized testing was also performed on brackish water samples analyzed for metals which utilized chelation extraction and arsenic / selenium analysis by gaseous hydride ICP/MS. Silica gel, florisil and gel permeation chromatography clean ups were also employed for particularly challenging sediment and tissue sample matrices analyzed for trace organics. Additional logistical support was also provided to facilitate sample pickups in that the project site was in an extremely remote area that was not always conducive to shipping given hold time constraints. Signed chain of custodies and sample submittal receipts consisting of a summary listing of samples received and parameters logged in for analysis were sent the following morning for each sample submittal. Complete CLP-like data deliverables were provided for all sample analyses. All data was automatically incorporated into the client's Alpha Data Exchange (ADEx) account which allowed for on-going project status checks and the ability to download data in a wide variety of additional formats. The ADEx deliverable included the "Data Merger" tool, which has the capability to group multiple laboratory reports into one electronic file, and the "Criteria Checker" format which automatically summarizes and compares the data to up to 5 sets of the applicable regulatory criteria

PROJECT NAME

Active Industrial Facility Site Assessment and Remediation

Beginning in 2005 and continuing to the present, Alpha analyzed soil and groundwater samples worth approximately $850,000 in support of this site characterization and remediation support project. Parameters included volatile organics, semi-volatile organics, low level PAHs, pesticides, PCBs, metals, TCLP, and SPLP as well as explosives, perchlorate and additional metals not commonly analyzed for. All analyses were conducted and reported in strict accordance with the state of Connecticut's Reasonable Confidence Protocols. Project was characterized by the need for reporting limits to meet stringent, project specific action levels that required the need for additional method development to modify standard procedures. Signed chain of custodies and sample submittal receipts consisting of a summary listing of samples received and parameters logged in for analysis were sent the following morning for each sample submittal. All data was automatically incorporated into the client's Alpha Data Exchange (ADEx) account which allowed for on-going project status checks and the ability to download data in a wide variety of additional formats. The ADEx deliverable included the "Data Merger" tool, which has the capability to group multiple laboratory reports into one electronic file, and the "Criteria Checker" format which automatically summarizes and compares the data to up to 5 sets of the applicable regulatory criteria.

ADDITIONAL PROJECTS

Environmental Consultant - Long term remedial investigation to establish range of contamination. Analyzed hundreds of water, soil samples as well as long term air analysis. Able to handle frequent quick TAT requests over long periods of time.

Environmental Consultant - Performed volatile organic analysis for fortune 500 specialty gas company on quarterly basis at multiple sites throughout New Jersey.

Environmental Consultant - Performed extensive amount of analytical in support of site investigation at a municipal airport in New Jersey. Suite of analyses included volatiles, semi-volatiles, metals and various hydrocarbon analyses.

Environmental Consultant - Real Estate Site Development in Long Island, NY - Alpha Analytical supported a full scale site investigation, remediation end point sampling, insitu waste characterization and vapor point monitoring for soil vapor extraction systems. Project requirements included 24-hour turnaround to meet disposal waste hauling schedule and development timelines.

Environmental Consultant - Alpha provided analytical support for a private NYC non-profit expanding their facility under the NYC Office of Environmental Remediation (OER). A full scale site investigation was conducted that provided information on the extent of contamination from historic fill. Data supporting the investigation was presented to OER for review.

Environmental Consultant - Alpha provided support for a NYC agency that included soil, water and vapor analysis. Often work was performed off hours so as not to interfere with the normal business operations of the agency. Alpha provided logistical support through our extensive courier system that supports various site investigations and remediations in the five boroughs of New York City.

Environmental Consultant - Alpha conducted a full scale building interior and subslab vapor investigation at a large warehouse in Woodhaven, Queens. Analysis was provided in support of future planned develpment of the site for retail and residential use.

PROFESSIONAL PROFILE

QUALIFICATIONS SUMMARY

- Over 25 years of experience in professional business management
- Proven success as COO of 11th largest environmental lab in USA
- Expertise specializing in:
- Improved Sales
- Increased Profitability
- Improved Operational performance
- Responsible for doubling company revenues from $8m to $16m
- Proven success in improving profitability and balance sheet
- Development of nationwide sales and marketing plans
- Negotiated contracts for several Fortune 500 companies

MARK H. WOELFEL

President/COO

PROFESSIONAL AFFILIATIONS

Society of Military Engineers (SAME)

Member Young Presidents Organization (YPO)

FIELDS OF EXPERTISE

Proven senior level manager with over 25 years of success specializing in improving sales, profitability and operational performance. Key strengths include sales and business development; operations management; customer relationship management, business plan development; strategic planning; acquisitions; and proposal/contract. Proven leader in developing and motivat- ing senior managers, operations, customer service and sales personnel.

HIGHER EDUCATION

MBA – Babson College, (1991)

BS Business Management – Fitchburg State College, Magna Cum Laude (1983)

EMPLOYMENT HISTORY

2001-Present	Alpha Analytical
1999-2001	Cendant, Inc. – VP Sales/Marketing
1991-1999	Clean Harbors, Regional Vice President
1983-1991	Data General Corporation, Corporate

QUALIFICATIONS SUMMARY

- Over 30 years of experience
- Extensive experience in all aspects environmental laboratory operations
- Actively involved in State regulatory programs
- Defined successful business and marketing strategy for Matrix Environmental Lab.
- Responsible for business development in various markets including the private sector, state and federal programs

GLEN BRELAND

VP Technical Sales / Client Services/Sales Manager

PROFESSIONAL AFFILIATIONS

Associate Member, Licensed Site Professionals (LSPA)

Associate Member, Environmental Professionals of CT (EPOC)

Society of Military engineers (SAME)

Member MA DEP Data Enhancement Workgroup

Member CT DEP Quality Control Workgroup

FIELDS OF EXPERTISE

Glen brings over 30 years of experience in Analytical and Environmental lab testing. As previous Lab Director and cofounder of Matrix Analytical, Inc., Mr. Breland managed all operational aspects of the laboratory including a large staff of chemists, technicians, and administrative personnel. His position covered laboratory budget projections and controls, establishment of laboratory systems and procedures, selection of test methodologies, and overall responsibility for laboratory safety and the Quality Assurance Program.

HIGHER EDUCATION

MS – Clinical Chemistry – Northeastern Univ. (71-74)

BS – Chemistry/Botany – Valdosta State College, GA (1971)

EMPLOYMENT HISTORY

2000-Present	Alpha Analytical
1983-2000	Matrix Analytical , Co-Founder, Director
1983-1991	Gemini Medical Systems - Consultant
1981-1982	NE Medical Lab – Computer Ops Director
1974-1981	NE Medical Lab – Lab Manager

PUBLICATIONS AND PRESENTATIONS

Sample Integrity and Laboratory Ethics; Presentation given to National Conference of Clinical Laboratories, Philadelphia, PA 1979

Getting Paid The Laboratory Dilemma; Article published in Environmental Laboratory August 1991

Detection Limits: A Laboratory Perspective; Presentation & paper given at National Waste Water Conference, Providence, RI 1994

Implementation of the Massachusetts DEP Data Enhancement Program; Presentation given at Amherst Soils Conference, University of Massachusetts, Amherst October 2003.

QUALIFICATIONS SUMMARY

- Over 15 years of professional management experience in environmental laboratories
- Extensive experience in all aspects of environmental laboratory operation.
- Directed and implimented facility wide expansion to accommodate the integration of product testing operations.
- Defined successful business and marketing strategy to capitalize on new business opportunities
- Responsible for all aspects of two facilities with 180 employees and annual revenues of $28M
- Recognition and awards for:
- Most Improved Performance
- Highest Financial Growth
- Most Improved laboratory performance
- Highest profit growth

CHRISTOPHER A. OUELLETTE

VP/Operations Director

PROFESSIONAL AFFILIATIONS

SCORE: Service Corps of Retired Executives, Vermont Charter

FIELDS OF EXPERTISE

Extensive experience with process improvements directed at production, capacity, forecast management and business operations. Proven ability to develop, implement and drive the execution of operational excellence business models to support both revenue and margin growth. Leadership skill that develop and motivate senior managers, operations, customer service and sales personnel and production managers to exceed business financial goals and objectives.

HIGHER EDUCATION

BS Biology – University of Vermont (1989)

EMPLOYMENT HISTORY

2006-Present	Alpha Analytical
2004-2006	STL – Colchester, Vermont – Director
2001-2004	STL – Edison, NJ – Laboratory Director
1998-2001	STL – Colchester, Vermont – Laboratory Director
1995-1998	Intertek Testing Services – Director Client Services
1991-1995	Inchape Testing Services – Project Director

QUALIFICATIONS SUMMARY

- Over 25 years of experience
- Extensive experience in all aspects environmental laboratory operations
- Actively involved in State regulatory programs and industry associations
- President of Independent Testing Laboratory Association (ITLA)
- Extensive knowledge of:
    - –Data interpretation
    - –Data usability
    - –Sampling techniques
    - –Method selection
    - –QA/QC

JAMES OCCHIALINI

VP Technical Sales

PROFESSIONAL AFFILIATIONS

Associate Member, Licensed Site Professionals (LSPA)

Associate Member, Environmental Professionals of CT (EPOC)

Society of Military Engineers (SAME)

Member MA DEP Data Enhancement Workgroup

FIELDS OF EXPERTISE

Jim brings 25 years of environmental analytical and consulting experience which includes working on a wide range of project applications from water supply, wastewater and solid waste to hazardous waste characterization and remediation. As a Principal Scientist with Camp Dresser & McKee Inc. and Laboratory Manager, he oversaw the technical and administrative activities of the laboratory, which provided a wide range of environmental testing, treatability and consulting services. Jim provided considerable direction in the design of the laboratory facility and the development of many of its unique, full-service analytical support capabilities.

HIGHER EDUCATION

BS Environmental Science, University of Massachusetts (1978)

PUBLICATIONS AND PRESENTATIONS

"Data Quality Objectives for Hazardous Waste Site Remediation" by James F. Occhialini and Linda Y. Boornazian, USEPA. Presented at the Fourth Annual Hazardous Materials Management Conference, Atlantic City NJ, 1986

"Investigating Dioxin in Treatment Plant Sludge" by Robert H. Sheldon, James F. Occhialini and Albert B. Pincince. Presented at the Water Pollution Control Conference, Philadelphia PA, 1987

"A Comparison of EPA Method 510.1, the Determination of Maximum Total THM Potential, with a Procedure Developed to Model THM Formation in Distribution Systems" by James F. Occhialini, Peter T. Maynard and Daniel P. Roberge. Presented at the American Water Works Association Water Quality Technology Conference, Toronto, Ontario, Canada, 1992

"Nuisance Odors Associated with the Use of Propylene Glycol Based Deicers" by James F. Occhialini. Presented at the ACI-NA Joint Environmental/Technical Committee Meeting, Pittsburgh, PA 1996

JAMES OCCHIALINI (continued)

"Evaluation of a GC PID/FID Procedure for the Analysis of EPH" by James F. Occhialini, David L. Gottshall and Robert A. Burke. Presented at the 11th Annual Conference on Contaminated Soils, University of Massachusetts, Amherst, 1996

"Round Robin HAA Testing Prompts Uncertainty in EPA Method 552.1" by Sarah Elizabeth Seckinger, Carol Ashe and James F. Occhialini. Presented at the American Water Works Association Water Quality Technology Conference, Boston MA, 1996

"An Evaluation of Method 552.1 and SM 6233B Performance for the Determination of Haloacetic Acids" by James F. Occhialini, Susan Crowell, Daniel P. Roberge, and Peter T. Maynard. Presented at the American Water Works Association Water Quality Technology Conference, Boston MA, 1996

"Aircraft and Runway Deicers Environmental Considerations" by Brent A. McCarthy, Robert A. Dangel and James F. Occhialini. Position paper prepared for the CDM Technical Council, 1996

"Successful Laboratory Operations" by James F. Occhialini. Presented at the New England Water Works Association training session "Current Issues Impacting Drinking Water Quality Laboratories", Boxboro, MA, October, 1998

"Sampling and Analysis of Soils for VOCs" by James F. Occhialini, LSPA Membership Meeting, Fall, 2000

"Trace Organics Analysis" by James F. Occhialini, The Massachusetts Pretreatment Forum, Millbury MA, March 2000

"Case Study: VPH and EPH Report Review" by James F. Occhialini and James C. Todaro,
The MADEP Petroleum Analytical Methods: VPH, EPH and APH, Marlborough MA, May 2001 (2 sessions)

"Update on Laboratory Analysis" by James F. Occhialini, New England Water Works Association, Spring 2001 Joint Regional Operations Conference and Exhibition, Worcester MA, April 2001

"MCP Data Quality Enhancement Program" by James F. Occhialini, Air & Waste Management Association Conference, New England Section, Worcester MA, October 2002

"MCP Data Quality Enhancement Program" by James F. Occhialini, Changes to the MCP- Impacts to Business and Municipalities, Waltham MA, June 2002

"Laboratory Quality Assurance and Quality Control Concepts" by James F. Occhialini, MADEP Data Quality Enhancement Training, Massachusetts (12 sessions statewide), Spring 2002

"MCP Data Quality Enhancement Program – The Laboratory Perspective", by James F. Occhialini, LSPA Membership Meeting, Marlborough MA, January 2002

"A Comparison of Commonly Used Cyanide Analytical Methodologies for Manufactured Gas Plant (MGP) Applications" by James F. Occhialini, James C. Todaro, Joseph Clements, James Roth, Elena Dayn, Tamara Burke Devine, William R. Swanson, and Michael Rostkowski, presented at the 19th Annual International Conference for Contaminated Soils, Sediments and Water, UMASS Amherst, October, 2003

"Modified In Vitro Method for the Determination of Lead and Arsenic Bioaccessibility" by James F. Occhialini, James C. Todaro and Joseph Clements, poster presentation, 19th Annual International Conference for Contaminated Soils, Sediments and Water, UMASS Amherst, October, 2003

"The Massachusetts Contingency Plan (MCP) Data Quality Enhancement Program – Implementation Overview and Lessons Learned from a Laboratory Perspective" by James F. Occhialini. Presented at The National Environmental Monitoring Conference, Washington DC, July 2003

"MCP Data Quality Enhancement Program – Overview & Current Status" by James F. Occhialini, AMEL/LANH Tradeshow, Sacco ME, May 2003

"Got Sulfur? Analytical Methods in the Odor Threshold Range" by Andrew Rezendes, James F. Occhialini and Michael Lannan. Water Environment Federation / Air & Waste Management Association, Bellevue, WA, April, 2004

QUALIFICATIONS SUMMARY

- Over 20 years of experience in the field of environmental chemistry
- Extensive experience in all aspects of environmental analysis including analytical techniques, method development and SOP generation
- Excellent knowledge of laboratory methods, procedures, instrument operation and method development
- Data review and validation
- Implemented new air division including writing and implementing all procedures, SOP's, quality control.
- Technical chair for ITLA
- Workgroup participant and reviewer for MA DEP Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430
- Contributor and reviewer for MA DEP Air Phase Petroleum Hydrocarbon Method
- Consultant for MA DOH for Superfund site GE-PCB contamination of Pittsfield, MA

CHRISTOPHER J. WAKEFIELD, PhD

VP/Operations Director

PROFESSIONAL AFFILIATIONS

American Chemical Society (ACS)

Air & Waste Management Association (AWMA)

FIELDS OF EXPERTISE

Environmental chemist with extensive experience in analytical techniques with proven managerial and communication skills. Technical excellence in analytical chemistry in all aspects of the laboratory from quality control to instrumentation.

HIGHER EDUCATION

PhD Environmental Engineering – Kennedy Western University (2007)

BS Chemistry – Westfield State College (1999)

BS Exercise Science – University of Massachusetts (1982)

EMPLOYMENT HISTORY

2006-Present	Alpha Analytical
2005-2006	Spectrum Analytical – Technical Director
2002-2005	Spectrum Analytical – Air Division Manager
1997-2002	Con-Test Analytical – Air Division Manager
1995-1997	Commonwealth Analytical – Technical Director
1993-1995	Tighe & Bond – Laboratory Supervisor
1991-1993	ACZ Laboratories – Organic Lab Supervisor
1984-1990	Aquatec – GC/MS Chemist

QUALIFICATIONS SUMMARY

- Over 35 years of experience in the field of environmental chemistry and analytical laboratory field
- Extensive experience in all aspects of environmental analysis including analytical techniques, method development and SOP generation
- Experienced in all aspects of Quality Assurance programs
- Responsible for adherence to both State and National certification programs
- Extensive experience involving management of environmental laboratory operations

JAMES C. TODARO

Quality Assurance Officer

PROFESSIONAL AFFILIATIONS

Massachusetts DEP Laboratory Advisory Committee

American Chemical Society (ACS)

American Society of Testing Materials (ASTM)

Society of American Military Engineers (SAME)

National Environmental Laboratory Accreditation Conference (NELAC)

FIELDS OF EXPERTISE

Experienced in all aspects of environmental analysis including, but not limited to, inorganic analyses on soil, wastewater, drinking water; development and implementation of Quality Assurance program; data review and final approval. Extensive experience in Laboratory Management.

HIGHER EDUCATION

BA Biology - Ricker College (1970)

MTASCP- Norwood Hospital (1971)

EMPLOYMENT HISTORY

2000-Present	Alpha Analytical Quality Assurance Officer (current) Laboratory Director - Mansfield facility Laboratory Director - Westboro facility
1983-2000	Matrix Analytical - Principal, Lab Director
1980-1983	NE Medical Lab - Lab Director
1976-1980	Corning Medical - Quality Assurance Officer
1974-1976	NE Deaconess Hospital - Lab Tech
1971-1974	NE Medical Lab - Chemistry Manager

QUALIFICATIONS SUMMARY

- Over 17 years experience in the Environmental Laboratory industry
- Experienced in all aspects of GC and GC/MS systems
- Excellent knowledge of extraction and preparatory procedures
- High quality standards while ensuring quick turnaround and increased productivity
- Implemented new extraction equipment and methodologies
- Experienced in data review and final approval adhering to QA/QC guidelines

SCOTT J. ENRIGHT

Volatiles, Semi Volatiles, Extraction Lab Department Manager

FIELDS OF EXPERTISE

Extensive working knowledge of organic analysis including extraction and preparatory procedures; supervision of analytical departments; development and maintenance of laboratory methods, training of new analysts and instrument setup. Experienced in QA/QC procedures, data review and Level 5 report generation.

HIGHER EDUCATION

BS Chemical Engineering - Tufts University (1992)

EMPLOYMENT HISTORY

1995-Present	Alpha Analytical

QUALIFICATIONS SUMMARY

- More than 14 years experience in various sample preparation methods with extensive experience using a variety of analytical instrumentation methods
- Experience in trace metals chemistry, low level methods development, and measurement using, ICP/MS; Wet Chemistry and Microbiology
- Familiar with EPA methodologies for metals analysis including ICP, ICP/MS, GFAA, CVAA/AF
- Intimate knowledge of regulatory requirements for analytical programs such as MADEP and NELAC
- Supervises, organizes schedules, analyzes, and reviews data for client specific reporting limits and formats

JOHN KOWALSKI

Metals Department Manager

FIELDS OF EXPERTISE

Extensive working knowledge of, but not limited to, Inductively Coupled Plasma (ICP), Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS), HPLC, Ion Chromatograph, TOC analyzer and Lachat autoanalyzer.

HIGHER EDUCATION

B.S. in Chemistry from Bridgewater State College (1992)

EMPLOYMENT HISTORY

2011-Present	Alpha Analytical, Inc. – Metals Manager
2004-2011	Groundwater Analytical, Inc. – Inorganics Manager
2002-2004	Chromaceutical Advanced Technology – Lab Manager
2000-2002	Precision Detectors – Instrument Service/Sales
1998-2000	Groundwater Analytical, Inc. – Inorganics Manager
1997-1998	Jordi Associates – Polymer Chemist
1992-1997	Groundwater Analytical, Inc. – Inorganics Analyst/Supervisor

KEY PROJECTS/TRAINING

Designed analytical methods for CONRAD, an organization developing polymer based contraceptives. Worked with the scientists on an analytical and stability testing framework for the NDA.

Co-authored a patent for the purification of an iron hematinic drug. The purpose is to remove impurities that cause adverse reaction in patients receiving the hematinic drug while undergoing hemodialysis with supplemental epoetin therapy.

Received training in trace metals analytical methods from Perkin Elmer and Leeman Labs.

Performed Instrument installations, IQ/OQ/PQ, customer training and instrument repair.

Developed analytical methods for the analysis of cyanide compounds in solar panel coatings.

LISA S. WESTERLIND

Data Reporting Manager

QUALIFICATIONS SUMMARY

- Extensive knowledge of quality control and method protocol in regards to analytical reporting
- Strong technical background in GC/MS, GC and HPLC based methods
- Independent research in Synthetic Organic Chemistry for National Science Foundation
- Proficient computer skills include ISIS Draw, 3D Molecular Modeling and LIMs
- Experienced in development of GC/MS and HPLC method

FIELDS OF EXPERTISE

Extensive working knowledge of, but not limited to, all aspects of organic analysis, sample extraction procedures; QA/QC procedures; data deliverables including Level 5 data packages.

PROFESSIONAL AFFILIATIONS

Member of American Chemical Society

EDUCATION

BA Chemistry - Assumption College (2000) Cum Laude

EMPLOYMENT HISTORY

2002-Present	Alpha Analytical
2001-2002	Geomet Technologies – Analytical Chemist
2000-2001	Georgetown University – Teaching Assistant
1996-2000	University of Massachusetts – Lab

QUALIFICATIONS SUMMARY

- Over 20 years experience in analytical chemistry
- Extensive experience in all phases of chemical laboratory analysis
- College lecturing with strong background in scientific research

ELENA A. DAYN

Inorganic Chemistry Manager

FIELDS OF EXPERTISE

Experience Analytical Chemist with a strong European background in all phases of chemical laboratory work including HPLC, TLC, GC, NMR- spectrometry, Ion Chromatography.

EDUCATION

BS Chemistry – Moscow University, Russia (1984)

EMPLOYMENT HISTORY

1993-Present	Alpha Analytical
1989-1992	Moscow Technical College – Chemistry Professor
1984-1989	Moscow Institute of Organic Chemistry
1982-1984	Moscow University

Alkalinity, Titration Method

Reference Methods: **Method 2320 B,** Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 1997.

1. Scope and Application

Matrices: This method is applicable to water matrices.

Definitions: See Alpha Laboratories Quality Manual Appendix A.

The alkalinity of a water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates, or other bases if these are present. Alkalinity in excess of alkaline earth metal concentrations is significant in determining the suitability of a water for irrigation. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes. Raw domestic wastewater has an alkalinity less than, or only slightly greater than, that of the water supply. Properly operating anaerobic digesters typically have supernatant alkalinities in the range of 2000 to 4000mg calcium carbonate ($CaCO_3$)/L.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case by case basis.

2. Summary of Method

Hydroxyl ions present in a sample as a result of dissociation or hydrolysis of solutes react with additions of standard acid. Alkalinity thus depends on the end-point pH used, and for total alkalinity a pH of 4.5 is used for the end-point.

When alkalinity is due entirely to carbonate or bicarbonate content, the pH at the equivalence point of the titration is determined by the concentration of carbon dioxide (CO_2) at that stage. Carbon dioxide concentration depends, in turn, on the total carbonate species originally present and any losses that may have occurred during titration. “Phenolphthalein alkalinity” is the term traditionally used for the quantity measured by titration to pH 8.3 irrespective of the colored indicator used in the determination.

The results obtained from the phenolphthalein and total alkalinity determinations offer a means for stoichiometric classification of the three principal forms of alkalinity present in many waters. The classification ascribes the entire alkalinity to bicarbonate, carbonate, and hydroxide, and assumes the absence of other (weak) inorganic or organic acids, such as silicic, phosphoric, and boric acids. It further presupposes the incompatibility of hydroxide and bicarbonate alkalinities. Because the calculations are made on a stoichiometric basis, ion concentrations in the strictest sense are not represented in the results, which may differ significantly from actual concentrations, especially at a pH > 10.

2.1 Method Modifications from Reference

The reporting limit for this method is less than that in the Reference Method.

0.02N NaOH (Sodium Hydroxide) is used for LCS instead of 0.05N Na2CO3 (Potassium Carbonate) for LCS. All reagents are commercially prepped and have certificate of analysis.

3. Detection Limits

The laboratory follows the procedure found in 40CFR Part 136 to determine the MDL on an annual basis. The method detection limits determined by the laboratory are on file for review.

The reported detection limit is 2.0mg/L.

4. Interferences

Soaps, oily matter, suspended solids, or precipitates may coat the glass electrode and cause a sluggish response. Allow additional time between titrant additions to let the electrode come to equilibrium or clean the electrode between samples.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Samples for Alkalinity analysis are collected in exclusive plastic or glass bottles, with Alkalinity as the only analysis from the bottle. The bottles are filled completely, without any headspace, and capped tightly. The sample container is not opened until the time of analysis.

6.2 Sample Preservation

Store at 4 ± 2°C.

6.3 Sample Handling

The sample holding time is 14 days from collection. Initial sample pH measurement is documented during the beginning of alkalinity analysis. The pH results are included on the printout with the Alkalinity data.

7. Equipment and Supplies

7.1 **DL58 Mettler Toledo Titrator:** With Rhondo 60 autosampler, pH meter and stirplate.

7.2 **Combination Electrode:** Incorporates measuring and referenced functions; solid, gel-type filling material.

7.3 **Computer:** with related accessories. LabXLight software, version 1.00.000

7.4 **Pipets:** Volumetric, various volumes; or Eppendorf pipets, various volumes.

7.5 **Flasks:** Volumetric, various volumes.

7.6 **Kimwipes.**

7.7 **Plastic Cups:** Mettler Toledo brand, 100mL volume.

8. Standards and Reagents

8.1 **Standard Sulfuric Acid, 0.1N:** A commercially prepared standard solution which has been standardized against a NIST standard. A certificate of analysis is kept on file. Store at room temperature. Expires upon manufacturer's specified date.

8.2 **Standard Sulfuric Acid, 0.02N:** A commercially prepared standard solution which has been standardized against a NIST standard. A certificate of analysis is kept on file. Store at room temperature. Expires upon manufacturer's specified date.

8.3 **Sodium Hydroxide Solution, 0.1N:** A commercially prepared solution. A certificate of analysis is kept on file. Store at room temperature. Expires upon manufacturer's specified date.

8.4 Sodium Hydroxide Solution, 0.02N: A commercially prepared solution. A certificate of analysis is kept on file. Store at room temperature. Expires upon manufacturer's specified date.

8.5 Sodium Hydroxide Solution, 0.5N: A commercially prepared solution. A certificate of analysis is kept on file. Store at room temperature. Expires upon manufacturer's specified date.

8.6 pH Buffer Solutions: pH 4 and pH 10; two sources/Lot numbers of pH 7. Use to calibrate pH meter. Store at room temperature. Expires upon manufacturer's specified date.

9. Procedure

9.1 SET-UP

Calibrate the pH meter of the Mettler/Toledo Titrator each day prior to use. Follow the manufacturer's instructions for calibration, using pH 4, pH 7, and pH 10. Buffer solutions. Validate the calibration by using a second source pH 7 Buffer. The results must be within ± 0.05 pH units, otherwise recalibration is necessary.

9.2 Equipment Operation and Sample Analysis

9.2.1 Shake sample and pour 50mL into a plastic Mettler-Toledo cup. Place cups into the Rhondo autosampler.

9.2.2 Ensure that the Autotitrator is in "Remote Control" mode and that the rinse bottle is full of DI water and titrant bottle is full of standard acid (one from Section 8.1 – 8.2).

9.2.3 Open LabX software package. Click "Open View" on the Titrator. Choose appropriate method:

9.2.3.1 Meth .3" – Total Alkalinity for Total Alkalinity determination

9.2.3.2 Meth .4" – 2 Step Alkalinity for other types of alkalinity determinations.

9.2.4 Purge the buret of any air bubbles present.

9.2.5 With a right click on the computer mouse, select "New Sample Series". Type series ID and the sample ID to be analyzed. Click on the "Save" button.

9.2.6 The Series ID will appear in the "Samples" column. Click on that Series ID and using a right mouse-click, select "Run" from the drop-down menu.

9.2.7 After the Run is complete, check for printout results. The initial sample pH results are included on the data printout and are available upon request.

9.2.8 NOTE: Only 30mL of titrant may be used. If samples use more than 30mL of titrant, sample dilution and reanalysis are necessary. Dilutions are prepared by using a known amount of standard acid and then titrating a smaller volume of sample.

9.3 Preventative Maintenance

9.3.1 The pH electrode is replaced as necessary.

9.3.2 Prior to each analytical run, the Autotitrator buret is checked and purged of any air bubbles present.

9.3.3 Autotitrator buret is checked quarterly by the QA department to ensure accuracy.

9.4 Calculations

9.4.1 Alkalinity, mg $CaCO_3$/L = $\dfrac{\mathbf{A} \times \mathbf{N} \times 50{,}000}{\text{mL sample}}$

where:

A = mL of the standard acid titrated
N = normality of the standard acid

9.4.2 **Calculation of Alkalinity Relationships:** The mathematical conversion of the results is shown in Table 1.

9.4.2.1 **Carbonate (CO_3) Alkalinity** is present when phenolphthalein alkalinity is not zero but is less than total alkalinity.

9.4.2.2 **Hydroxide (OH) Alkalinity** is present if phenolphthalein alkalinity is more than half the total alkalinity.

9.4.2.3 **Bicarbonate (HCO_3) Alkalinity** is present if phenolphthalein alkalinity is less than half the total alkalinity.

9.4.2.4 **Carbon Dioxide (CO_2)**

9.4.2.4.1 **Free CO_2** is present if the total Alkalinity of a water is due almost entirely to hydroxides, carbonates or bicarbonates, and Total Dissolved Solids is not greater than 500mg/L.

mg Free CO_2/L = $2.0 \times B \times 10^{(6-pH)}$

Where:

B = Bicarbonate alkalinity, mg $CaCO_3$/L

9.4.2.4.2 **Total CO_2** is calculated from the Free CO_2, bicarbonate alkalinity and carbonate alkalinity.

mg Total CO_2/L = $[A + 0.44\,(2B + C)]$

Where:

A = mg free CO_2/L (Section 9.4.2.4.1)

B = Bicarbonate alkalinity, mg $CaCO_3$/L

C = Carbonate alkalinity, mg $CaCO_3$/L

Table 1: Alkalinity Relationships

Result of Titration	**Hydroxide Alkalinity as $CaCO_3$**	**Carbonate Alkalinity as $CaCO_3$**	**Bicarbonate Concentration as $CaCO_3$**
P = 0	0	0	T
P < ½ T	0	2P	T – 2P
P = ½ T	0	2P	0
P > ½ T	2P – T	2 (T – P)	0
P = T	T	0	0

Key: P = Phenolphthalein Alkalinity
T = Total Alkalinity

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When the parameter tested fails at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test.

10.2 Blank

Analyze one Blank per batch of 20 samples or less. The Blank consists of 50mL of DI water. Blank results must be less than the reported detection limit. No samples may be analyzed until an acceptable Blank is obtained.

10.3 Laboratory Control Samples (LCS)

Analyze one LCS per batch of 20 samples or less.

A 100ppm LCS is prepared by adding 5mL of 0.02N Sodium Hydroxide solution (Section 8.4) to 45mL of DI water. The LCS must be recovered within control limits generated by QA. If the LCS falls outside of acceptance criteria, it is reprepared and reanalyzed. If failure continues, the titrator is rinsed and the LCS analyzed again. No samples may be analyzed until an acceptable LCS recovery is obtained.

10.4 Matrix Spike

Analyze one matrix spike per batch of 20 samples or less.

A 100mg/L spike is prepared by adding 1.0mL of 0.1 N Sodium Hydroxide solution (Section 8.3) to 50mL of sample. The MS recovery must be within control limits. If the MS is outside of acceptance criteria, the sample and its spike are reanalyzed. If failure continues, report the data with a narrative to be included on the final report.

10.5 Duplicates

Analyze one sample in duplicate per batch of 20 samples or less.

The %RPD between the sample and its duplicate must within control limits. If %RPD is outside of acceptance criteria the sample and its duplicate are reanalyzed. If failure continues, report the data with a narrative to be included on the final report.

10.6 Continuing Calibration

A Continuing Calibration Verification (CCV) (equivalent to the LCS) and a Continuing Calibration Blank (CCB) pair is analyzed at the end of each analytical run to ensure that calibration is still valid.

Acceptance criteria for the CCV are 90-110% of the true value. If the CCV fails these criteria, all samples in the associated batch are reanalyzed.

The CCB must be less than the RL of 2.0mg/L. If the CCB fails these criteria but the associated sample concentrations are non-detect, the sample results are reported with a narrative. If the CCB fails these criteria but the associated sample concentrations are greater than 10x the Reporting Limit, the sample results are reported with a narrative. Otherwise, if the CCB fails, all samples in the associated batch are reanalyzed.

10.7 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained.

Control limits for the method parameters are generated by the QC staff. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.8 Analytical Sequence

- Calibrate the pH meter and verify calibration with second source standard.
- Measure the sample and QC sample aliquots.
- Titrate to the pH endpoint on the autotitrator.
- Calculate the results.

11. Method Performance

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

Method performance data is on file in the laboratory QC department. Comparison of method performance data for the laboratory to the reference method criteria occurs when laboratory in-house acceptance limits are generated. In-house generated data must be within the specifications of the reference method or the analysis is not continued until corrective action is completed.

12. Corrective Actions

Holding time exceedence and improper preservation are noted on the nonconformance report form.

Review of LCSs, blanks, spikes and duplicates occur for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the LCS recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

See Chemical Hygiene Plan for waste handling and disposal.

Nitrogen, Ammonia

Reference Methods: **SM4500 NH_3-BH,** Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 1997.

Method 350.1, Methods Methods for the Chemical Analysis of Water and Wastes, EPA 600/ 4-82-055, Revision 2.0, August 1993.

Method 10-107-06-1-A, Methods for Automatied Ion Analyzers, May 20, 1998.

1. Scope and Application

Matrices: Ammonia nitrogen can be determined in potable, surface, and saline waters as well as domestic and industrial wastewaters and in soils.

Definitions: See Alpha Laboratories Quality Manual Appendix A.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Tecator and/or Lachat Instrument and in the interpretation of Lachat data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case by case basis.

In waters and wastewaters the forms of nitrogen of greatest interest are, in order of decreasing oxidation state: nitrate, nitrite, ammonia, and organic nitrogen. All these forms of nitrogen, as well as nitrogen gas (N_2), are biochemically interconvertible and are components of the nitrogen cycle. They are of interest for many reasons. Organic nitrogen is defined functionally as organically bound nitrogen in the trinegative oxidation state. It does not include all organic nitrogen compounds. Analytically, organic nitrogen and ammonia can be determined together and have been referred to as “kjeldahl nitrogen,” a term that reflects the technique used in their determination. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials. Typical organic nitrogen concentrations vary from a few hundred micrograms per liter in some lakes to more than 20mg/L in raw sewage.

Ammonia is present naturally in surface and wastewaters. Its concentration generally is low in groundwaters because it adsorbs to soil particles and clays and is not leached readily from soils. It is produced largely by deamination of organic nitrogen containing compounds and by hydrolysis of urea. At some water treatment plants ammonia is added to react with chlorine to form a combined chlorine residual.

In the chlorination of wastewater effluents containing ammonia, virtually no free residual chlorine is obtained until the ammonia has been oxidized. Rather, the chlorine reacts with ammonia to form mono- and dichloramines. Ammonia concentrations encountered in water vary from less than 10µg ammonia nitrogen/L in some natural surface and groundwaters to more than 30mg/L in some wastewaters.

In this discussion, organic nitrogen is referred to as organic N, nitrate nitrogen as NO_3-N, nitrite nitrogen as NO_2-N, and ammonia nitrogen as NH_3-N.

2. Summary of Method

The sample is buffered at pH 9.5 with a borate buffer to decrease hydrolysis of cyanates and organic nitrogen compounds. It is distilled into a solution of boric acid. The ammonia in the distillate is determined colorimetrically by the phenate method.

The phenate method is base on the Berthelot reaction. Ammonia reacts with alkaline phenol, then with sodium hypochlorite to form indophenol blue. Sodium nitroprusside (nitroferricyanide) is added to enhance sensitivity. The absorbance of the reaction product is measured at 630nm, and is directly proportional to the original ammonia concentration.

2.1 Method Modifications from Reference

Method was modified to include soil sample distillation. Samples are buffered at pH 9.5. pH is checked using pH paper 7.5-14 (not pH meter)

3. Detection Limits

The laboratory follows the procedure found in 40CFR Part 136 to determine the MDL on an annual basis. The method detection limits determined by the laboratory are on file for review.

The RDL is determined to be 0.075mg/L based on a 100mL sample size for waters and 7.5 mg/kg based on 1g of soil material used for distillation..

4. Interferences

Most of the following interferences refer to the direct analysis of a water sample. The distillation steps remove most of these interferences.

4.1 Instrument

Samples with a high concentration of NH_3 may carry-over into the next sample and therefore yield false high results in that next sample. If a sample with a low concentration follows a sample with a high concentration, re-analyze the low sample to ensure results are accurate.

4.2 Parameters

4.2.1 Glycine, urea, glutamic acid, cyanates, and acetamide hydrolyze very slowly in solution on standing but, of these, only urea and cyanates will hydrolyze on distillation at pH of 9.5. Hydrolysis amounts to about 7% at this pH for urea and about 5% for cyanates. Some of the organic compounds that may interfere, such as formaldehyde, may be eliminated by boiling off at a low pH before nesslerization. Remove residual chlorine by sample pretreatment.

4.2.2 Color and turbidity of the sample distillate may interfere with analysis. These interferences are removed by manual filtration of the distillate prior to Lachat analysis, or by dilution of the sample prior to distillation.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

Note: Phenol used in this method is hazardous and general laboratory safety practices must be observed.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

The most reliable results are obtained on fresh samples. Use plastic or glass containers.

6.2 Sample Preservation

If prompt analysis is impossible, preserve samples with approximately 0.8mL concentrated H_2SO_4/L sample. The pH of the acid-preserved samples should be <2. (Some wastewaters may require more concentrated H_2SO_4 to achieve this pH.) Store samples at 4ºC.

Soils samples are received without preservation and stored at 4ºC

6.3 Sample Handling

Samples (both waters and soils) are analyzed within 28 days after collection.

7. Equipment and Supplies

7.1 **Distillation apparatus:** Tecator Instruments Automatic Distillation Unit. Follow the instrument manufacturer's instructions for proper operation.

7.2 **pH Strips:** Range 7.5 to 14 units.

7.3 **250mL Disposable Polypropylene cups with covers.**

7.4 **Automated Ion Analyzer:** Lachat Instruments.

7.5 **Helium gas, He:** 140kPa (20 lb/in^2).

7.6 **Volumetric flasks,** various volumes.

7.7 **Pipets,** various volumes.

7.8 **Analytical Balance**

7.9 Centrifuge Tubes: 50mL volume.

8. Standards and Reagents

8.1 Borate buffer solution: Add 88mL 0.1N NaOH solution to 500mL of approximately 0.025M sodium tetraborate ($Na_2B_4O_7$) solution (9.5g $Na_2B_4O_7 \cdot 10\ H_2O$/L) and dilute to 1L with DI water. Store at room temperature. Expires one month from date of preparation.

8.2 Sodium thiosulfate (dechlorinating reagent): Dissolve 0.35g $Na_2S_2O_3 \cdot 5H_2O$ in DI water and dilute to 100mL. Prepare fresh daily as needed.

8.3 Neutralization agents: Prepare with DI water:

8.3.1 Sodium hydroxide, NaOH, 6N: In a 1L volumetric flask, carefully mix 240g of NaOH (Section 8.11) pellets with 500mL DI water. Dissolve and bring to volume with DI water. Store at room temperature. Expires one month from date of preparation.

8.3.2 Sulfuric acid, H_2SO_4, 10%: To a 1L volumetric flask, add 500mL DI water. Carefully add 100mL of concentrated Sulfuric Acid (Section 8.12). Bring to volume with DI water. Store at room temperature. Expires one month from date of preparation.

8.4 Sodium Phenolate: CAUTION! Wear gloves. Phenol causes severe burns and is rapidly absorbed into the body through the skin. In a 1L volumetric flask, dissolve 88mL of 88% liquified phenol or 83g crystalline phenol (C_6H_5OH) in approximately 600mL DI water. While stirring, slowly add 32g sodium hydroxide (NaOH). Cool, dilute to the mark, and invert three times. Do **not** degas this reagent. Store at room temperature. Expires one month from date of preparation.

8.5 Sodium Hypochlorite (approximate 2.6%): In a 500mL volumetric flask, dilute 250mL Regular Chlorine bleach [5.25% sodium hypochlorite (NaOCl)] to the mark with DI water. Invert three times to mix. Store at room temperature. Expires one month from date of preparation.

8.6 Sodium Nitroprusside (coloring agent): In a 1L volumetric flask, dissolve 3.50g sodium nitroprusside (Sodium Nitroferricyanide [$Na_2Fe(CN)_5NO_2 \cdot H_2O$]) dilute to the mark with DI water. Degas with helium to prevent bubble formation. Use He at 140kPa (20 lb/in^2) through a helium degassing tube. Bubble He vigorously through the solution for one minute. Store refrigerated at 4 ± 2 °C. Expires one month from date of preparation.

8.7 Boric 1.5% Boric Acid Solution: To a 1000mL volumetric flask add 15g Boric Acid. Dilute to the mark with DI water. Store at room temperature. Expires one month from date of preparation.

8.8 0.2% Boric Acid Solution (Carrier Solution): To a 2L volumetric flask, dissolve 4g Boric Acid (H_3BO_3) in DI water. Degas by bubbling vigorously with Helium for one minute. Store at room temperature. Expires one month from date of preparation.

8.9 Stock Standard, 1000ppm as NH_3 (for calibration and spike solutions): Commercially prepared. Certificate of analysis is required. Store refrigerated at 4 ± 2 °C. Expires upon manufacturer's specified date.

8.9.1 Intermediate Calibration Stock Standard, 100ppm as NH_3: To a 100mL volumetric flask, add 10.0mL of Stock Standard (Section 8.9) and dilute to the mark with 0.2%

Boric Acid solution (Section 8.8). Invert three times. Store refrigerated at 4 ± 2 °C. Expires one month from date of preparation.

8.9.1.1 **Nine Working Calibration Standards:** The following standards are prepared in volumetric flasks fresh each day of use:

8.9.1.1.1 **20.0ppm:** 40mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.2 **10.0ppm:** 20mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.3 **8.00ppm:** 8mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.4 **4.00ppm:** 8mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.5 **2.00ppm:** 2mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.6 **1.00ppm:** 1mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.7 **0.400ppm:** 4mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.1.8 **0.200ppm:** 1mL of 20ppm standard (Section 8.9.1.1.1) to 100mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler.

8.9.1.1.9 **0.100ppm:** 1mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler.

8.9.1.1.10 **0.050ppm:** 20mL of 0.100ppm standard (Section 8.9.1.1.8) to 40mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler.

8.9.1.2 **Continuing Calibration Standards:**

8.9.1.2.1 **0.400ppm Low CCV:** 4mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.2.2 **4.00ppm Hi CCV:** 8mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.2 **Spiking solution, 200ppm as NH_3:** To a 100mL volumetric flask add 20mL of 1000ppm Stock Standard (Section 8.9) and dilute to the mark with DI water.

8.10 Stock Standard Solution, 1000ppm as NH_3 (for ICV and LCS):

Commercially prepared. Certificate of analysis is required. This must be from a <u>different source</u> than that used for Stock Standard (Section 8.9). Store refrigerated at 4 ± 2 °C. Expires upon manufacturer's specified date.

8.10.1 **Initial Calibration Verification Standards (ICV):**

8.10.1.1 Hi ICV, 10ppm: To a 100mL volumetric flask add 1mL of 1000ppm standard (Section 8.10). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation.

8.10.1.2 Hi ICV, 8.0ppm: To a 100mL volumetric flask add 0.8mL of 1000ppm standard (Section 8.10). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation

8.10.1.3 Low ICV, 1.0ppm: To a 100mL volumetric flask add 10mL of 10ppm ICV (Section 8.10.1.1). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation.

8.10.2 LCS solution, 200ppm as NH_3: To a 100mL volumetric flask add 20mL of 1000ppm Stock Standard (Section 8.10) and dilute to the mark with DI water. Store refrigerated at 4 ± 2 °C. Expires one month from date of preparation.

8.11 NaOH Pellets: ACS Grade. Store well sealed at room temperature. This salt does not have an expiration date.

8.12 Sulfuric Acid (Concentrated): Store at room temperature. Expires upon manufacturer's specified date. Use extreme caution when handling.

8.13 Ottawa sand: store at room temperature. Expires upon manufacturer's specified date.

9. Procedure

9.1 SET-UP

9.1.1 Prior to analysis, organize samples in order from low to high odor.

9.1.2 Clean 250mL Tecator tubes by rinsing twice with approximately 0.5mL of 6N NaOH solution and 100mL RO water. Rinse twice again with DI water.

9.2 Initial Calibration

Calibrate the Lachat ion analyzer according to manufacturer's instructions.

9.2.1 Calibration

Two boards are used to calibrate the Lachat instrument. Each curve has 7 calibration points. The correlation coefficient of each curve must be $\geq$ 0.995, otherwise re-calibration is necessary. Prepare standard curves by plotting the peak areas of standards processed through the manifold against NH_3-N concentrations in standards.

9.2.1.1 Channel 1 is used to generate a calibration curve on the low range from 0.00 – 2ppm.

9.2.1.2 Channel 2 is used to generate a calibration curve on the high range from 0 – 20ppm.

Alternative method: One board can be used to calibrate the Lachat instrument. !0 point calibration curve will be used with calibration standards 10.0, 8.0, 4.0, 2.0, 1.0,04, 0.2, 0.1, 0.05 mg/l each and blank. The correlation coefficient must be $\geq$ 0.995, otherwise re-calibration is necessary. Prepare standard curves by plotting the peak areas of standards processed through the manifold against NH_3-N concentrations in standards

9.2.2 Initial Calibration Verification (ICV)
Prior to sample analysis, an ICV is analyzed at 1.0ppm to verify the low calibration curve on Channel 1. Another ICV is analyzed at 10ppm to verify the high calibration curve on Channel 2. Both ICVs must yield results ± 10% of their true value, otherwise re-calibration is necessary.

Note: if instrument is calibrated using one board calibration, then both ICV's (Low and High), will be evaluated and high ICV will be 8.0 mg/l ICV standard (Section 8.10.1.2)

9.2.3 Initial Calibration Blank (ICB)
Following the ICV is the analysis of an ICB. The ICB consists of an aliquot of 0.2% Boric Acid (Section 8.8). Results must be less than the Reporting Limit.

9.3 Standardization (Continuing Calibration Verification)

Analyze the following after every 10 samples and at the completion of analysis:

0.400ppm Low CCV, (Section 8.9.1.2.1)

4.0ppm Hi CCV, (Section 8.9.1.2.2)

Blank, 0.2% Boric Acid Solution. (Section 8.8)

9.4 Equipment Operation and Sample Analysis

9.4.1 Sample preparation

9.4.1.1 Sample Aliquots

9.4.1.1.1 Aqueous Samples
Add 100mL dechlorinated sample or a portion diluted to 100mL with DI water, to pre-washed Tecator tubes that are numbered to correspond with the samples.

9.4.1.1.1 Soil Samples
One gram of a well-homogenized sample is weighed out into a centrifuge tube (record weight in notebook). The sample is then transferred into a Tecator tube with 100 mL of DI.

9.4.1.1.2 QC Samples
In a similar manner, prepare the QC samples to be distilled with the batch (refer to Sections 10.2.1, 10.3, 10.5 and 10.8).

9.4.1.2 Add approximately 1.0mL of $Na_2S_2O_3$ to each tube, followed by 5.0mL of Borate Buffer solution.

9.4.1.2.1 Aqueous Samples

Add small amounts of 6N NaOH until the pH is adjusted to 9.5.

9.4.1.2.2 Soil Samples
No pH adjustment is needed.

9.4.2 Distillation

9.4.2.1 Equipment preparation: To clean any prior contamination, first rinse the Tecator distillation unit by running a series of 3 rinse tubes. The first rinse containing 90mL DI and 10mL 6N NaOH. The second and third rinses are with100mL DI and 0.5mL 6N NaOH.

9.4.2.2. Distillation: Begin by distilling rinse tubes, Blank, Low and Hi LCS, and then Samples and QC Samples using the Tecator Instruments Automatic Distillation Unit according to the manufacturer's instructions.

Distillate is collected from the Tecator unit in 250mL disposable polypropylene cups that contain 20mL of 1.5% Boric acid (Section 8.7). Distillation is complete after collection of approximately 140mL. Fill each cup to 150mL with DI water. Cover and store at 1-4º C if Lachat analysis is to be delayed.

9.4.3 Ammonia analysis of distillate: Follow the manufacturer's instructions for the proper operation of the Lachat ion analyzer. The following are specific notes for this analysis.

Sample throughput:	90 samples/hr; 40sec/sample
Pump speed:	35
Cycle period:	40 s
Inject to start of peak period:	25 s
Inject to end of peak period:	63 ± s

9.4.4 System Notes:

9.4.4.1 Allow 15 minutes for heating unit to warm up to 60ºC.

9.4.4.2 System IV GAIN: 175 X 1

9.4.4.3 If standards are not distilled, samples should be multiplied by 1.5 to correct for the increase in volume after the distillation.

9.4.4.4 If baseline drifts, peaks are too wide, or other problems with precision arise, clean the manifold by the following procedure:

9.4.4.4.1 Place all reagent lines in deionized water and pump to clear reagents (2-5 minutes).

9.4.4.4.2 Place reagent lines and carrier in 1M hydrochloric acid (1 volume concentrated HCl added to 11 volumes of deionized water) and pump for several minutes.

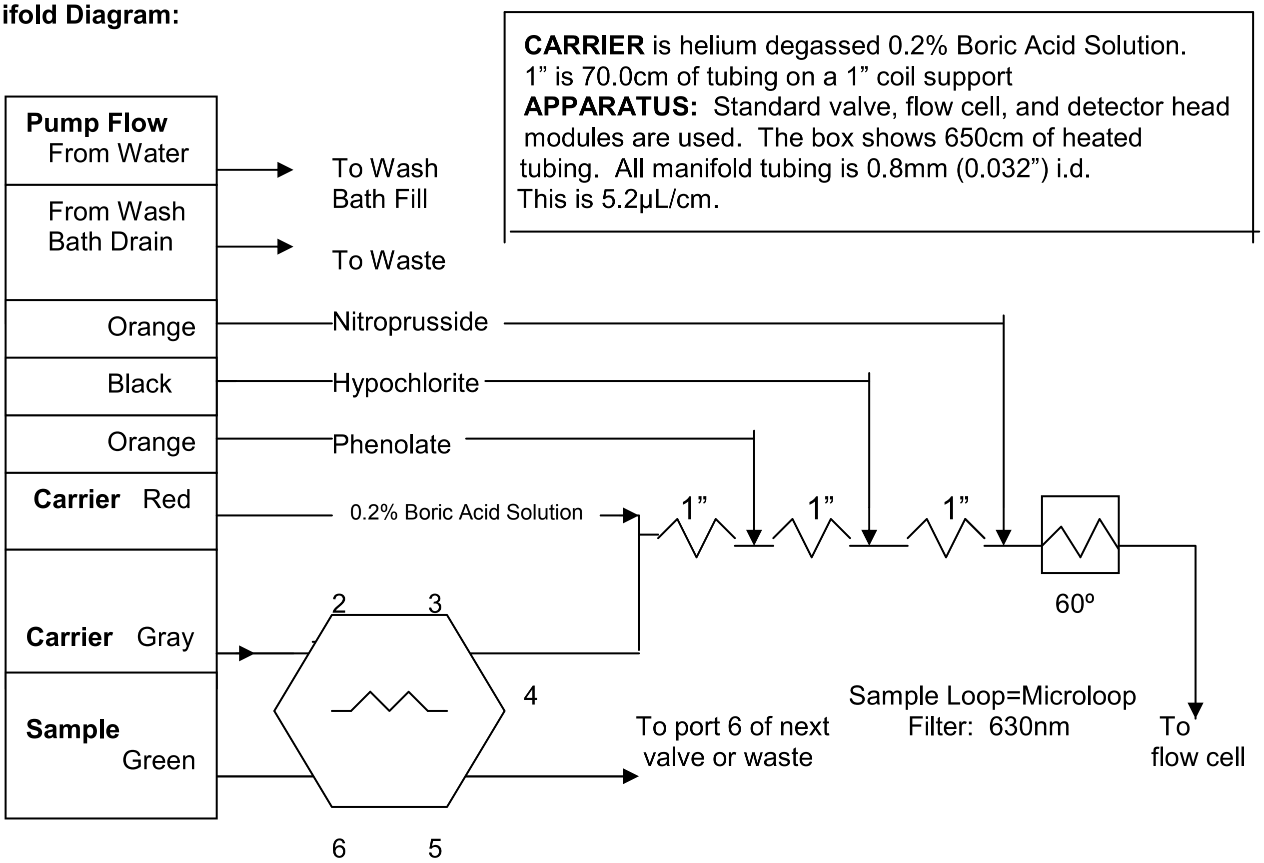
9.4.4.4.3 Place all lines in deionized water and pump until the HCl is thoroughly washed out.

9.4.4.4.4 Resume pumping reagents.

9.4.4.4.5 If sample distillate is colored or turbid, discard the sample distillate and re-distill the original sample at a higher dilution (Sections 9.4.1 and 9.4.2).

If there is not sufficient original sample volume for re-distillation, the colored/turbid distillate may be filtered through a 0.45µm filter and diluted on the Lachat instrument.

Manifold Diagram:



CARRIER is helium degassed 0.2% Boric Acid Solution.
1” is 70.0cm of tubing on a 1” coil support
APPARATUS: Standard valve, flow cell, and detector head modules are used. The box shows 650cm of heated tubing. All manifold tubing is 0.8mm (0.032”) i.d. This is 5.2µL/cm.

9.5 Preventative Maintenance

9.5.1 All lines are flushed at the end of each run.

9.5.2 All equipment is kept clean.

9.6 Calculations

Compute sample NH_3-N concentration by comparing sample peak areas with standard curve, as determined by the Lachat instrument software.

9.6.1 If the sample has a concentration of less than 2ppm, calculate results by using the low curve generated on Channel 1.

9.6.2 If the sample concentration is greater than 2ppm but less than 20ppm, calculate results by using the high curve generated on Channel 2.

9.6.3 If the concentration is greater than 20ppm, dilute the sample and reanalyze.

NOTE: For soil samples Lachat reading is multiplied by extraction volume (150ml) and divided by sample weight (the exact weight is used as recorded in the laboratory notebook). Calculations are done using Lachat software.

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test for failed parameters of the method.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test for all parameters listed in the method.

10.2 Blank

10.2.1 The Distillation Blank is 100 mL DI for waters or 1g of Ottawa sand for soils. Distill one per batch of 20 samples or less. Results for the Distillation Blank must be less than the Reporting Limit. If results for the Distillation Blank are greater than the reporting limit, and all sample results for the batch are greater than 10x the Blank result, sample results may be reported with a narrative to be included on the final report. Otherwise, all samples must be redistilled and reanalyzed.

10.2.2 The Analytical Blank (ICB) for the Lachat analysis is not distilled and is 0.2% Boric Acid Solution (Section 8.8).

The ICB is run after the initial calibration verification standards (ICV) and another is run after the continuing calibration standards (CCV).

If results for the Analytical Blank are greater than the reporting limit, the ICB is reinjected. If failure continues the instrument must be recalibrated. Samples are not to be analyzed until an acceptable ICB is obtained.

10.3 Laboratory Control Samples (LCS)

10.3.1 Distillation: Distill a Low and a Hi LCS with each batch of 20 samples or less. Recovery of the LCSs must be within Control Chart limits. If recovery is outside of this range, the standard is reanalayzed once. If recovery still fails criteria, the entire sample batch must be redistilled and reanalyzed.

10.3.1.1 Low 2ppm LCS: Add 1mL of 200ppm LCS solution (Section 8.10.2) to 100mL DI for waters or for 1.0g of Ottawa sand for soils. This is used for the Low 0 – 2ppm curve.

10.3.1.2 Hi 20ppm LCS: Add 10mL of 200ppm LCS solution (Section 8.10.2) to 100mL DI for waters or for 1.0g of Ottawa sand for soils. This is used for the Hi 2 – 20ppm curve.

10.4 Initial Calibration Verification Standards

10.4.1 Lachat Analysis: The ICVs are not distilled. Analyze the following Hi and Low ICVs after calibration of the Lachat instrument. Recoveries must be within 10% of the true value. If results are outside of this range, the ICV may be reinjected once. If failure continues, recalibration of the instrument is necessary. Samples are not to be analyzed until acceptable ICV results are obtained.

10.4.1.1 Low ICV, 1.0ppm (Section 8.10.1.2)

10.4.1.2 Hi ICV, 10ppm (Section 8.10.1.1). **HI ICV** will be 8.0 ppm (Section 8.10.1.2) in case of one board calibration.

10.5 Continuing Calibration Verification Standards

10.5.1 Lachat Analysis: The CCVs are not distilled. Analyze the following Low and Hi CCVs after every ten samples and at the completion of analysis. Recoveries must be within 10% of the true value.

If recoveries fall outside of this range, the CCV is reanalyzed. If recovery is acceptable, the analysis may continue. If recovery is again unacceptable, the cause for the failure is determined and corrected, and the instrument is recalibrated. All samples that were analyzed since the last CCV that was within range are reanalyzed.

10.5.1.1 0.4ppm Low CCV (Section 8.9.1.2.1)

10.5.1.2 4.0ppm Hi CCV (Section 8.9.1.2.2)

10.6 Interference Check Standards

None.

10.7 Matrix Spike

One per batch of 20 samples or less. Prior to distillation, use 2mL of 200ppm Intermediate Stock Standard (Section 8.9.2) per 100mL of sample for waters or 1.0g of sample for soils. Recovery of the Matrix Spike must be within Control Chart limts. If the recovery is outside of acceptance criteria, and the LCS is within acceptance criteria, matrix interference may be assumed. The associated data is reported with a narrative to be included on the final report.

10.8 Duplicates

Distill one duplicate sample per batch of 20 samples or less. The %RPD for the duplicate sample must be within Control Chart limits. If results are outside of the acceptance criteria, a narrative to be included on the final report.

10.9 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained.

Control limits for the method parameters are generated. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.10 Analytical Sequences

10.10.1 Distillation Sequence:

3 Rinse tubes
Blank
Low LCS
Hi LCS
Rinse
Samples
Rinse after suspected high samples
Duplicate
Spike
Rinse
Shut-Down

10.10.2 Lachat Analytical Sequence:

Instrument Calibration
CCV: Low, Hi,CCB
Low ICV
Hi ICV

IC Blank
Samples
CCV : Low, Hi, CC Blank every 10 samples and at completion of analysis
Shut-Down

11. Method Performance

11.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

11.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734, 1739 for further information regarding IDC/DOC Generation.

11.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

11.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

12. Corrective Actions

Holding time exceedence, improper preservation and observed sample headspace are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the CV or LCS recovery of any parameter falls outside the designated acceptance range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time and/or recalibration of the instrument.

13. Pollution Prevention

NOTE: Lachat Phenol waste is hazardous and must be disposed of in “Hazmat” Lachat waste drums.

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

See Chemical Hygiene Plan for waste handling and disposal SOP/1728

Biochemical Oxygen Demand (BOD), 5-Day

Soluble BOD (SBOD), 5-Day
Carbonaceous BOD (cBOD), 5-Day

Reference Methods: **SM 5210B** Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 2001.

1. Scope and Application

Matrices: This method is applicable to most water and wastewater samples.

Definitions: See Alpha Laboratories Quality Manual Appendix A

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Dissolved Oxygen (DO) Meter and in the interpretation of Dissolved Oxygen data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of laboratory control samples and acceptable performance from proficiency test samples. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case by case basis.

The biochemical oxygen demand (BOD) test is used to determine the relative oxygen requirements of wastewaters, effluents, and polluted waters. The test has its widest application in measuring waste loadings to treatment plants and in evaluating the BOD-removal efficiency of such treatment systems. The test measures the oxygen utilized during a specified incubation period for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic materials such as sulfides and ferrous iron. It also may measure the oxygen used to oxidize reduced forms of nitrogen (nitrogenous demand). The seeding and dilution procedures provide an estimate of the BOD at pH 6.5 to 7.5.

The BOD concentration in most wastewaters exceeds the concentration of dissolved oxygen (DO) available in an air-saturated sample. Therefore, it is necessary to dilute the sample before incubation to bring the oxygen demand and supply into appropriate balance. Because bacterial growth requires nutrients such as nitrogen, phosphorus, and trace metals, these are added to the dilution water, which is buffered to ensure that the pH of the incubated sample remains in a range suitable for bacterial growth. Complete stabilization of a sample may require a period of incubation too long for practical purposes; therefore, 5 days has been accepted as the standard incubation period.

2. Summary of Method

The method consists of filling with sample, an airtight bottle of the specified size and incubating it at the specified temperature for 5 days. Dissolved oxygen is measured initially and after incubation, and the BOD is computed from the difference between initial and final DO.

2.1 Method Modifications from Reference

Soluble BOD determinations: Soluble BOD determinations may be performed by filtration of the sample through 0.45µm filter. Following filtration, the sample is placed in a 1L plastic bottle and shaken vigorously for 1 minute, before any sample pretreatment procedures are performed.

3. Detection Limits

The minimum calculated RL for BOD is 2 mg O_2 / L, based on a 50% dilution of the sample (i.e. 150mL sample in the 300mL BOD bottle.)

The minimum dilution of the sample that meets acceptance criteria is used to determine the final calculated RL for the sample as follows:

$$\text{Reporting Limit, } BOD_5\text{, mg } O_2 / L = \frac{1}{\frac{(\text{mL sample used for minimum dilution meeting criteria})}{300}}$$

Refer to Table 1.

4. Interferences

4.1 Instrumental

The DO Meter must be calibrated and maintained according to manufacturer's instructions in order to avoid any instrumental interferences.

BOD Analyzer must be maintained according to manufacturer's suggestions for optimum performance.

4.2 Parameters

The samples must be free of biological poisons or materials that produce oxygen.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Samples are collected in 1L plastic containers.

6.2 Sample Preservation

No preservative is added to samples.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Samples for BOD analysis may degrade significantly during storage between collection and analysis, resulting in low BOD values. Minimize reduction of BOD by analyzing sample promptly or by cooling it to near-freezing temperature during storage.

6.4.1 **Grab samples:** If analysis is begun within 2 hours of collection, cold storage is unnecessary. If analysis is not started within 2 hours of sample collection, keep sample at or below 4ºC, but not freezing, from the time of collection. Analysis must begin within 48 hours of collection.

6.4.2 **Composite samples:** Use the same criteria as for storage of grab samples, starting the measurement of holding time from the end of the compositing period. Analysis must begin within 48 hours of collection.

7. Equipment and Supplies

7.1 **BOD Incubation Bottles:** 300mL capacity, with glass stoppers and plastic snap-caps. Clean bottles, stoppers and snap-caps with a detergent; rinse thoroughly, and drain before use.

7.2 **Air Incubator:** Thermostatically controlled at 20 ± 1ºC. Exclude all light to prevent possibility of photosynthetic production of DO.

7.3 **pH Paper.**

7.4 **15mL Centrifuge Tubes.**

7.5 **COD Reactor:** HACH, 150º C.

7.6 **Spectrophotometer.**

7.7 **Pipets:** Glass, 1mL to 30 mL graduated.

7.8 **YSI Model DO Meter with DO Electrode.**

7.9 **BOD Analyst Software.**

7.10 **Volumetric Flasks:** 100mL volume.

7.11 Autopipettor: With disposable tips, 1 - 5mL volume.

7.12 Peroxide Test Strips: Range 0 – 30 mg/L.

7.13 BOD Analyzer System by MANTECH: With AutoMax 122, and all associated equipment.

7.14 Stir plates: 1 with heat; 1 without heat

7.15 Wide-mouth 500ml flask

8. Reagents and Standards

8.1 Glucose-Glutamic Acid Stock Solution (for LCS and Spike): Dry reagent-grade glucose and reagent-grade glutamic acid at 105ºC for a minimum of one hour, and cool before use. In a 100mL volumetric flask, add 150mg glucose and 150mg glutamic acid to distilled water and dilute to volume. Slightly heat this solution until dissolved and also allow to stir for at least 30 minutes. Prepare fresh immediately before use.

8.1.1 198ppm LCS: While stirring, withdraw 1mL of the glucose-glutamic acid stock solution (Section 8.1) and add to a 100mL volumetric flask. Dilute to the mark with DI.

8.1.2 100ppm Spike: While stirring, withdraw 1mL of the glucose-glutamic acid stock solution (Section 8.1) and add to 200mL of sample.

8.1.3 198ppm Spike: While stirring, withdraw 1mL of the glucose-glutamic acid stock solution (Section 8.1) and add to 100mL of sample.

8.2 BOD Nutrient Solution/Dilution Water: Preferably prepare at least a day prior to use. The Nutrient Solution/ Dilution Water can be used for 3 days. Store in the dark at room temperature.

- Fill carboy to 38L with DI water.
- Saturate with DO by aerating for 2 hours. Protect water quality by using clean tubing.
- Add 2 BOD Nutrient Buffer Pillows (HACH Brand, 1 pillow is for preparation of 19L). Agitate tank to mix after adding pillows.

8.3 Sulfuric Acid Solution: For neutralization of caustic samples. Slowly and while stirring, add 2.8mL concentrated H_2SO_4 to distilled water. Dilute to 100mL with DI. Store refrigerated at 1-4 °C. Expires one year from date of preparation.

8.4 Sodium Hydroxide Solution: For neutralization of acidic samples. Dissolve 40g sodium hydroxide (NaOH) in distilled water. Dilute to 1L. Dilute to 100mL with DI. Store refrigerated at 1-4 °C. Expires one year from date of preparation.

8.5 Sodium Sulfite Solution: Dissolve 0.1575g Na_2SO_3 in 100mL distilled water. This solution is not stable; prepare fresh immediately before use.

8.6 Polyseed Inoculum: Dissolve one Polyseed capsule (Idexx Laboratories, commercial BOD seed inoculum) in 500mL nutrient solution; stir for a minimum of two hours prior to use. Stir at a spin speed which permits approximately ½ inch vortex. Warning: If the seed is set to spin too quickly, this could lead to the death of organisms in the seed and therefore a low recovery value. The Polyseed solution is viable for 6 hours from time of preparation.

Adjust the Polyseed volume added to each batch based on the Polyseed lot strength. The desired seed recovery range is 0.6 – 1.0 mg/L. Test each lot of Polyseed prior to use to determine a volume that will produce results within this acceptance range.

If the Polyseed is to be used with the BOD Analyzer procedure, then stop spinning the Polyseed after the minimum of 2 hours, allow sediment to settle for 5 minutes, then carefully pour the top portion of the solution into a different, clean 500ml flask, trying not to disturb any of the settled material while doing so.

This poured off portion of the Polyseed becomes the solution used with BOD and cBOD setup with the BOD Analyzer (to avoid having sedimentary material caught in the equipment lines).

Note: A capsule from new lots of polyseed should be analyzed *in advance*, to determine the correct dilution range. Record the use of a new lot of polyseed in the Bod logbook.

8.7 DPD Free Chlorine Reagent Powder Pillows: HACH brand, for 5mL sample. Store at room temperature. Expires upon manufacturer specified date.

8.8 COD Tubes:

8.8.1 CPI (catalog # COD1500), range 0 – 1500 mg/L.

8.8.2 Environmental Express (catalog # B1015), range 0 – 1500 mg/L. Store at room temperature. Expires upon manufacturer specified date.

8.9 1:1 Acetic Acid Solution: 50mL of DI + 50mL Acetic Acid. Dilute to 100mL with DI. Store refrigerated at 1-4 °C. Expires one year from date of preparation

8.10 KI Solution: 10 grams KI per 100mL DI. Dilute to 100mL with DI. Store refrigerated at 1-4 °C. Expires one year from date of preparation

8.11 Starch Indicator Solution: HACH brand. Store at room temperature. Expires upon manufacturer specified date.

8.12 Nitrification Inhibitor: HACH brand, with 0.2g dispensing scoop. Store at room temperature. Expires upon manufacturer specified date.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

9.1.1 **Dilution Water Check:** Determine initial DO for 3 BOD bottles of dilution water for each analytical batch (Section 8.2). Incubate these bottles along with the samples for 5 days at 20 ± 1ºC. Determine the final DO.

The DO depletion after 5 days at 20 ± 1ºC should not be more than 0.2mg/L and preferably not more than 0.1mg/L. If the blank depletion falls outside of these limits, the analytical batch is not valid. Notify the Department Supervisor and/or the Laboratory Manager for instructions on how to proceed.

9.1.2 **Method Blank:** Determine initial DO for 3 BOD bottles of DI water with volumes of 30mL, 60mL and 150mL for each analytical batch (Section 8.2). Incubate these bottles along with the samples for 5 days at 20 ± 1ºC. Determine the final DO after incubation for 5 days at 20 ± 1ºC. Results must be less than the RL. If failure occurs, the Inorganics Supervisor is notified.

9.2 Laboratory Control Sample (LCS)

Determine initial DO for the LCS as stated in Section8.1.1. Incubate these bottles along with the samples for 5 days at 20 ± 1ºC. Determine the final DO.

The true value of the LCS equals 198mg O_2/L. The % Recovery must be between 85 – 115%. If the % Recovery for the LCS falls outside these limits, the analytical batch is not valid. Notify the Department Supervisor and/or the Laboratory Manager for instructions on how to proceed.

9.3 Initial Calibration Verification (ICV)

Not applicable.

9.4 Continuing Calibration Verification (CCV)

Not applicable.

9.5 Matrix Spike

Prepare and analyze a matrix spike for one sample (as determined in Section 8.1.2 or 8.1.3) per batch of 20 samples or less. % Recovery must be 85-115%, or according to in house control limits.

9.6 Laboratory Duplicate

Prepare and analyze a duplicate set of dilutions for one sample per batch of 20 samples or less. % RPD must be $\leq$ 20%, or according to in house control limits.

9.7 Method-specific Quality Control Samples

9.7.1 Seed

Determine initial DO for the volumes of Polyseed as stated in Section 8.6. Incubate these bottles along with the samples for 5 days at 20 ± 1ºC. Determine the final DO.

The final seed depletion after 5-day incubation at 20 ± 1ºC ideally should be between 0.6 and 1.0 mg/L.

9.8 Method Sequence

The analytical sequence is:

- Dilution Water Blank
- Seed
- Glucose-Glutamic Acid LCS
- Method Blank
- Samples 1-20 or less
- Duplicate
- Matrix Spike

10. Procedure

10.1 Equipment Set-up

10.1.1 **Preparation of Dilution Water Blank:** Fill three 300mL BOD bottles with Nutrient Solution/Dilution Water (Section 8.2). Determine the BOD of the Dilution Water as for any other sample. (If setup is done with BOD Analyzer, skip to step 10.1.3).

10.1.2 **Preparation of Polyseed Value:** Make dilutions of the Polyseed solution (Section 8.6) using volumes of 6mL, 8mL, 10mL, and 12mL. Determine the BOD of the seeding material as for any other sample. (If setup is done with BOD Analyzer, skip to step 10.1.3).

10.1.3 **Preparation of LCS:** Use 3mL, 3mL, 6mL, 6mL volumes of the 198ppm LCS solution (Section 8.1.1). Determine the BOD of the LCS as for any other sample.

10.1.4 **Preparation of Method Blank:** Fill 3 bottles with DI volumes of 30mL, 60mL and 150mL. (If setup is done with BOD Analyzer, skip to step 10.1.5).

10.1.5 **cBOD Dilution Bottle Preparation:** If samples are to be analyzed for cBOD, add 0.2g (1 scoop) of Nitrification Inhibitor (Section 8.12) to each dilution bottle, prior to filling with sample, and prior to filling/reading on BOD Analyzer.

10.1.6 **Sample Pretreatment:**

10.1.6.1 **Samples containing caustic alkalinity or acidity:** Check the pH of all samples using pH paper. If necessary, neutralize samples to pH 6.5 to 7.5 with sulfuric acid solution (Section 8.3) **or** sodium hydroxide solution (Section 8.4). *<u>NOTE</u>: Do not use both solutions on the same sample.*

The quantity of reagent added must not dilute the sample by more than 0.5%. If 0.5% is exceeded, notify the Department Supervisor and/or the Laboratory Manager for instructions on how to proceed.

10.1.6.2 **Samples containing residual chlorine compounds:** Test samples for chlorine by adding 1 DPD free chlorine reagent powder pillow (Section 8.7) to a 15mL centrifuge tube. Add 5mL sample. Mix. Chlorine is present if sample turns a pinkish color. If there is no color change, no chlorine is present. Proceed to Section 10.1.6.3.

(**NOTE:** If there is a change to a very rosy pink color, sample is checked for peroxide using a peroxide strip. If the sample is positive for peroxide, sample analysis is ended and results are narrated as invalid due to peroxide interference.)

If chlorine is present, it must be removed from the sample. To do this, it is necessary to determine the required volume of Sodium Sulfite (Na_2SO_3) solution (Section 8.5) to add to a 100mL portion of neutralized sample. Do this by adding 1mL of 1:1 acetic acid solution (Section 8.9), 1mL potassium iodide (KI) solution (Section 8.10) and 1mL starch indicator solution (Section 8.11) to 100mL of sample, and titrating with Na_2SO_3 solution to the starch-iodine end point. The end point is reached when blue color disappears.

Determine the volume titrated. This is the volume of Na_2SO_3 solution necessary to dechlorinate 100mL of sample. (**NOTE:** If the volume of Na_2SO_3 solution is greater than 10mL for 100mL sample, consult the Department Supervisor and/or the Laboratory Manager before proceeding.) (**NOTE**: Discard titrated sample.) Add this determined volume of Na_2SO_3 solution per 100mL of sample. Mix. After 10 to 20 minutes check sample again for residual chlorine. (**NOTE**: Excess Na_2SO_3 exerts an oxygen demand and reacts slowly with certain organic chloramine compounds that may be present in chlorinated samples.)

10.1.6.3 **COD Check for Determination of BOD Dilutions:** A COD allowed to reflux for 30 minutes is enough time to be able to calculate an estimated BOD value. (Refer to the Standard Operating Procedure for COD.) Once a COD value is calculated, use TABLE 1 to select dilutions for the BOD. TABLE 1 is based on the RDL at each dilution. Compare the COD result to the BOD RDL in TABLE 1. Since the BOD is always less than the COD, choose the 5 BOD sample volumes less than the COD value. In the case of a COD less than 20mg O_2/L, choose the 30mL, 60mL, and 150mL volumes (10, 20, 50% of a 300mL BOD bottle).

10.1.6.4 **Sample temperature adjustment**: Bring samples to 20 ± 1ºC before making dilutions.

10.2 Initial Calibration

10.2.1 If following the Manual procedure in Section 10.3.1, calibrate the YSI Dissolved Oxygen Meter per manufacturer's instructions.

10.2.2 Winkler Titration Calibration – Weekly Check

10.2.2.1 Fill 1 extra BOD bottle with only Nutrient Solution. Prepare this bottle for dissolved oxygen analysis as per the Dissolved Oxygen SOP 2249.

10.2.2.2 Immediately following the probe reading of the first blank BOD bottle in the batch (Section 10.3.2), titrate the extra Nutrient Solution bottle prepared in Section 10.2.2.1. according to the Dissolved Oxygen SOP 2249. Record the D.O. result from the Winkler titration in the BOD logbook

10.2.2.3 The D.O. results obtained from the probe and the Winkler titration should be very similar. If results are not within this criteria, refer to Section 10.5 for preventive maintenance procedures for the D.O. probe, and repeat Sections 10.2.2.1 – 10.2.2.2.

10.3 Equipment Operation and Sample Processing

10.3.1 MANUAL PROCEDURE: USE OF BOD ANALYST SOFTWARE

10.3.1.1 Using a wide-tip pipet, add the desired volumes of Polyseed, LCS and samples to the individual BOD bottles and dilute with BOD Nutrient Solution/Dilution Water (Section 8.2).

For sample dilutions greater than 1:100, make a primary dilution using BOD Nutrient Solution/Dilution Water in a volumetric flask before making the final dilution in the BOD bottle

10.3.1.2 **Preparing the Matrix Spike:**

The spike concentration chosen (either Section 8.1.2 or Section 8.1.3), should be greater than or equal to the expected sample value as determined in Section 9.1.5.3. Therefore, choose a sample to spike that has both of the following:

(1) a COD result less than or equal to the spike amount chosen and

(2) enough volume in the sample container to allow setting both the sample and the spike.

Determine the BOD dilutions for the spike as in Section 8.1.2 or 8.1.3. Be sure to calculate the sample COD value and add in the spike amount chosen. Use this value to compare with TABLE 1. Four volumes are needed when setting the spike.

10.3.1.3 Using the autopipettor set at 2.0mL, add 2mL of seed material to the individual BOD bottles for the LCS and samples. ((Note: The seed volume added to the batch may vary, depending on the current seed value of the polyseed lot currently in use (Section 8.6)).

10.3.1.4 Fill BOD bottles with enough nutrient solution so as to come halfway up the neck of the bottle.

10.3.1.5 **Determination of Initial DO:** Following the manufacturer's instructions, use the DO electrode, DO meter, and BOD Analyst Software to determine initial DO for all sample dilutions, dilution water blanks, seed controls, and the glucose-glutamic acid LCS. Rinse electrode between determinations to prevent cross-contamination of samples.

10.3.1.6 Tightly insert a glass stopper to displace all air, leaving no bubbles and creating a water-seal. Place a plastic snap-cap over the flared mouth of the bottle to prevent evaporation.

10.3.1.7 **Incubation:**

10.3.1.7.1 Incubate BOD bottles for 5 days at 20 ºC ± 1 ºC.

10.3.1.7.2 Note the time IN and Incubator ID in the BOD prep logbook. (The initial incubation date/time is used as the "prep time" for the data).

10.3.1.8 **Determination of Final DO**:

10.3.1.8.1 After a 5-day incubation period, determine final DO for all sample dilutions, dilution water blanks, seed controls and the glucose-glutamic acid LCS, using the membrane electrode, DO meter and BOD Analyst Software.

10.3.1.8.2 Note the time OUT in the Bod prep logbook. (The final DO reading (end of incubation) date/time is used as the "analysis time" for the data).

10.3.1.8.3 The OUT time is derived from absolutely <u>no more than</u> +/- 6 hours of the IN date/time of the BOD batch of samples to the incubator. (example: If the IN time is 12:00pm, then the batch must be taken out of the incubator and the final DO readings conducted no earlier than 6:00am and no later than 6:00pm).

10.3.2 AUTOMATED PROCEDURE: USE OF BOD ANALYZER

10.3.2.1 Setup of Solutions Prior to Analysis of Samples

1. Make Nutrient Solution/Dilution Water (refer to Section 8.2). This should be made several hours in advance in order for the dissolved oxygen level of the tank to be relatively stable prior to use.
2. Make LCS/SPK stock standard (refer to Section 8.1) a minimum of two hours prior to use of analyzer.
3. Make Polyseed (refer to Section 8.6) a minimum of two hours prior to use of analyzer.

10.3.2.2 Setup of Equipment Prior to Sample Analysis

1. Turn on analyzer and associated computer. The analyzer should have 5 lights lit on the equipment, indicating that all pieces are powered on.
2. Make sure that the manifold shelf is pushed back <u>behind</u> the autosampler main section. (VERY IMPORTANT: if this is not in the

correct location, the autosampler arm will crash during operation and disrupt analysis).

3. Fill the DI tank so there is ample water to supply the probe washing station.
4. Make sure that the autosampler tray base is completely on the laboratory countertop (refer to arrow markings on either side), to ensure the base does not become unstable during use.

10.3.2.3 Setup of Samples Prior to Analysis (Preparing Dilutions Directly in BOD Bottles)

10.3.2.3.1 Preparing the Polyseed Value and LCS bottles

Using a calibrated pipet or calibrated autopipettor, add the desired volumes of Polyseed and LCS to the individual BOD bottles. Use wide-mouth pipets for samples. (Do not add NS/Dilution water to bottles. It will be added automatically by the Analyzer).

For sample dilutions greater than 1:100, make a primary dilution using BOD Nutrient Solution/Dilution Water in a volumetric flask before making the final dilution in the BOD bottle.

10.3.2.3.2 Preparing the Matrix Spike and Sample Bottles

The spike concentration chosen (either Section 8.1.2 or Section 8.1.3), should be greater than or equal to the expected sample value as determined in Section 10.1.6.3. Therefore, choose a sample to spike that has both of the following:

1. A COD result less than or equal to the spike amount chosen

   and

2. Enough volume in the sample container to allow setting both the sample and the spike.

Determine the BOD dilutions for the spike as in Section 10.1.6.3. Be sure to calculate the sample COD value and add in the spike amount chosen. Use this value to compare with TABLE 1. Four volumes are needed when setting the spike. Use a calibrated pipet or calibrated autopipettor to dispense spiked sample solution.

10.3.2.3.3 Preparing the Polyseed bottles

(Skip this section if the Polyseed is to be added automatically by the Analyzer).

Using the autopipettor set at 2.0 mL, add 2mL of seed material to the individual BOD bottles for the LCS and samples. [Note: The seed volume added to a batch is determined in advance per lot of Polyseed to ensure the value should fall within the ideal range. (Refer to Section 8.6).]

10.3.2.4 Preparation of Analyzer Equipment for Use

10.3.2.4.1 On the computer desktop screen, double-click on the yellow “Z lightning bolt” icon to open the BOD Analyzer software.

10.3.2.4.2 The page which opens will be entitled "PC-BOD Main Menu". (This will be referred to as the Main Menu screen going forward.)

NOTE: If a batch is being set up for initial readings, then proceed here. If a batch is to be read for final Bod/CBod, then skip to Section 10.3.A.9.

10.3.2.4.3 On the bottom of the Main Menu screen, there are several icons. They are defined as follows:

- #1 = BOD daily
- #2 = CBOD daily
- Blue/purple spots = change membrane
- Green cup = prime pumps
- Water drip = probe calibration
- Ringing bell = park the probe
- Raindrops = clean the system

10.3.2.5 Priming the System

10.3.2.5.1 Double-click on the prime pumps icon; this will initialize the software communication. A new page will open, called the Timetable/Sample Entry Screen. (This will be referred to as the Timetable screen going forward.)

10.3.2.5.2 Unhook the bod bottle from the autosample arm/probe (Note: HOLD autosampler arm/probe with one hand and gently twist bod bottle off to lower to tray. DO NOT twist and remove bottle without holding the arm/probe while doing this!)

10.3.2.5.3 Hit the start button (green rectangle on bottom right of Timetable page). A box will appear, asking "enter a valid rack #". Type "0". Hit ok. A box will appear, asking "is seed reservoir filled?". (Refer to Section 8.6 for Polyseed preparation.) If yes, then hit ok. A box will appear, asking "is dilution water reservoir filled?". (Refer to Section 8.2 for NS/dilution water preparation.) If yes, then hit ok.

10.3.2.5.4 At this time, the autosampler will move to wash the probe at the washing station. It is normal equipment behavior that some water will overflow during this process. When the priming of the system is completed, a box will appear, stating "pumps are now primed and ready for use". Hit ok. Then hit the done button at the bottom right of the Timetable page. This will close the page back out to the Main Menu screen.

NOTE: Make sure the drain/waste line is secured to the equipment, and able to flow in a gravimetrically and unobstructed fashion, to prevent backwash into the equipment.

10.3.2.6 Calibrating the Probe

10.3.2.6.1 On the Main menu screen, press the water drip icon, for calibrating the probe. This will open the Timetable page.

10.3.2.6.2 On the Timetable page, press the start button (green rectangular box). A box will appear, asking "enter a valid rack #". Enter "0", and hit ok.

10.3.2.6.3 After the probe is finished at the washing station, a box will appear, asking to “wipe off excess water from probe”. Do this VERY GENTLY, just blotting the tip with a soft towel, so as not to tear or otherwise damage the membrane. Hit ok.

10.3.2.6.4 A box will appear, asking “is a bottle with 1 inch of water in position #1?”. If yes, then hit ok. Another box will appear, stating to “attach the probe to the bottle for a good seal”.

10.3.2.6.5 At this time, the system will automatically become immobile for 10 minutes, during the countdown to ensure probe stability prior to calibration.

10.3.2.6.6 Once the 10 minutes has passed, a box will appear, asking “is the reading stable?”. At this time, the probe needs to be calibrated manually, as follows: [Refer to Section 10.2.A.1 for further information on calibrating the probe per the manufacturer’s instructions.]

- Press the mode button on the probe meter twice to return the meter to the main menu, hit ok.
- Press the calibrate button, then adjust the meter reading to 100%, hit ok.
- Press the mode button twice, then the remote button twice to return the meter to the remote mode, hit ok.
- Make sure the meter is in remote mode, hit ok.
- **Very important!!** Unhook the BOD bottle from the probe.

10.3.2.6.6.1 The reading should be within 85 – 115 % on the probe meter. If yes, then hit ok.
The Shazam Report Wizard page will open; hit “X” to close (this page is not needed at this time). After closing this Shazam page, the green start button will be visible again.

10.3.2.6.6.2 A box will appear, stating that “now the system is primed and calibrated, and ready for use”. Hit ok, and then done, to close out of the calibration page.

10.3.2.6.6.3 Park the probe!!! (Section 10.3.2.10)

10.3.2.7 Running a Batch of BOD/CBOD Samples

10.3.2.7.1 On the bottom left part of the Main Menu screen, there are 2 icons. The ‘1” is for BOD daily, and the “2” is for CBOD daily. Select the appropriate icon button for the samples to be analyzed. This will open the Timetable page.

10.3.2.7.2 Hit the edit button, located near the middle of the page, to enter sample/batch information. Enter name/date/time at the top of the page. Add rows as needed (using the add rows button). Hit the done edit button when the sample/batch process is completed.

10.3.2.7.3 Hit the green rectangular start button on the bottom right of the page, once the rack of sample bottles is placed on the autosampler base tray. A box will appear, asking “enter a rack #”. Enter the rack #, and hit ok. The run will be initiated at this time, and the autosampler will begin to read and fill bottles.

Note: If multiple racks are used in the same batch, only the LAST rack can be less than completely full of bottles.

10.3.2.7.4 After the first rack (and each additional rack when applicable), a box will appear, instructing “remove rack and replace with next rack”, at which time, the current rack is removed, the next rack is placed on the autosampler base tray, hit the start button, and a box will appear again, asking for the rack #..

Note: If there is no additional rack, then just hit ok. If all the racks have been read for the batch, then the Shazam Report Wizard page opens. Print a copy of the initial readings of the batch for future reference. Hang the copy on the appropriate BOD incubator where the batch will be housed. Close the Shazam page after printing. When the start button becomes green again, hit the done button to return to the Main Menu page.

(REMINDER: On the printout front page, write the date/time of when the BOD or cBOD batch is to come out of the incubator to be read.)

Tightly insert a glass stopper to displace all air, leaving no bubbles and creating a water-seal. Place a plastic snap-cap over the flared mouth of the bottle to prevent evaporation.

10.3.2.8 Incubation:

10.3.2.8.1 Incubate BOD bottles for 5 days at 20 ºC ± 1 ºC.

10.3.2.8.2 Note the time IN and Incubator ID in the BOD prep logbook. (The initial incubation date/time is used as the “prep time” for the data).

10.3.2.9 Cleaning the System After Use

10.3.2.9.1 On the Main Menu page, the icon with the multiple raindrops refers to the cleaning of the system. This procedure drain and rinses the dilution water and seed lines associated with the equipment.

Note: This procedure is done after all the initial and final readings are completed for the period of time that the equipment was continually in use.

10.3.2.9.2 Press the Clean System icon button. The page will appear stating that it is for the cleaning of the system. Hit the start button.

- A box will appear, asking “enter a valid rack #”. Enter 0. Hit ok.
- A box will appear, instructing to “remove seed and dilution water lines from reservoirs”. Hit ok. This process removes all liquid from the lines.

- Once completed, another box will appear, instructing to "put the lines in separate containers of DI". Hit ok. This process rinses DI thru the lines to clean them.
- Next, another box will appear, stating to "remove seed and dilution lines from the DI containers". Hit ok. This process will empty all remaining liquid from the lines.
- Finally, when this has been completed, a box will appear, stating that "the pumps are now clean". Hit ok.

10.3.2.10 Parking the Probe

It is important now to park the probe (the ringing bell icon).

- Push the park probe icon.
- A box will appear, stating to "place a bottle in position 1 of rack". Hit ok.
- A box will appear, stating to "snug the bottle on the probe for a good seal".

  Note: This keeps the probe membrane from drying out.
- Hit done to close the page back to the Main Menu page.
- If no further use of the equipment is necessary at this time, close out of the software by hitting the "X" at the top right of the Main Menu page. The software will automatically conduct a saving procedure, and then close entirely.

10.3.2.11 Determination of Final DO

10.3.2.11.1 After a 5-day incubation period, determine final DO for all sample dilutions, dilution water blanks, seed controls and the glucose-glutamic acid LCS, using the membrane electrode, DO meter and BOD Analyzer.

10.3.2.11.2 Note the time OUT in the Bod prep logbook. (The final DO reading (end of incubation) date/time is used as the "analysis time" for the data).

10.3.2.11.3 The OUT time is derived from absolutely <u>no more than</u> +/- 6 hours of the IN date/time of the BOD batch of samples to the incubator. (example: If the IN time is 12:00pm, then the batch must be taken out of the incubator and the final DO readings conducted no earlier than 6:00am and no later than 6:00pm).

- Open software (see Section 10.3.A.3) to Main Menu page.
- This page has a list of batches which need to be read, which are still in progress.
- Click on the icon "1" for Bod, or icon "2" for CBod.
- At the bottom left of the page, click on "load existing runs"
- Select the batch to read finals on (by date of setup). Hit "load selected".

- Then hit “start” (once probe calibration has been completed first! If it has not, refer to section 10.3.A.5). Probe should be unhooked from bottle at this time, and the rack of samples to be read first should be on the autosampler tray (with all plastic caps and glass corks removed).
- Read the racks, as in section 10.3.A.6, and when all readings have been finished, print data from the Shazam Wizard. Then hit “done”.
- Park the probe and snug the bottle onto the probe.
- Close out of the software.
- Turn off computer, if done using for the day/night.

10.3.2.12 Printing a Previous BOD/cBOD batch

- If a copy of a previous batch is needed, simply open the software, as explained in Section 10.3.A.3, and go to the top of the Main Menu page.
- Click on the BOD heading, and then select “Post Run Bod Analysis”.
- On this new page which opens, at the bottom is a box which says “completed runs”.
- Select the start date of the batch to be opened. Click on the batch. Then hit “load selected”.
- Once the selected batch is visible, hit “run method” to provide results for the batch on the screen.
- Hit “print results”. Then select “printer”. Hit “print”. Then hit “done”.

IMPORTANT NOTE: If software is opened only to print a previous batch, then initiation of software with equipment is not necessary; therefore, the bottle does not need to be unhooked from the probe. But whenever the software AND equipment are to be used, for initial and final readings, the bottle MUST be unhooked prior to hitting ‘start”, or the probe could crash.

10.4 Continuing Calibration

Not applicable.

10.5 Preventative Maintenance

The membrane on the DO electrode should be changed and the electrode tip serviced at regular intervals per the manufacturer’s instructions.

Temperatures of the BOD incubators are recorded continuously by an automated datalogger. The temperatures are checked by the analysts twice daily (with a minimum of 4 hours between readings) and adjusted as necessary.

The BOD incubators are calibrated on an annual basis by an instrument service company. These records are kept on file.

BOD Analyzer must be maintained according to manufacturer’s suggestions for optimum performance.

11. Data Evaluation, Calculations and Reporting

11.1 Both the BOD Analyst Software and the BOD Analyzer Software will calculate the BOD results automatically upon completion of final dissolved oxygen readings. However, the following is an explanation of the manual calculation should it be necessary:

$$\text{BOD}_5\text{, mg O}_2\text{ / L} = \frac{[(\mathbf{D_1} - \mathbf{D_2}) - \mathbf{f}]}{\mathbf{P}}$$

where:

D_1 = DO of diluted sample immediately after preparation, mg/L,
D_2 = DO of diluted sample after 5-day incubation at 20ºC, mg/L,
P = Decimal volumetric fraction of sample used,
f = Average DO depletion for 2mL of seed.

11.2 If more than one sample dilution meets the criteria of a final DO of at least 1mg/L and a DO depletion of at least 2mg/L, and there is no evidence of toxicity at higher sample concentrations or the existence of an obvious anomaly, then calculate the average of the BOD results in the acceptable range.

11.3 In these calculations, do not make corrections for DO depletion by the dilution water blank during incubation. This correction is unnecessary if dilution water meets the blank criteria specified in Section 9.1.2.

11.3.1 If the dilution water does not meet these criteria, proper corrections are difficult and results become questionable. Notify the Department Supervisor and/or the Laboratory Manager for instructions on how to proceed.

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Dilution Blank (Section 9.1.1) If this falls outside the acceptance limit, a lab note is included with the batch if the seed is within the acceptable range. If the dilution blank and seed are both out of range, then the batch is invalid and the client is notified.

12.2 Seed (Section 9.7.1) If the seed is outside the ideal acceptance range, the reason for the failure is evaluated and eliminated by adjusting the seed volume used in future sample batches. If any batch falls outside of the ideal acceptance range, but the LCS is still within acceptable range, the data is released without further action to the client. However, if the LCS falls outside acceptable range for the method, the client is notified and the data is only released (with an appropriate narrative) upon the client's request.

12.3 LCS (Section 9.2) If the LCS is outside of the acceptance range, and the seed is within its acceptance range, then a narrative is included on the Client report and the data is reported (per the department manager evaluation of the data).

12.4 Method Blank (Section 9.1.2) If the method blank is too high, either a narrative is included on the Client report (per department manager) or the batch is considered invalid and the client is notified.

12.5 Matrix Spike (Section 9.5) If the spike is outside of the acceptance limits, the data is reported with a narrative that is included on the Client report.

12.6 Laboratory Duplicate (Section 9.6) If the duplicate is outside of the acceptance limits, the data is reported with a narrative that is included on the Client report.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

However, for BOD and CBOD analyses, the MDL is a calculated value. Therefore, MDL studies are not performed.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734 and 1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method

14. Pollution Prevention and Waste Management

Refer to Alpha’s Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1734, 1739 IDC/DOC Generation

SOP/1728 Waste Management and Disposal SOP

16. Attachments

TABLE 1: Reported Detection Limits for Sample Volumes Indicated

TABLE 1

Reported Detection Limits for Sample Volumes Indicated

BOD RDL (mg O_2 / L)	Sample Volume (mLs)
100,000	0.003
50,000	0.006
20,000	0.015
10,000	0.03
5,000	0.06
2,000	0.15
1,000	0.3
500	0.6
200	1.5
100	3.0
50.0	6.0
20.0	15.0
10.0	30.0
5.0	60.0
2.0	150

Determination of Inorganic Anions
by Ion Chromatography

Reference Methods: **EPA 300.0,** Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August, 1993.

Method 9056, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997.

1. Scope and Application

Matrices: Drinking water, surface water, mixed domestic and industrial wastewaters, groundwater, reagent waters, solids (after extraction) leachates (when no acetic acid is used).

Definitions: See Alpha Laboratories Quality Manual Appendix A.

Regulatory Parameter List:

Parameter
Bromide
Chloride
Fluoride
Nitrate – N
Sulfate

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in use of ion chromatography and in the interpretation of ion chromatograms. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and Laboratory Director on a case-by-case basis.

2. Summary of Method

A small volume of sample is introduced into an ion chromatograph. The anions are separated and measured, using a system comprised of a guard column, analytical column, suppressor device, and conductivity detector.

2.1 Method Modifications from Reference

Use of other eluents that improve method performance are minor modifications of the method and are considered by the method to be acceptable.

3. Detection Limits

The laboratory follows the procedure found in 40CFR Part 136 to determine the MDL on a semi-annual basis. The method detection limits determined by the laboratory are on file for review.

4. Interferences

4.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. Large amounts of an anion can interfere with the peak resolution of an adjacent anion. Sample dilution and/or fortification can be used to solve most interference problems associated with retention times.

4.2 Method interferences may be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus that lead to discrete artifacts or elevated baseline in ion chromatograms.

4.3 Samples that contain particles larger than 0.45 microns and reagent solutions that contain particles larger than 0.20 microns require filtration to prevent damage to instrument columns and flow systems.

4.4 Any anion that is not retained by the column or only slightly retained will elute in the area of fluoride and interfere. Known coelution is caused by carbonate and other small organic anions. At concentrations of fluoride above 1.5mg/L, this interference may not be significant, however, it is the responsibility of the user to generate precision and accuracy information in each sample matrix.

4.5 The acetate anion elutes early during the chromatographic run. The retention times of the anions also seem to differ when large amounts of acetate are present. Therefore, this method is not recommended for leachates of solid samples when acetic acid is used for pH adjustment.

4.6 The quantitation of unretained peaks should be avoided, such as low molecular weight organic acids (formate, acetate, propionate, etc.) which are conductive and coelute with or near fluoride and would bias the fluoride quantitation in some drinking and most waste waters.

4.7 Any residual chlorine dioxide present in the sample will result in the formation of additional chlorite prior to analysis. If any concentration of chlorine dioxide is suspected in the sample, purge the sample with an inert gas (argon or nitrogen) for about five minutes or until not chlorine dioxide remains.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

Sulfuric acid used in this method has the potential to be highly toxic or hazardous.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Samples are collected in glass or plastic bottles of sufficient volume to allow replicate analyses of the anions of interest.

6.2 Sample Preservation

Samples are refrigerated at 4°C.

6.3 Sample Handling

The sample holding time is 48 hours for the following anions: Nitrate –N.

The sample holding time is 28 days for the following anions: Bromide, Chloride, Fluoride, and Sulfate.

7. Equipment and Supplies

7.1 Balance: Analytical, capable of weighing to 0.0001g.

7.2 Ion Chromatograph: Analytical system (Dionex ICS-2000) complete with ion chromatograph and all required accessories including syringes, autosampler, analytical columns, compressed gasses and detectors.

7.2.1 Anion guard column: AG-18 (Dionex PN 060551) A protector of the separator column. If omitted from the system the retention times will be shorter. Usually packed with a substrate the same as that in the separator column.

7.2.2 Anion analytical column: AS-18 (Dionex PN 060549). This column produces the separation shown in Figure 1.

7.2.3 Anion supressor: ASRS Ultra II 4mm (PN 061561). The supressor column is packed with a high capacity cation exchange resin that is capable of converting the eluent and separated anions to their respective acid forms.

7.2.4 Detector: DS6 (PN 057985) Temperature controlled, heated conductivity cell

7.2.5 Eluent Generator: EG40 (Dionex PN 058900) Prepares the eluent electronically, controlled by the software; equipped with KOH cartridge.

7.3 Software: The Dionex IC Instrument uses Chromeleon Software.

7.4 0.45µm Membrane Filter Syringes.

7.5 Volumetric Flasks: Various volumes.

7.6 Volumetric Pipets: Various volumes.

7.7 0.5mL Vials with Caps: Dionex PN 038142.

8. Standards and Reagents

Note: All analytical standards used for calibration and calibration verification must be traceable to NIST. Each standard is recorded in a Logbook and unique ID is assigned to each standard. The unique IDs must also be included in all analytical sequences.

8.1 Reagent Water: Deionized water, free of the anions of interest. Water should contain particles no larger than 0.20 microns.

8.2 Eluent Solution: 32mM KOH, Prepared by the Eluent Generator.

8.3 Stock Calibration / ICV Standard Solutions, 1000mg/L (1mg/mL): Stock standards for all analytes are usually purchased as certified solutions. Certificates of analysis are kept on file.

However, if it is necessary, the Stock Solutions may be prepared from ACS reagent grade materials (dried at 105°C for 30 minutes) as listed below. The ICV Standards must be prepared from a different source than the calibration standards.

NOTE: Stock calibration/ ICV standards are stable for at least six months when stored at 4°C. Dilute working standards are prepared weekly.

8.3.1 Standard 1: Fluoride Stock Standard, 1000mg F^-/L

In a 250mL volumetric flask, dissolve 0.5526g of sodium fluoride (NaF, CASRN 7681-49-4) in about 200mL reagent water. Dilute to the mark with reagent water, and invert to mix.

8.3.2 Standard 2: Fluoride Stock Standard, 100mg F^-/L

In a 250mL volumetric flask, pipet 25mL of Standard 1, dilute to the mark with reagent water, and invert to mix.

8.3.3 Standard 3: Chloride Stock Standard, 1000mg Cl^-/L

In a 250mL volumetric flask, dissolve 0.4121g of sodium chloride (NaCl, CASRN 7647-14-5) in about 200mL reagent water. Dilute to the mark with reagent water, and invert to mix.

8.3.4 Standard 4: Bromide Stock Standard, 1000mg Br^-/L

In a 250mL volumetric flask, dissolve 0.3219g of sodium bromide (NaBr, CASRN 7647-15-6) in about 200mL reagent water. Dilute to the mark with reagent water, and invert to mix.

8.3.5 Standard 5: Bromide Stock Standard, 100mg Br^-/L

In a 250mL volumetric flask, pipet 25mL of Standard 4, dilute to the mark with reagent water, and invert to mix.

8.3.6 Standard 8: Nitrate Stock Standard, 1000mg NO_3^--N /L

In a 250mL volumetric flask, dissolve 1.5170 g of sodium nitrate ($NaNO_3$, CASRN 7631-99-4) in about 200mL reagent water. Dilute to the mark with reagent water, and invert to mix.

8.3.7 Standard 9: Nitrate Stock Standard, 100mg NO_3^--N /L

In a 250mL volumetric flask, pipet 25mL of Standard 8, dilute to the mark with reagent water, and invert to mix.

8.3.8 Standard 12: Sulfate Stock Standard, 1000mg SO_4^{2-} /L

In a 250mL volumetric flask, dissolve 0.4535 g of anhydrous dibasic, potassium sulfate (K_2SO_4, CASRN 7778-80-5) in about 200mL reagent water. Dilute to the mark with reagent water, and invert to mix.

8.3.9 Stock Bromide Standard, 1000ppm

Commercially available. Certificate of analysis required and kept on file. Use separate sources for the ICV and Calibration standards listed below.

8.3.9.1 ICV Bromide Standard, 100ppm

In a 100mL volumetric flask, add 1mL of Stock 1000ppm Bromide standard (Section 8.4.13). Bring to volume with reagent water.

8.4 Working Mixed Stock Standard A (Calibration Stock)

In a 200mL volumetric flask, transfer using volumetric pipets, 2mL each of Standards Bromide 1000ppm and Nitrate 1000ppm; 20mL of Chloride 1000ppm and Fluoride 100ppm (Section 8.3). Dilute to the mark with reagent water and invert to mix. Store at 4 ± 2°C for up to one month.

This makes Standard A containing F^-, Cl^-, NO_2^- -N, Br^-, NO_3^- -N and SO_4^{2-} at the concentrations of 10, 100, 10, 10 and 200ppm respectively.

8.4.1 Analyte Matrix Spike Solution

Volumetrically prepare the spike solution by bringing 1.0 mL of the calibration stock standard (Section 8.4) up to a 25mL final volume with the sample.

8.5 Working Mixed Standards B through G (Calibration Curve)

Working mixed standards B through F are prepared by diluting Standard A as summarized in the following Table. These are prepared fresh as needed for calibration.

Std.	Std. A (mL)	Final Vol. (mL)	F^-	Cl^-	Br	NO_3^- -N	SO_4^{2-}
B	5	10	5.0	50.0	5.0	5.0	100.0
C	5.0	25	2.0	20.0	2.0	2.0	40.0
D	1.25	25	0.5	5.0	0.5	0.5	10.0
E	0.5	25	0.2	2.0	0.2	0.2	4.0
F	1 of Std D	10	0.05	0.5	0.05	0.05	1.0
G	0.5 of Std D	10	0.025	0.25	0.025	0.025	0.5

Example: To make up Standard B, take 25mL of Standard A in a 10mL volumetric flask and dilute to the mark with reagent water.

Note: The dynamic range for the method is two orders of magnitude. The concentrations for the standards could be changed to bracket the concentrations of the samples to be analyzed.

8.6 ICV Stock Standard (Second Source Verification)

To a 200mL volumetric flask add 20mL of the following standards: Chloride 1000ppm and Sulfate 1000ppm, and 2mL of Fluoride 1000ppm, Bromide 1000ppm and Nitrate 1000ppm (Section 8.3). Dilute to volume with reagent water.

8.6.1 ICV Working Standard / LCS Solution

In a 25mL volumetric flask, add 2mL of the ICV Stock Standard. Bring to volume with reagent water. Store at 4 ± 2°C. Prepare weekly.

ICV working standard will have the following concentrations: 0.8 mg/L for Fluoride, Nitrate and Bromide; 8.0 mg/L for Chloride and Sulfate.

8.7 CCV Working Solution

The CCV Working Solution is made by diluting 2.5 ml of Mixed Stock Standard A up to 25 ml of DI Section 8.4. Final concentrations are: 1.0 mg/L for Fluoride, Nitrate and Bromide; 10.0 mg/L for Chloride and 20.0mg/l for Sulfate. Store at 4 ± 2°C. Prepare weekly.

9. Procedure

9.1 SET-UP

9.1.1 Determination of Linear Calibration Range (LCR)

The LCR must be determined initially and verified every six months or whenever a significant change in instrument response is observed or expected. The initial demonstration of linearity must use sufficient standards to ensure that the resulting curve is linear. The verification of linearity must use a minimum of a blank and three standards. If any verification data exceeds the initial values by ± 10%, linearity must be reestablished. If any portion of the range is shown to be nonlinear, sufficient standards must be used to clearly define the nonlinear portion.

9.1.2 **Prime Pump:** The pump must be primed prior to analysis, to ensure that there is no gas entering the column.

9.1.3 **Monitor Baseline:** From the main Panel screen, press the “Startup” Button. This will turn on, in order, the pump, the eluent generator, and the conductance cell. Allow the instrument to warm up for 10 – 20 minutes to ensure the baseline is stable and flat.

9.1.4 While the baseline stabilizes, the sample sequence can be written and the autosampler may be loaded.

9.1.5 When the baseline is stabilized, the sample sequence may be loaded into the analytical run, and started from the Chromeleon software.

9.1.6 Operating Conditions: Dionex IC Instrument

Eluent Concentration: 32mM KOH

Flow rate: 1.0mL / minute

Injection volume: 100µL

ASRS: ON

Conductivity Cell Temperature: 30 °C

9.1.7 **Monitor instrument stability:** Prior to QC sample and sample analysis, analyze a DI water blank to ensure the instrument is stable.

9.1.8 **Sample filtration:** Autosampler vials are equipped with a filter. If additional filtration is necessary, samples may be filtered through a 0.45µm membrane filter attached to a syringe. **NOTE:** If samples require filtration, all associated batch QC samples must also be filtered.

9.1.9 **Extraction of solid materials :** Add a volume of reagent water equal to 10 times the weight of dry solid material taken as a sample. This slurry is mixed for 10 minutes using a magnetic stirring device. Filter the resulting slurry before injecting using a 0.45µ membrane filter attached to a syringe. Care should be taken to show that good recovery and identification of peaks is obtained with the user's matrix through the use of matrix spikes (Section 10.5).

9.2 Calibration Curve Generation

For each analyte of interest, prepare calibration standards at a minimum of three concentration levels and a blank by adding accurately measured volumes of one or more stock standards (Section 8.5) to a volumetric flask and diluting to volume with reagent water. If a sample analyte concentration exceeds the calibration range, the sample may be diluted to fall within the range.

Using injections of 100µL of each calibration standard, tabulate peak height or area responses against the concentration. The results are used to prepare a calibration curve for each analyte. During this procedure, retention times must be recorded.

The calibration curve for each analyte is prepared by plotting instrument response against the standard concentration. A correlation coefficient of 0.995 or greater is considered acceptable for all analytes.

9.2.1 **Initial Calibration Verification (ICV/LCS):** The calibration curve must be verified on each working day, and after every 20 samples. The ICV/LCS sample is prepared from a different source than that used for the calibration standards (Section 8.6). If the response or retention time for any analyte varies from the expected values by more than ± 10%, the analysis must be repeated, using fresh calibration standards. If the results are still more than ± 10%, a new calibration curve must be prepared for that analyte.

9.3 Standardization (Continuing Calibration Verification)

This standard (Standard D: Section 8.5) is prepared weekly. The CCV is analyzed at the beginning of each run, after every tenth sample, and at the end of the sample run. The % Recovery of this standard must be within ± 10% of the calibration standard. Refer to Section 10.3 if % Recovery falls outside of the acceptance range.

9.4 Equipment Operation and Sample Analysis

9.4.1 An automated constant volume injection system is used. Load and inject a fixed amount of well-mixed sample. Flush injection loop thoroughly, using each new sample. Use the same size loop for standards and samples. Record the resulting peak size in area or peak height units.

9.4.2 The width of the retention time window used to make identifications should be based upon measurements of actual retention time variations of standards over the course of a day. Three times the standard deviation of a retention time can be used to calculate a suggested window size for each analyte. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

9.4.3 If the response for the peak exceeds the working range of the system, dilute the sample with an appropriate amount of reagent water and reanalyze.

9.4.4 If the resulting chromatogram fails to produce adequate resolution, or if identification of specific anions is questionable, fortify the sample with an appropriate amount of standard and reanalyze.

Note: Retention time is inversely proportional to concentration. Nitrate and sulfate exhibit the greatest amount of change, although all anions are affected to some degree. In some cases this peak migration may produce poor resolution or identification.

9.5 Preventative Maintenance

Follow the Preventative Maintenance Schedule as outlined on the Dionex ICS-2000 CDROM.

As Needed

- Check the eluent reservoir to see if it needs to be refilled.

Daily

- Check the ICS-2000 component mounting panel for leaks or spills. Wipe up spills. Isolate and repair leaks. Rinse off any dried eluent with reagent water.
- Check the waste container daily and empty when needed.

Weekly

- Once a week, check fluid lines for crimping or discoloration. Relocate any pinched lines. Replace damaged lines.
- Check the junctions between the pump heads and the pump casting for evidence of liquid leaks. If piston seal wash tubing is not connected, check the drain tubes at the rear of the pump heads for evidence of moisture. Normal friction and wear may gradually result in small liquid leaks around the piston seal. If unchecked, these leaks can gradually contaminate the piston housing, causing the pump to operate poorly. If leaks occur, replace the piston seals.

- Check the end-line filter (PN 045987) and change if needed. When new, end-lline filters are pure white. If the system is in continuous operation, change the end-line filter weekly, or whenever it becomes discolored. Replace the filter more often if bacterial buildup is visible or if the eluent does not contain solvent.

NOTE: It is especially important to regularly replace end-line filters when using aqueous eluents, which may contaminate the filter with bacteria or algae. The bacterial buildup may not be visible.

Yearly (performed by Dionex technician)

- Calibrate the cell.
- Calibrate the vacuum degas assembly
- Replace the pump piston rinse seals and piston seals.

9.6 Calculations

9.6.1 Compute the sample concentration by comparing sample response with the standard curve. Multiply the result by the appropriate dilution factor.

9.6.2 Report only those values that fall between the lowest and the highest calibration standards. Samples exceeding the highest standard should be diluted and reanalyzed.

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test for failed parameters of the method.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test for all parameters listed in the method.

10.2 Method Blank

One Method Blank consisting of an aliquot of reagent water is analyzed with each batch of 20 samples or less. Data produced are used to assess contamination from the laboratory environment. Method Blank results must be less than the Reporting Limit (RL) for the analyte.

Note: If samples have to be filtered prior to analysis, all associated batch QC must also be filtered.

10.3 Continuing Calibration Verification (CCV) Standard

The CCV Standard is the equivalent of Standard D in Section 8.5. Store at 4 ± 2°C. Prepare weekly. The CCV is analyzed at the beginning of each run, after every tenth sample, and at the end of the sample run. The % Recovery of this standard must be within ± 10% of the calibration standard.

10.4 Initial Calibration Verification (ICV) Standard / Laboratory Control Sample (LCS)

The ICV/LCS is analyzed at the beginning of each run, but after the CCV standard. This standard is prepared from a different source than that used to prepare the calibration standards (Section 8.6). The % Recovery of this standard must be within ± 10% of the calibration standard.

10.5 Matrix Spike

Prepare and analyze one spiked sample per batch of 20 samples or less (Section 8.4.1). Recovery of the Matrix Spike must be within the Laboratory defined control limits (Section 10.7).

10.6 Duplicates

Prepare and analyze one duplicate sample per batch of 20 samples or less. The RPD for the duplicate measurements must be within the Laboratory defined control limits (Section 10.7).

10.7 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained. After the analysis of 20 spiked samples, and 20 laboratory control samples, calculate the average percent recovery (R) and the standard deviation of the percent recovery (S).

Control limits for the method parameters are generated by the QC staff and distributed to the analysts. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.8 Analytical Sequence

- Instrument calibration
- DI Blank
- CCV
- ICV
- Ten samples
- CCV
- Blank
- Shut-down

11. Method Performance

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL concentrations were obtained using reagent water. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

MDL's must be established for all analytes, using reagent water (blank) fortified at a concentration of two to three times the estimated calculated detection limit.

Method performance data is on file in the laboratory QC department. Comparison of method performance data for the laboratory to the reference method criteria occurs when laboratory in-house acceptance limits are generated. In-house generated data must be within the specifications of the reference method or the analysis is not continued until corrective action is completed.

12. Corrective Actions

If the Method Blank result exceeds the Reporting Limit (RL) for the analyte, the Blank is reanalyzed. If the second result remains > RL, notify the Laboratory Manager to ensure maintenance is performed on the water filtration system and seek an alternate reagent water source within the laboratory. If the alternate reagent water source is acceptable, this source must be utilized for all blanks, standards and sample dilutions for the sample batch. If the second source reagent water also fails, the Laboratory Manager is notified.

If the Continuing Calibration cannot be verified within the specified limits, reanalyze the CCV solution. Record the reason for re-injection. If the second analysis of the CCV solution confirms calibration to be outside the limits, sample analysis must be discontinued, the cause determined and/or in the case of drift, the instrument recalibrated. All samples following the last acceptable CCV solution must be reanalyzed. The analysis data of the calibration blank and CCV solution must be kept on file with the sample analyses data.

If the ICV/LCS acceptance criterion cannot be met, reanalyze the standard. If failure continues, the instrument is recalibrated.

If the Matrix Spike acceptance criteria is not met, the spiked sample is reanalyzed (if possible). If failure continues and if all other QC performance criteria are met, the data is reported and a narrative is included with the final report.

If the RPD for the Duplicate measurements falls outside the Laboratory defined control limits (Section 10.7), the sample is reanalyzed (if possible). If failure continues, and if all other QC performance criteria are met, the data is reported and a narrative is included with the final report.

Holding time exceedence and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the CCV or LCS recovery of any parameter falls outside the designated acceptance range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

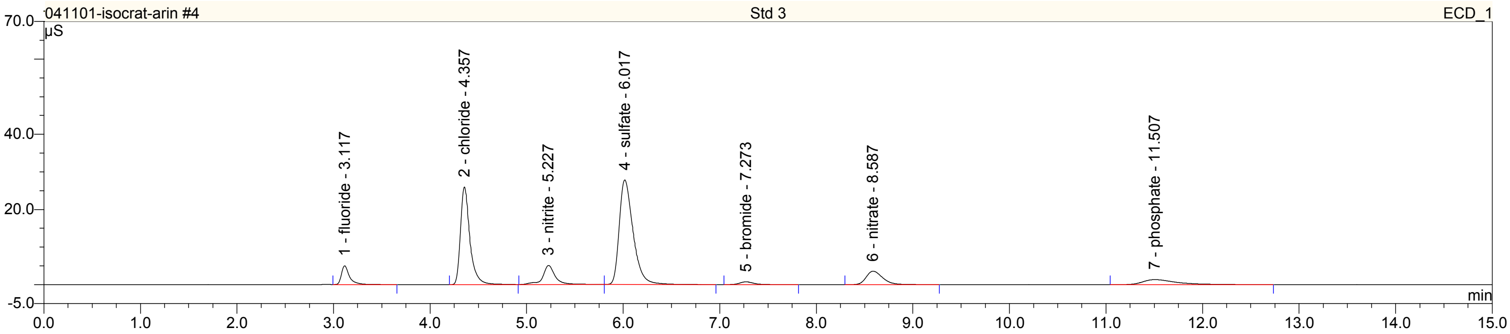
See Chemical Hygiene Plan for waste handling and disposal.

15. Attachments

Figure 1: Isocratic Anion Standard Separation

Figure 1

Isocratic Anion Standard Separation



Chemical Oxygen Demand (COD)
Including: High (0-1500ppm) and Low (0-150ppm) Levels
Closed Reflux, Colorimetric Method (Total and Soluble in Liquid)

References: **SM 5220 D,** Standard Methods for the Examination of Water and Wastewater, 21st Edition (1997)

Method 410.4, Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.

1. Scope and Application

Matrices: This method is applicable to liquid samples.

Definitions: Refer to Alpha Analytical Quality Manual.

The Chemical Oxygen Demand (COD) is used as a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. For samples from a specific source, COD can be related empirically to BOD, organic carbon, or organic matter. The test is useful for monitoring and control after correlation has been established. The dichromate reflux method is preferred over procedures using other oxidants because of superior oxidizing ability, applicability to a wide variety of samples, and ease of manipulation. Oxidation of most organic compounds is 95 to 100% of the theoretical value. Pyridine and related compounds are oxidized only to the extent that they remain in contact with the oxidant. Ammonia, present either in the waste or liberated from nitrogen-containing organic matter, is not oxidized in the absence of significant concentration of free chloride ions.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the ICP-MS and in the interpretation of ICP-MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

Most types of organic matter are oxidized by a boiling mixture of chromic and sulfuric acids. A sample is refluxed in strongly acid solution with a known excess of potassium dichromate ($K_2Cr_2O_7$). After digestion, the remaining unreduced $K_2Cr_2O_7$ is determined colorimetrically and the oxidizable organic matter is calculated in terms of oxygen equivalent. Keep ratios of reagent weights, volumes, and strengths constant. The standard two-hour reflux time may be reduced if it has been shown that a shorter time yields the same results.

2.1 Method Modifications from Reference

2.1.1 **Soluble COD (SCOD):** Filter the sample through 0.45µm filter followed by preservation to pH ≤ 2 using 1:1 H_2SO_4.

2.1.2 **Low Level COD:** Analyze samples in low level range COD tubes for more precise results on lower concentrations of target analyte.

3. Reporting Limits

The reported detection limit for chemical oxygen demand, closed reflux, colorimetric method, is 20.0mg/L for (High) COD method, and 10.0mg/L for (Low) COD method.

4. Interferences

4.1 Instrumental

The Spectrophotometer and COD Reactors are subject to preventative maintenance, which will minimize instrumental interferences. (Refer to Section 10.6)

4.2 Parameters

4.2.1 **Volatile Straight-Chain Aliphatic Compounds:** These compounds are not oxidized to any appreciable extent. This failure occurs partly because volatile organics are present in the vapor space and do not come in contact with the oxidizing liquid. Straight-chain aliphatic compounds are oxidized more effectively when silver sulfate (Ag_2SO_4) is added as a catalyst. However, Ag_2SO_4 reacts with chloride, bromide, and iodide to produce precipitates that are oxidized only partially. The difficulties caused by the presence of the halides can be overcome largely, though not completely, by complexing with mercuric sulfate ($HgSO_4$) before the refluxing procedure. Although 1g $HgSO_4$ is specified for 50mL sample, a lesser amount may be used where sample chloride concentration is known to be less than 2000mg/L, as long as a 10:1 ratio of $HgSO_4$ is maintained. Do not use the test for samples containing more than 2000mg Cl/L. Techniques designed to measure COD in saline waters are available.

4.2.2 **Nitrite (NO_2^-**) exerts a COD of 1.1mg O_2/mg NO_2^- -N. Because concentrations of NO_2^- -N in waters rarely exceed 1 or 2mg NO_2^- -N/L, the interference is considered insignificant and usually is ignored. To eliminate a significant interference due to NO_2^-, add 10mg sulfamic acid for each mg NO_2^- -N present in the sample volume used; add the same amount of sulfamic acid to the reflux vessel containing the distilled water blank.

4.2.3 **Reduced Inorganic Species,** such as ferrous iron, sulfide, managanous manganese, etc., are oxidized quantitatively under the test conditions. For samples containing significant levels of these species, stoichiometric oxidation can be assumed from known initial concentration of the interfering species and corrections can be made to the COD value obtained.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

NOTE: COD tubes contain Mercury, Dichromate and Sulfuric Acid. General laboratory safety practices must be observed

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Preferably, collect samples in glass bottles. Blend samples containing settleable solids with a homogenizer to permit representative sampling.

6.2 Sample Preservation

If delay before analysis is unavoidable, preserve sample by acidification to pH ≤ 2 using 1:1 H_2SO_4 . Preferably acidify any sample that cannot be analyzed the same day it is collected.

6.3 Sample Shipping

No specific requirements.

6.4 Sample Handling

Test unstable samples without delay. Preserved samples are analyzed within 28 days of sampling. Store samples under refrigeration at 4 ± 2°C.

7. Equipment and Supplies

7.1 COD Reactor: HACH Company, 150ºC

7.2 Spectrophotometer: For use at 620nm.

7.3 Computer and related accessories: with LIMS access and Excel

7.4 Automatic Pipettor: Capable of 2.0mL

7.5 Pipets: 10mL and 1mL, borosilicate glass.

7.6 Centrifuge.

7.7 Kim Wipes.

7.8 Volumetric flasks, assorted sizes (1000mL, 100mL)

8. Reagents and Standards

8.1 Stock Calibration Standard (for calibration curve generation): 5000ppm Potassium Hydrogen Phthalate (KHP) Stock Calibration Standard: 4.25g of dry KHP and 1ml H3PO4 brought up to 1L with DI. Prepare stock calibration standard every six months and generate a new calibration curve (Section 10.1). Store stock calibration standard under refrigeration at 4 ± 2 °C. Standard expires after six months.

8.1.1 Working Calibration Standards for High COD: Prepare fresh standards for each calibration curve. The following Potassium Hydrogen Phthalate (KHP) standards are prepared in volumetric flasks:

8.1.1.1 400ppm: 8ml of 5000ppm (Section 8.1) to 100ml with DI.

8.1.1.2 800ppm: 16ml of 5000ppm (Section 8.1) to 100ml with DI.

8.1.1.3 1000ppm: 20ml of 5000ppm (Section 8.1) to 100ml with DI.

8.1.1.4 1250ppm: 25ml of 5000ppm (Section 8.1) to 100ml with DI.

8.1.1.5 20ppm: 2ml of 1000ppm (Section 8.1.1.3) to 100ml with DI.

8.1.1.6 50ppm: 5ml of 1000ppm (Section 8.1.1.3) to 100ml with DI.

8.1.1.7 100ppm: 10ml of 1000ppm (Section 8.1.1.3) to 100ml with DI.

8.1.1.8 200ppm: 20ml of 1000ppm (Section 8.1.1.3) to 100ml with DI.

8.1.2 Working Calibration Standards for Low COD:

8.1.2.1 500ppm: 10ml of 5000ppm (Section 8.1) to 100ml DI.

8.1.2.2 5ppm: 1ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.1.2.3 10ppm: 2ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.1.2.4 20ppm: 4ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.1.2.5 50ppm: 10ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.1.2.6 100ppm: 20ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.1.2.7 125ppm: 25ml of 500ppm (Section 8.1.2.1) to 100ml DI.

8.2 Stock Verification Standard (for calibration curve verification): 5000ppm Potassium Hydrogen Phthalate (KHP) Stock Verification Standard: 4.25g of dry KHP and 1ml H3PO4 brought up to 1L with DI. Prepare stock verification standard every six months. Stock verification standard must be of a different source than that used for the stock calibration standard (Section 8.1). Store stock verification standard under refrigeration at 4 ± 2 °C. Standard expires after six months.

8.2.1 Working Verification Standards [Including LCS (Laboratory Control Standard), ICV (Initial Calibration Verification), and CCV (Continuing Calibration Standard), (Section 9.2)]: Prepare fresh standards monthly or as needed. Standards are stored at room temperature in complete darkness. Standards expire after one month. The following Potassium Hydrogen Phthalate (KHP) standards are prepared in volumetric flasks:

8.2.1.1 1000ppm: 20ml of 5000ppm (Section 8.2) to 100ml with DI. (Also Low Cod Spike Solution).

8.2.1.2 500ppm Hi LCS/ICV Solution: 10ml of 5000ppm (Section 8.2) to 100ml with DI.

8.2.1.3 200ppm CCV Solution: 4ml of 5000ppm (Section 8.2) to 100ml with DI.

8.2.1.4 400ppm CCV Solution: 8ml of 5000ppm (Section 8.2) to 100ml with DI.

8.2.1.5 50ppm Low LCS Solution: 5ml of 1000ppm (Section 8.2.1.1) to 100ml with DI.

8.2.1.6 60ppm CCV Solution: 6ml of 1000ppm (Section 8.2.1.1) to 100ml with DI.

8.2.1.7 20ppm ICV/CCV Solution for Low Cod: 4ml of 500ppm (Section 8.2.1.1) to 100ml DI.

8.3 COD Tubes: High Cod Range 0 – 1500 mg/L, Low Cod Range 0-150 mg/L. Follow the manufacturer's directions for use and date of expiration. Store at room temperature in a complete darkness. NOTE: A new calibration curve must be generated for each brand of COD tubes purchased. The same curve cannot be used for different brands.

8.3.1 High Level COD Tubes (0-1500ppm): Environmental Express, Catalog # B1015

8.3.2 High Level COD Tubes (0-1500ppm): CPI International, Catalog #4380-1500-150

8.3.3 Low Level COD Tubes (0-150ppm): Environmental Express, Catalog # B1010

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

9.1.1 Method Blank/Initial Calibration Blank (ICB)

Add 2 mL DI to COD tube and digest. One Method Blank is analyzed per batch of 20 samples or less. The Method Blank result must be less than the RL. If the Method Blank fails acceptance criteria, the entire batch must be reset and reanalyzed. This Blank is used to zero the spectrometer before reading the cod batch samples and associated QC.

9.1.2 Continuing Calibration Blank (CCB)

The tube used the as the ICB is the same one used as the CCB. One CCB is analyzed every 10 samples. If the CCB fails acceptance criteria, the previous 10 samples need to be reread. If it fails a second time, then the entire batch must be reset and reanalyzed.

9.2 Laboratory Control Sample (LCS)

9.2.1 ICV / LCS

One Low LCS and one Hi LCS/ICV pair are analyzed per batch of 20 samples or less.

The results of the low LCS and Hi LCS/ICV must be within ± 10% of the true value, otherwise the low LCS and Hi LCS/ICV are re-made and reanalyzed. If these criteria are still not met, a new calibration curve must be generated (Section 10.1), and the entire batch of samples is reset.

9.2.1.1 High Cod:

9.2.1.1.1 Low Lcs: 2.0mL of 50ppm standard (Section 8.2.1.5) is added to a Cod tube.

9.2.1.1.2 High Lcs/Icv: 2.0mL of 500ppm standard (Section 8.2.1.2) is added to a Cod tube.

9.2.1.2 Low Cod:

9.2.1.2.1 Low Lcs: 2.0mL of 20ppm standard (Section 8.2.1.7) is added to a Cod tube.

9.2.1.2.2 High Lcs/Icv: 2.0mL of 50ppm standard (Section 8.2.1.5) is added to a Cod tube.

9.3 Initial Calibration Verification (ICV)

Refer to Section 9.2.

9.4 Continuing Calibration Verification (CCV) (Applies to High Cod only).

A CCV standard is analyzed after a Blank sample in the sample batch and after every 10 samples. The CCV is to verify that the calibration curve is valid over the range of use. The CCV concentration is rotated daily, with a different concentration each day.

To a COD tube, add 2.0mL from one of the CCV standards: 60ppm (Section 8.2.1.6), 200ppm (Section 8.2.1.3) or 400ppm (Section 8.2.1.4).

% Recovery must be within ± 10% of the true value. If % recovery is outside of these limits, the CCV Standard is re-made and reanalyzed. If these criteria are still not met, a new calibration curve must be generated (Section 10.1), and the entire batch of samples is reset.

9.5 Matrix Spike

One matrix spike is analyzed per batch of 20 samples or less:

9.5.1 High Cod: 100µL of 5000ppm KHP stock working standard (Section 8.2) is added to 2.0mL of sample in a COD tube. (Base value before dilutions = 238.1 mg/L).
9.5.2 Low Cod: 100uL of 1000ppm KHP stock working standard (Section 8.2.1.1) is added to 2.0mL of sample in a Cod tube. (Base value before dilutions = 47.6 mg/L).

% Recovery must be within ± 20% of the true value. If % recovery is outside of these limits, and the LCS recovery is acceptable, the matrix spike sample is reset. If failure continues, the matrix spike is reset on dilution. If recovery is acceptable, a narrative is submitted with the data indicating a dilution was necessary due to sample matrix. If failure still continues, and the LCS is acceptable, a narrative is submitted with the data indicating failure is due to sample matrix.

9.6 Laboratory Duplicate

One duplicate sample is analyzed per batch of 20 samples or less. % RPD must be ≤ 20%. If % RPD is outside of these limits, the sample and its duplicate are reset. If failure continues, a narrative is submitted with the data indicating the sample is non-homogeneous.

9.7 Method-specific Quality Control Samples

Not applicable.

9.8 Method Sequence

- Blank (ICB)
- Low LCS
- Hi LCS (ICV)
- Samples/QC Samples (1-10 or less)
- CCV
- CCB
- Samples/QC Samples (11-20 or less)
- CCV
- CCB

10. Procedure

10.1 Equipment Set-up

10.1.1 **Preparation of Calibration Curve:** A Calibration Curve is generated every six months when new Stock Calibration Standard is prepared (Section 8.1), upon purchase of a new brand of COD tubes, or sooner if necessary. A Calibration Curve must be in place prior to sample analysis. The curve is generated using the eight calibration standards included within Section 8.1.1. for High Cod, or Section 8.1.2 for Low Cod.

10.2 Initial Calibration

Analyze these standards according to Section 10.3.

Plot the absorbance values of the standards versus the corresponding COD concentrations. The correlation coefficient must be ≥ 0.995 for the curve to be considered valid.

10.3 Equipment Operation and Sample Processing

10.3.1 Preparation of COD tubes:

Preheat the COD reactor to 150°C.

Measure 2.0mL of sample or diluted sample into a COD tube. (NOTE: Use appropriate range level of tubes for High or Low cod analysis). In a similar manner, prepare the QC samples to be digested with the samples (refer to Sections 9.2 – 9.4 for High Cod, and Sections 9.2 – 9.3 for Low Cod).

Tightly cap tubes and invert several times to mix completely. **CAUTION! Protect hands from heat produced when the contents of the vessel are mixed.** In order to prevent local heating of vessel bottom and a possible explosive reaction, mix vessel contents thoroughly before placing in the COD reactor.

Place the prepared COD tubes into the heated COD reactor. Record the “Time in” and the reactor temperature on the batch sheet for later entry onto excel sheet. Reflux for 2 hours. Remove tubes from the COD reactor. Record the “Time out” and the reactor temperature on the batch sheet for later entry onto excel sheet. Allow tubes to cool to room temperature.

10.3.2 Measurement of Dichromate Reduction: If any liquid is visible on the walls of the cooled COD tubes, invert the tubes to incorporate this liquid. Allow solids to settle before measuring absorbance. If solids do not settle, the COD tubes must be centrifuged. Refer to section 10.3.3 for instructions on how to enter the data directly onto the Cod excel sheet.

10.3.3 Entering data onto the COD excel sheet

10.3.3.1 Turn on the computer and the spectrophotometer, at least 30 minutes prior to use.

10.3.3.2 On the computer desktop, double-click with the mouse to open the Gensys1 shortcut, hit “okay” when the box that says “device error” appears, then minimize the box which shows that the device has been activated.

10.3.3.3 Next, open the \\Fileserv\wetchem shortcut, followed by the cod_xlt file for High Cod, and cod_low_xlt file for Low Cod. Once these excel sheet opens, located at the top, right of the page, enter the WG batch number from the LIMS printout (done prior to Cod analysis). Enter the technician’s initials in the appropriate area. Enter the date and time of the Cod preparation, then the date and time of the cod analysis.

10.3.3.4 Select which corresponding COD product is being analyzed: (ex. COD-5210), from the “buttons” area.

10.3.3.5 In the reagents/media information section of the excel sheet, enter the date of the preparation of the working standards (the High LCS/ICV, Low LCS, and CCV) used during the procedure (in order for the excel sheet to accept these dates, a “ ‘ “ must be typed first, followed by the date in an only numerical fashion, (for example: ‘091108 would express that the standards were made on 09-11-08 on the excel sheet) note that when this is typed, the “ ‘ “ will not be visible, but it is required to enter on the sheet).

10.3.3.6 On the MS line, enter the date of preparation of the original stock standard by typing it the same way.

10.3.3.7 On the COD Tubes line, enter the WC # which is the Wet Chemistry reagent log identifier, (for example: on the exterior of the cod box, a handwritten identifier saying WC-596 is visible).

10.3.3.8 Use the mouse to hit the “Get Samples” button on the screen. This will call up all the batch information and place it onto the excel sheet.

10.3.3.9 Below the column heading entitled Time, count down 10 samples; use the mouse to click on the far left, row numbers column, right-click on the mouse to activate the choice to insert another row. Do this process twice. In these newly added rows, type in (under column heading entitled Sample number), and the concentration of the (rotating for High Cod only) CCV standard, which was used for the Cod batch to be read. If the batch is a full batch of 20 samples, this process of inserting extra rows will need to be repeated below the next 10 samples also. (Therefore, when reading the Cod tubes, the Blank, ICV, and first 10 samples will be read, then the CCV and CCB, followed by the next 10 samples, the CCV and CCB a second time, followed by the Duplicate and Spike, followed by the CCV and CCB a third time to finish the readings for that batch. If there are less than 20 samples, the rows are entered accordingly where necessary, allowing for the CCV and CCB to be read every 10 samples.)

10.3.3.10 Once all of the initial setup of the excel sheet has been accomplished, set the curser above the Time column and use the arrows to move the cursor down to the first box in the column. It is imperative that the box does NOT have a blinking cursor present in it when readings are begun.

10.3.3.11 Ensure that the spectrophotometer is set to the 620 wavelength and that all Cod tubes are ready for reading as described in section 10.3.1

10.3.4 Reading COD tubes (including Initial and Continuing Calibration requirements)

10.3.4.1 Wipe the exterior of the digested Method Blank COD tube with a Kim Wipe. Insert the Blank COD tube into the light path of the spectrophotometer set at 620nm. Set the absorbance to Zero.

10.3.4.2 Initial Calibration for the analysis requires that all initial QC (i.e. Blank, Low and High LCS) pass method requirements before proceeding on to read samples.

10.3.4.3 Read the absorbance of all samples and QC samples, wiping each tube with a Kim Wipe prior to reading.

10.3.4.4 On the lower right side of the face of the spectrophotometer, there is a print button. Once zeroing the Blank, and making sure to have the correct box highlighted on the excel sheet, hit the print button and it will beep as the date, time, and absorbance information are transferred to the excel sheet. The batch should be read in order as it occurs on the excel sheet, to enable the time sequence to be accurate.

10.3.4.5 Continuing Calibration requires that, following each 10 samples, the CCV (rotating value for High Cod only) is read, followed by the CCB, in order to demonstrate that the curve is valid. If the recovery result is valid according to the method criteria, then continue reading the next 10 samples. If the CCV and/or CCB fail, the previous 10 samples are no longer valid and must be reanalyzed as well as the CCV, CCB, and future unread samples in the batch.

10.3.4.6 When all readings have been taken, manually fill in the spike result based on the result shown in the above readings. Then hit the Save To LIMS button. Once this has been done, the data will be available in the LIMS, and a hardcopy will automatically print to review.

10.3.4.7 To repeat this process for a new COD batch, return to section 10.3.3.3.

10.4 Continuing Calibration

See Section 10.3.4.5

10.5 Preventive Maintenance

All spectrophotometers are calibrated on a semi-annual basis and an instrument service company calibrates the COD Reactors on an annual basis. Records are kept on file.

11. Data Evaluation, Calculations and Reporting

$$\text{COD as mg } O_2 / L = \frac{\text{Absorbance - Y-intercept}}{\text{Slope}} \times \text{dilution factor}$$

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Holding time exceedence and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the LCS and/or MS recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734 and 1739 for further information regarding IDC/DOC Generation.

13.2.1 **Initial (IDC)**

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1734, 1739 IDC/DOC Generation

SOP/1728 Waste Management and Disposal SOP

16. Attachments

None

True and Apparent Color

Visual Comparison Method

Reference Method No.: **STM # 2120 B**

Reference: Standard Methods for the Examination of Water and Wastewater, 20th Edition (SDWA), 21st Edition (2011 CWA).

1. Scope and Application

Matrices: The platinum-cobalt method is useful for measuring color of potable water and of water in which color is due to naturally occurring materials. It is not applicable to most highly colored industrial wastewaters.

The visual comparison method is applicable to nearly all samples of potable water. Pollution by certain industrial wastes may produce unusual colors that cannot be matched. In this case use an instrumental method.

Definitions: See Alpha Laboratories Quality Manual Appendix A

Color in water may result from the presence of natural metallic ions (iron and manganese), humus and peat materials, plankton, weeds, and industrial wastes. Color is removed to make a water suitable for general and industrial applications. Colored industrial wastewaters may require color removal before discharge into watercourses.

The term “color” is used here to mean true color, that is, the color of water from which turbidity has been removed. The term “apparent color” includes not only color due to substances in solution, but also that due to suspended matter. Apparent color is determined on the original sample without filtration or centrifugation. In some highly colored industrial wastewaters, color is contributed principally by colloidal or suspended material. In such cases both true color and apparent color should be determined.

To determine color by currently accepted methods, turbidity must be removed before analysis. The optimal method for removing turbidity without removing color has not been found yet. Filtration yields results that are reproducible from day to day and among laboratories. However, some filtration procedures also may remove some true color. Centrifugation avoids interaction of color with filter materials, but results vary with the sample nature and size and speed of the centrifuge. When sample dilution is necessary, whether it precedes or follows turbidity removal, it can alter the measured color if large color-bodies are present.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, and completing the record of training.

A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

Color is determined by visual comparison of the sample with known concentrations of colored solutions. For true color determination, remove turbidity by the filtration procedure. Apparent color is determined on the original sample without filtration or centrifugation.

2.1 Method Modifications from Reference

None.

3. Detection Limits

The laboratory follows the procedure found in 40CFR Part 136 to determine the MDL on an annual basis. The method detection limits determined by the laboratory are on file for review.

The reported detection limit is 5.0 color units.

The determination of a MDL is not applicable to this method.

4. Interferences

4.1 Even a slight turbidity causes the apparent color to be noticeably higher than the true color; therefore, remove turbidity before approximating true color.

4.2 The color value of water is extremely pH-dependent and invariably increases as the pH of the water is raised. When reporting a color value, specify the pH at which color is determined.

4.3 Samples that have hues different from the platinum-cobalt standards can not be analyzed by this method.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Collect representative samples in clean glass or plastic bottles.

6.2 Sample Preservation

Samples are stored at 4 ± 2 °C. Allow samples to warm up to room temperature before analysis.

6.3 Sample Handling

Make the color determination within 24 hours of sample collection because biological or physical changes occurring in storage may affect color. With naturally colored waters these changes invariably lead to poor results.

7. Equipment and Supplies

7.1 Nessler Tubes: Identical, 50mL, tall form.

7.2 pH meter: Laboratory bench-top model with automatic temperature compensation.

7.3 Volumetric Flasks: 100 mL

7.4 Combination Electrode: Incorporates measuring and referenced functions; solid, gel-type filling material.

7.5 Filtration Apparatus:

7.4.1 Vacuum Pump

7.4.2 0.45µm filters

7.4.3 Filter Funnels

7.4.4 Side-arm Erlenmeyer Flasks

8. Standards and Reagents

8.1 Stock Color Standard, 500 units:

Commercially available with Certificate of Analysis..

8.2 9 Working Standards

Prepare standards having colors of 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 units by diluting the stock standard (Section 8.1) as follows: Pipet 1.0mL, 2.0mL, 3.0mL, 4.0mL, 5.0mL, 6.0mL, 7.0mL, 8.0mL, 9.0mL and 10.0mL, each into separate 100mL volumetric flasks. Dilute each to 100.0mL with DI water. Transfer 50mL of each standard into separate Nessler tubes placed into a rack. Label the rack with the unique standard ID for each tube. Protect these standards against evaporation and contamination when not in use.

Standards expire 1 months from the date of preparation. Store at room temperature in sealed Nessler tubes.

8.3 pH Buffers: Commercially available pH 4 (or 4.01), pH 7, pH 10 (or 10.1). Buffers must have been validated by comparison to NIST Standards. Certificate of Analysis is required.

8.4 Deionized Water (DI)

9. Procedure

9.1 SET-UP

Prepare color standards as described in Section 8.2.

In the laboratory notebook, record the calibration stock ID and a unique ID for each standard.

9.2 Initial Calibration

The pH meter is calibrated on each day of use using three pH buffers (Section 8.3). Follow manufacturer's instructions for a 3-point calibration of the pH meter. The results of the calibration must be recorded in the pH Calibration Log. Refer to the pH Liquid Samples SOP/07-10.

9.3 Equipment Operation and Sample Analysis

9.3.1 For True Color determination, filter the sample through a 0.45 µm filter. Filter 25mL through filter and discard. Filter 50mL through filter for analysis. Analyst must use two different filtered aliquots for a replicate measurement.

9.3.2 Measure pH of each sample. Refer to the pH Liquid Samples SOP/07-10. Record the pH in the laboratory notebook. If outside the range of pH 4 to pH 10, than adjust to pH 7 and note the adjustment in the logbook.

9.3.3 Fill a clean Nessler tube that matches those used for the standards in Section 8.2 with 50 mL of sample. Observe sample color by comparing it with the standards as follows:

9.3.3.1 Look vertically downward through the tubes toward a white or specular surface placed at such an angle that light is reflected upward through the column of liquid. If turbidity is present and has not been removed, report as "apparent color."

9.3.4 If the color exceeds 50 units, dilute the sample with DI water in known proportions until the color is within the range of the standard.

9.4 Preventative Maintenance

9.4.1 The pH meter is calibrated each day of use by the analyst, as well as annually by an instrument service company. Certificates are kept on file.

9.4.2 When not in use, keep Nessler Tubes covered.

9.5 Calculations

9.5.1 Calculate color units by the following equation:

Color units = A x 50 / B

where:

A = estimated color of a diluted sample
B = mL sample taken for dilution

9.5.2 Report color results in whole numbers and record as follows:

Color Units	Record to Nearest
1-50	1
51-100	5
101-250	10
251-500	20

9.5.3 Report sample pH results

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

10.2 Duplicates

Analyze one sample in duplicate per batch of 10 samples or less.

10.3 Analytical Sequence

The analytical sequence is:

- Prepare color standards.
- Calibrate pH meter.
- Measure sample pH.
- For True Color determination, filter sample.
- Visually compare 50mL of sample to the range of color standards.
- Calculate results.

11. Corrective Actions

Holding time exceedance and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of blanks and duplicate response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

12. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

13. Waste Management

See Chemical Hygiene Plan for waste handling and disposal.

Nitrate, Nitrite and Nitrate/Nitrite Nitrogen

Automated Cadmium Reduction Method

References: **Methods 353.2:** Methods for the Determination of Inorganic Substances in Environmental Samples, EPA 600/ R-93/ 100. August, 1993.

Methods 4500NO$_3$-F, 4500NO$_2$-B: Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 2000.

Method 10-107-04-1, Lachat Instruments, 6645 West Mill Road, Milwaukee, WI 53218, 1992.

1. Scope and Application

Matrices: This method is limited to optically clear water samples with a total concentration of nitrite and nitrate below 8mg N/L.

Definitions: See Alpha Laboratories Quality Manual Appendix A

In waters and wastewaters, the forms of nitrogen of greatest interest are, in order of decreasing oxidation state, nitrate, nitrite, ammonia, and organic nitrogen. All these forms of nitrogen, as well as nitrogen gas (N_2), are biochemically interconvertible and are components of the nitrogen cycle. They are of interest for many reasons.

Organic nitrogen is defined functionally as organically bound nitrogen in the trinegative oxidation state. It does not include all organic nitrogen compounds. Analytically, organic nitrogen and ammonia can be determined together and have been referred to as “kjeldahl nitrogen,” a term that reflects the technique used in their determination. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea. Numerous concentrations vary from a few hundred micrograms per liter in some lakes to more than 20mg/L in raw sewage.

Total oxidized nitrogen is the sum of nitrate and nitrite nitrogen. Nitrate generally occurs in trace quantities in surface water but many attain high levels in some groundwater. In excessive amounts, it contributes to the illness known as methemoglobinemia in infants. A limit of 10mg nitrate as nitrogen/L has been imposed on drinking water to prevent this disorder. Nitrate is found only in small amounts in fresh domestic wastewater but in the effluent of nitrifying biological treatment plants, nitrate may be found in concentrations of up to 30mg nitrate as nitrogen/L. It is an essential nutrient for many photosynthetic autotrophs and has been identified as a growth-limiting nutrient.

Nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Such oxidation and reduction may occur in wastewater treatment plants, water distribution systems, and natural waters. Nitrite can enter a water supply system through its use as a corrosion inhibitor in industrial process water. Nitrite is the actual etiologic agent of methemoglobinemia. Nitrous acid, which is formed from nitrite in acidic solution, can react with secondary amines (RR’NH) to form nitrosamines (RR’N-NO), many of which are known to be carcinogens. The toxicologic significance of nitrosation reactions in vivo and in the natural environment is the subject of much current concern and research.

Within this SOP, organic nitrogen is referred to as organic N, nitrate nitrogen as NO_3^--N, and nitrite nitrogen as NO_2^--N.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Lachat Analyzer and in the interpretation of Lachat data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl)ethylenediamine dihydrochloride. The resulting water-soluble dye has a magenta color, which is read at 520nm. Nitrite alone can be determined by removing the cadmium column. The nitrate is calculated as the difference between the reduced and non-reduced sample.

2.1 Method Modifications from Reference

Soils can be analyzed using 1:10 ratio soil to water extraction, following filtration.

3. Detection Limits

This method has an analytical range of 0.1 to 8.0mg N/L in the form of nitrate, and 0.05 to 8.0mg N/L in the form of nitrite.

The Reporting Limit is 0.1mg/L for Nitrate and 0.05 mg/L for Nitrite. Reporting limit is 1.0 mg/kg for soils.

4. Interferences

4.1 Suspended matter in the column will restrict sample flow.

4.2 For turbid samples, filter through 0.45µm membrane filter prior to analysis.

4.3 Low results would be obtained for samples that contain high concentrations of iron, copper or other metals. In this method, EDTA is added to the buffer to reduce this interference.

4.4 Samples that contain large concentrations of oil and grease will coat the surface of the cadmium. In this case, only the water phase of the sample is used for analysis and a narrative is submitted with the data. Dilutions are performed as necessary.

4.5 Residual chlorine can interfere by oxidizing the Cd column, reducing its efficiency. Prior to analysis, check wastewater and drinking water samples for residual chlorine and record results in the Laboratory Notebook. If residual chlorine is present, and the samples are preserved with H_2SO_4, the sample may be analyzed for NO_3/NO_2 determination. However,

NO_2 must be performed by a manual method. If it is not possible to analyze NO_2 by a manual method, the result is reported as NA and a narrative is submitted.

4.6 Sample color interferes if it is absorbed at about 540nm.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Samples are collected in glass or plastic bottles; 250mL minimum volume. Soils can be collected in plastic or glass containers.

6.2 Sample Preservation

Refrigerate samples at 4 ± 2 °C.

For Nitrate/Nitrite analysis, the samples are preserved with 1:1 H_2SO_4.

6.3 Sample Handling

Begin NO_3^- and/or NO_2^- determinations promptly after sampling. If storage is necessary, store for up to 48 hours at 4 ± 2 °C.

NOTE: If the 48-hour hold time cannot be met, the sample is to be handled as follows, only in an emergency situation. These instructions are not to be used on a regular basis.

Prior to the expiration of the 48-hour hold time, the following three steps are executed:

1. A manually colored Nitrite test is performed by Method 354.2. Results are recorded in the Laboratory Notebook.
2. A 50mL aliquot of the sample is preserved to a pH of <2 with concentrated H_2SO_4. Preservation is recorded in the Laboratory Notebook.

Prior to analysis, within 14 days of preservation, the preserved sample is neutralized using 6N NaOH. The sample is analyzed using only the Lachat Instrument.

CAUTION! Samples must NOT be preserved with mercuric chloride or thiosulfate because this will degrade the cadmium column.

7. Equipment and Supplies

7.1 Lachat 8000 Automated Ion Analyzer or Lachat QuickChem 8500 Automated Ion Analyzer

7.2 Nitrate+Nitrite Lachat Board

7.3 Nitrite Lachat Board

7.4 Pre-packed Cadmium Columns: Available from Lachat.

7.5 Ottawa sand.

7.6 Disposable Culture Tubes 13x100 ml

7.7 Disposable pipettes.

8. Standards and Reagents

8.1 Stock Nitrate Standard, 1000mg N/L as NO_3^-: Purchased commercially prepared with certificate of analysis. Expires upon manufacturer's expiration date. There must be different manufacturers for calibration stock and ICV/LCS stock.

8.1.1 Stock Nitrate Standard, 200.0mg N/L as NO_3^-: Pipet 50mL of 1000ppm standard (Section 8.1) into 250mL volumetric flask and bring to volume with DI.

Alternately, in a 1L volumetric flask, dissolve 1.444g potassium nitrate (KNO_3) in about 600mL DI. Add 2mL chloroform. Dilute to the mark with DI and invert to mix. Refrigerate at 4±2°C. This solution is stable for six months.

8.2 Stock Nitrite Standard, 1000mg N/L as NO_2^-: Purchased commercially prepared with certificate of analysis. Expires upon manufacturer's expiration date. There must be different manufacturers for calibration stock and ICV/LCS stock.

8.2.1 Stock Nitrite Standard, 200.0mg N/L as NO_2^-: Pipet 50mL of 1000ppm standard (Section 8.2) into 250mL volumetric flask and bring to volume with DI.

Alternately, in a 1L volumetric flask, dissolve 0.986g sodium nitrite ($NaNO_2$) or 1.214g potassium nitrite (KNO_2) in approximately 800mL DI. Add 2mL chloroform. Dilute to the mark with DI and invert to mix. Refrigerate at 4±2°C. This solution is stable for six months.

8.3 Intermediate Nitrate Working Standard, 20 mg N/L as Nitrate: To a 250mL volumetric flask, add 25.0mL of the 200mg N/L NO_3^- stock standard. Dilute to the mark with DI and invert to mix. These solutions are stable for two weeks. Refrigerate at 4±2°C.

8.4 Intermediate Nitrite Working Standard, 20 mg N/L as Nitrite: To a 250mL volumetric flask, add 25.0mL of the 200mg N/L NO_2^- stock standard. Dilute to the mark with DI and invert to mix. These solutions are stable for two weeks. Refrigerate at 4±2°C.

8.5 Set of Six Calibration NO_3^- Standards, 8.0, 4.0, 1.00, 0.40, 0.20 and 0.1mg N/L as Nitrate: These standards are stable for 2 weeks. Refrigerate at 4±2°C.

To four 200mL volumetric flasks, add respectively: 8.0, 4.0, 1.0 and 0.4mL of the 200mg N/L NO_3^- stock standard. Bring to volume with DI water.

To two 200mL volumetric flasks, add respectively: 2.0 and 1.0mL of the 20mg N/L NO_3^- intermediate standard. Bring to volume with DI water.

Alternatively, an autodiluter can be used to make the standards during calibration, in which case only 8.0ppm and 1.0 ppm need to be manually prepared. If an autodiluter is used then it must be checked in an analytical tray by autodiluting 8.0mg N/L as Nitrite. The recovery for NO2 must be within 10% of the true value.

8.6 Set of Six Calibration NO_2^- Standards, 8.0, 4.0, 1.00, 0.40, 0.10 and 0.05mg N/L as Nitrite: These standards are stable for 2 weeks. Refrigerate at 4±2°C.

To three 200mL volumetric flasks, add respectively: 8.0, 4.0 and 1.0 of the 200mg N/L NO_2^- stock standard. Bring to volume with DI water.

To three 200mL volumetric flasks, add respectively:4.0, 1.0mL and 0.5mL of the 20mg N/L NO_2^- intermediate standard. Bring to volume with DI water.

Alternatively, an autodiluter can be used to make the standards during calibration, in which case only 8.0ppm and 1.0 ppm need to be manually prepared.

8.7 Ammonium Chloride Buffer, pH 8.5: In a 2L volumetric flask, dissolve 170g ammonium chloride (NH_4Cl) and 2.0g disodium ethylenediamine tetraacetic acid dihydrate ($Na_2EDTA \cdot 2H_2O$) in about 800mL water. Dilute to the mark with DI water and invert to mix. Adjust the pH to 8.5 with concentrated ammonium hydroxide. This solution is prepared monthly and stored at room temperature.

8.8 Sulfanilamide Color Reagent: To a 2L volumetric flask add about 1200mL water. Then add 200mL of 85% phosphoric acid (H_3PO_4), 80.0g sulfanilamide, and 2.0g N^-(1-naphthyl)ethylenediamine dihydrochloride (NED). Shake to wet, and stir to dissolve for 30 minutes. Dilute to the mark with DI water and invert to mix. Store in a dark bottle. This solution is stable for one month. Store at room temperature.

8.9 200ppm Nitrate Stock Standard, (for ICV/LCS): Pipet 50mL of 1000ppm standard (Section 8.1) into 250mL volumetric flask and bring to volume with DI. Store refrigerated at 4±2°C. Expires six months from preparation or upon manufacturer's expiration date.

8.10 200ppm Nitrite Stock Standard: Pipet 50mL of 1000ppm standard (Section 8.2) into 250mL volumetric flask and bring to volume with DI. Store refrigerated at 4±2°C. Expires six months from preparation or upon manufacturer's expiration date.

8.11 Initial Calibration Verification Standard (ICV)/Laboratory Control Sample (LCS): Store refrigerated at 4±2°C. Expiration is 2 weeks from date of preparation.

8.11.1 Nitrate LCS, 5.0ppm: Pipet 5.0mL of 200ppm stock (Section 8.9) into a 200mL volumetric flask and bring to volume with DI.

8.11.2 **Nitrate ICV, 0.5ppm:** Pipet 10.0mL of 5.0ppm standard (Section 8.11.1) into a 100mL volumetric flask and bring to volume with DI.

8.11.3 **Nitrite LCS, 5.0ppm:** Pipet 5.0mL of 200ppm stock (Section 8.9) into a 200mL volumetric flask and bring to volume with DI.

8.11.4 **Nitrite ICV, 0.5ppm:** Pipet 10.0mL of 5.0ppm standard (Section 8.11.3) into a 100mL volumetric flask and bring to volume with DI.

8.12 **DPD Free Chlorine Reagent Powder Pillows:** HACH brand, for 25mL sample. Store at room temperature. Expires upon manufacturer's expiration date.

8.13 **1N Hydrochloric acid (HCL):** To a 1L volumetric flask add about 600mL DI. Then add 83mL of concentrated hydrochloric acid (HCL) Stir to dissolve. Dilute to the mark with DI water and invert to mix. This solution is stable for six month. Store at room temperature.

8.14 **1N Sodium Hydroxide (NaOH):** To a 1L volumetric flask add about 600mL DI. Then add 40 g of sodium Hydroxide. Stir to dissolve. Dilute to the mark with DI water and invert to mix. This solution is stable for six month. Store at room temperature

9. Procedure

9.1 SET-UP

9.1.1 Preparation

9.1.1.1 Place the Nitrate+Nitrite board (containing the cadmium column) in Channel 1. Place the Nitrite board in Channel 2. Make sure the valve to the cadmium column is closed prior to starting to pump the reagents.

9.1.1.2 Commence pumping of reagents.

9.1.1.3 Once the lines are full of reagent and free of gas bubbles, open the valve to allow reagent to flow through the cadmium column.

NOTE: Be sure to switch the valve back before rinsing the manifold with DI water at the completion of the run.

NOTE: DO NOT LET AIR ENTER THE CADMIUM COLUMN.

9.1.2 Column Efficiency Procedure

9.1.2.1 Visually inspect the column. Check for air bubbles in the column or lines, gaps in the column or any change in the cadmium surface characteristics, (cadmium granules should be dark gray). If air bubbles are present in column, connect the column into the manifold, turn the pump on maximum and tap firmly with a screwdriver handle, being careful not to break the column, working up the column until all air is removed. If air cannot be removed, the column should be repacked. Cadmium columns should be stored filled with buffer. If air enters the column, efficiency will decrease. Check the flow efficiency by disconnecting the cadmium column from the manifold and reconnecting to a green pump tube. Pump buffer through the packed column and collect in a graduated cylinder. The flow rate with the column connected should be greater than 4.0 mL/minute.

9.1.2.2 **Column Efficiency – Slope Ratio Method:** Calibrate with the mid-range NO_3 –N standards. Calibrate with a matching concentration range of NO_2–N standards. The column efficiency is determined by the equation:

$$\mathbf{E} = \frac{\mathbf{S}_{\mathbf{NO3\text{-}N}}}{\mathbf{S}_{\mathbf{NO2\text{-}N}}} \times 100$$

where:

$\mathbf{S}_{\mathbf{NO3\text{-}N}}$ = slope of NO_3 calibration
$\mathbf{S}_{\mathbf{NO2\text{-}N}}$ = slope of NO_2 calibration
E = % efficiency

9.1.2.3 **Column Efficiency – Concentration Ratio Method:** Calibrate with the mid-range NO_2-N and NO_3-N standards. Run a known concentration NO_2-N standard. Run a matching concentration NO_3-N standard. The column efficiency is determined by the following equation:

$$\mathbf{E} = \frac{\mathbf{C}_{\mathbf{NO3\text{-}N}}}{\mathbf{C}_{\mathbf{NO2\text{-}N}}} \times 100$$

where:

$\mathbf{C}_{\mathbf{NO3\text{-}N}}$ = concentration of NO_3 standard
$\mathbf{C}_{\mathbf{NO2\text{-}N}}$ = concentration of NO_2 standard
E = % efficiency

9.1.2.4 **Column Efficiency Result:** If the efficiency is <75%, the column is repacked. All results are recorded and maintained on file in the QC department.

9.1.3 Residual Chlorine Screening

Check all wastewater and drinking water samples for residual chlorine prior to analysis.

9.1.3.1 Add 1 DPD Free Chlorine powder pillow (Section 8.12) to 25mL of sample in a centrifuge tube. An immediate color change to pink indicates residual chlorine is present. If residual chlorine is present, add a small amount of ascorbic acid to a sample aliquot (record this in logbook) and check for residual chlorine presence again. If residual chlorine remains, notify the Department Manager and/or the Laboratory Director. Results will be reported as Not Applicable (N/A).

If residual chlorine is not present, continue with sample analysis.

9.2 Initial Calibration

Calibrate the Lachat ion analyzer according to manufacturer's instructions.

9.2.1 Calibration

Two boards are used to calibrate the Lachat instrument. Each curve has seven calibration points. The correlation coefficient of each curve must be $\geq$0.995, otherwise recalibration is necessary. Prepare standard curves by plotting the peak areas of standards processed through the manifold against NO_3+NO_2 as N and NO_2 as N concentrations in standards.

9.2.1.1 Channel 1 is used to generate a calibration curve for Nitrate/Nitrite ranging from 0 to 8.0ppm.

9.2.1.2 Channel 2 is used to generate a calibration curve for Nitrite ranging from 0 to 8.0ppm.

Note: Instrument is calibrated daily, fixed calibration range is used; linearity is verified daily; three standards are used for linear calibration verification (low ICV (0.5 mg/l), High ICV (5.0 mg/l) and CCV (1.0 mg/l)). All standards must be within 10% of true value

9.2.2 Initial Calibration Verification (ICV)

9.2.2.1 Prior to sample analysis, the following ICVs must be analyzed to verify both calibration curves.

9.2.2.1.1 Nitrate ICV, 0.5ppm (Section 8.12.2)

9.2.2.1.2 Nitrate ICV, 5.0ppm (Section 8.12.1)
9.2.2.1.3 Nitrite ICV, 0.5ppm (Section 8.12.4)

9.2.2.1.4 Nitrite ICV, 5.0ppm (Section 8.12.3)

9.2.2.2 The results must be within ±10% of the true value, otherwise re-calibration is required.

9.3 Continuing Calibration Verification

9.3.1 Continuing Calibration Verification, (CCV) and Continuing Calibration Blank, (CCB)

9.3.1.1 At the beginning of the first tray, after every ten samples and at the end of every analytical sequence, a CCV and a CCB pair must be analyzed to verify both calibration curves.

9.3.1.1.1 1.0ppm Nitrate CCV (Section 8.5)

9.3.1.1.2 1.0ppm Nitrite ICV (Section 8.6)

9.3.1.1.3 Calibration Blank (DI)

9.3.1.2 The results of the CCVs must be within ±10% of the true value, otherwise re-calibration is required.

9.3.1.3 The results of the CCBs must be less than our standard limit of detection, otherwise the analysis is stopped and the problem corrected.

9.4 Equipment Operation and Sample Analysis

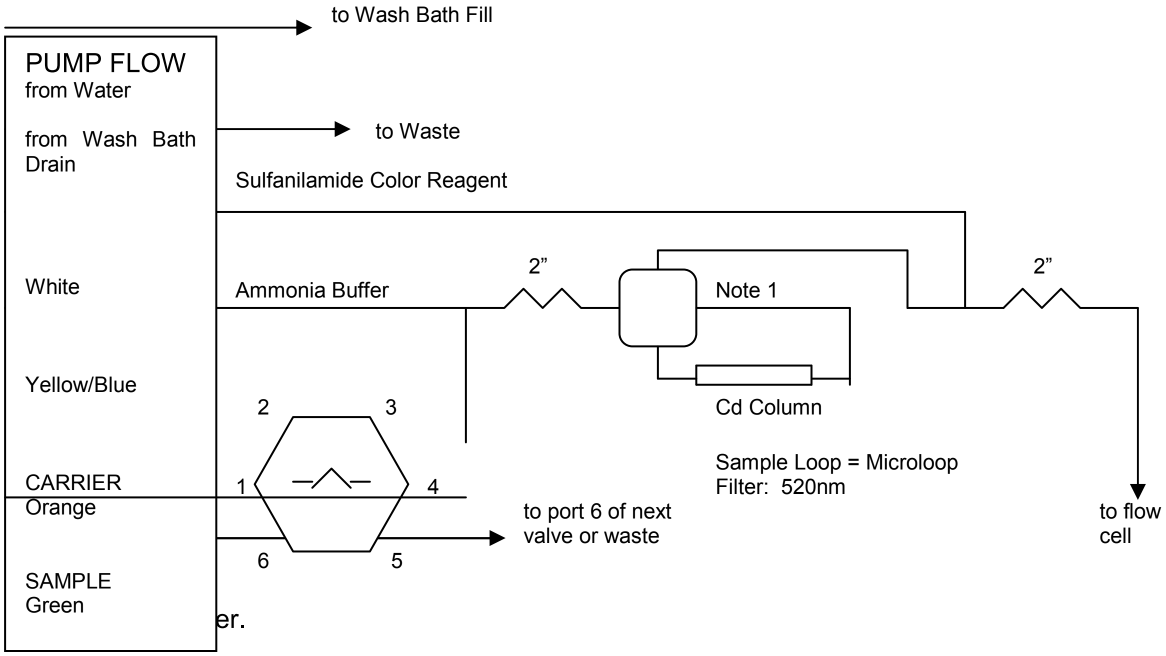
Follow the manufacturer's directions for the operation of the Lachat 8000.

All samples have to be inspected prior to analysis. Samples that are turbid or have sediment have to be filtered prior to analysis.
Check pH of the samples. If pH is less then 5 or greater then 9, then adjust pH using 1N Hydrochloric Acid (HCl) (8.13) or 1N Sodium Hydroxide (NaOH) (8.14). Record pH adjustment in the log book.

For soils: extract soils samples prior to analysis: take 5g of sample, add 50 ml of DI, extract for 30 min, then filter thorough 0.45 nm filter. Record all weights for calculations.

Note: if samples are filtered, then Method blank also have to be filtered

The Manifold Diagram follows:



er.

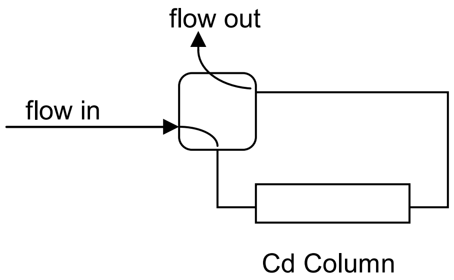
2" is 135cm of tubing on a 2-inch coil support.

APPARATUS: Standard valve, flow cell, and detector head modules are used.

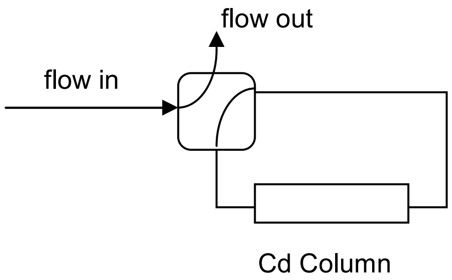
All manifold tubing is 0.8mm (0.032") i.d. This is 5.2μL/cm.

NOTE 1: This is a two-state switching valve used to place the cadmium column in line with the manifold.

State 1: Nitrate + Nitrite



State 2: Nitrite Only



9.5 Preventative Maintenance

Tubing is changed monthly or as needed.

At the end of each analytical sequence, the valve to the column is closed. DI is rinsed through the Lachat for five minutes followed by five minutes of air.

All maintenance is documented in the Instrument Maintenance Logbook.

9.6 Calculations

9.6.1 **Nitrate/Nitrite:** When the software is set up according to the manufacturer's recommendations, the concentration of nitrate plus nitrite in mg NO_3/NO_2-N/L is reported directly when the Cd column is included in the sample train in Channel 1.

9.6.2 **Nitrite:** When the software is set up according to the manufacturer's recommendations, the concentration nitrite in mg NO_2-N/L is reported directly when the Cd is not included in the sample train in Channel 2.

9.6.3 **Nitrate:** The concentration of nitrate is determined by the subtraction of the nitrite concentration, (Section 9.6.2 above), from the nitrate-nitrite concentration, (Section 9.6.1 above).

9.6.3.1 If the sample was preserved initially as described in Section 6.3, subtract the Nitrite value generated manually from the Nitrate/Nitrite value generated by the Lachat Instrument. This value is reported as the Nitrate result.

When the sample is preserved initially as described in Section 6.3, the value generated by the Lachat instrument for Nitrite is invalid and therefore disregarded.

9.6.4 If any sample exceeds a concentration of 8.0 mg/L, the sample must be diluted and re-analyzed. All sample concentrations must fall within the calibration curve.

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test for failed parameters of the method.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test for all parameters listed in the method.

10.2 Method Blank

One Method Blank is analyzed per batch of 20 samples or less The Method Blank consists of DI.
For soils: 5g of Ottawa sand extracted with 50 ml of DI. Results must be < 0.1mg/L. If this criterion is not met, the blank is re-analyzed. If there is still failure, the problem must be found and corrected prior to any sample analysis.

10.3 Calibration Verification and Laboratory Control Samples (LCS)

Two ICVs are analyzed at the beginning of the analytical sequence. One is at a concentration of 0.5ppm, and the other is at a concentration of 5.0ppm.

Both must be recovered within ± 10% of the true value. If these criteria are not met, the ICVs must be re-analyzed. If failure continues, the ICVs are to be re-made and/or a new calibration curve is to be generated.

The 5ppm ICV is reported as the LCS for the batch.

For soil LCS: 5g of Ottawa sand extracted with 0.25 ml of 1000 mg/l nitrate (8.1) (or 1000 mg/l Nitrite standard (8.2)) and 50 ml DI. The nitrate standard is used for spikes for Nitrate-N as well as Nitrate/Nitrite-N. LCS recoveries must be recovered within ± 10% of the true value. If these criteria are not met, LCS's must be re-analyzed. If failure continues, the batch has to be re-extracted and re-analyzed.

10.4 Matrix Spike

One Matrix Spike is analyzed per batch of 20 samples or less. Separate spikes are performed for Nitrate and Nitrite. In a 25mL volumetric flask, 0.5mL of 200ppm stock calibration standard (Section 8.1 or 8.2) is added to the sample. The final concentration of the matrix spike is 4.0ppm. The nitrate standard is used for spikes for Nitrate-N as well as Nitrate/Nitrite-N. The nitrite standard is used for spikes for Nitrite-N.

For soils: weigh 5.0 g of sample, add 2.0 ml of 200 mg/l Nitrate or Nitrite standard and 48 ml of DI. The final concentration of the matrix spike is 80.0 mg/kg. The nitrate standard is used for spikes for Nitrate-N as well as Nitrate/Nitrite-N. The nitrite standard is used for spikes for Nitrite-N.

% Recovery for the Matrix Spike must be within in-house control limits. If acceptance criteria are not met, the Matrix Spike is reanalyzed. If failure continues, a narrative is included with the data for inclusion on the Client report.

Note: For samples, analyzed by method **353.2** (NO2-353 and NO3-353) maximum batch size is 10 samples; every 10 samples required separate matrix spike (MS) to be analyzed. % Recovery for the Matrix Spike must be within +/- 10% of true value. If acceptance criteria are not met, the Matrix Spike is reanalyzed. If failure continues, a narrative is included with the data for inclusion on the Client report.

10.5 Duplicates

One Duplicate sample is analyzed per batch of 20 samples or less. A separate aliquot of the sample is analyzed for this purpose.

% RPD for the Duplicate must be within in-house control limits. If acceptance criteria are not met, the Duplicate is reanalyzed. If failure continues, a narrative is included with the data for inclusion on the Client report.

10.6 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained.

Control limits for the method parameters are generated by the QC staff. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.7 Analytical Sequence

- Calibration
- ICV/LCS – both levels
- Sample analysis
- CCV – every ten samples and at the end of the analytical sequence

11. Method Performance

11.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

11.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734 and 1739 for further information regarding IDC/DOC Generation.

11.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

11.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

12. Corrective Actions

Holding time exceedence and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the CV or LCS recovery of any parameter falls outside the designated acceptance range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

See Chemical Hygiene Plan for waste management and disposal.

Nitrogen, Total Kjeldahl

References: **Method 351.1,** Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, U.S. Environmental Protection agency, Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 (March 1979)

Method SM 4500N_{org}-C, Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 1997.

Method 10-107-06-2-D, Methods for Automated Ion Analyzers, May 20, 1998.

1. Scope and Application

Matrices: Total Kjeldahl nitrogen can be determined in potable, surface, and saline waters as well as domestic and industrial wastewaters.

Definitions: See Alpha Laboratories Quality Manual Appendix A

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Tecator and/or Lachat Instrument and in the interpretation of Lachat data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case by case basis.

This method covers the determination of total kjeldahl nitrogen in drinking, surface and saline waters, and domestic and industrial wastes. The procedure converts nitrogen components of biological origin such as amino acids, proteins and peptides to ammonia, but may not convert the nitrogenous compounds of some industrial wastes such as amines, nitro compounds, hydrazones, oximes, semicarbazones and some refractory tertiary amines.

In waters and wastewaters the forms of nitrogen of greatest interest are, in order of decreasing oxidation state, nitrate, nitrite, ammonia, and organic nitrogen. All these forms of nitrogen, as well as nitrogen gas (N_2), are biochemically interconvertible and are components of the nitrogen cycle. They are of interest for many reasons.

Organic nitrogen is defined functionally as organically bound nitrogen in the trinegative oxidation state. It does not include all organic nitrogen compounds. Analytically, organic nitrogen and ammonia can be determined together and have been referred to as “Kjeldahl nitrogen”, a term that reflects the technique used in their determination. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials. Typical organic nitrogen concentrations vary from a few hundred micrograms per liter in some lakes to more than 20mg/L in raw sewage.

Ammonia is present naturally in surface and wastewaters. Its concentration generally is low in groundwaters because it adsorbs to soil particles and clays and is not leached readily from soils. It is produced largely by deamination of organic nitrogen containing compounds and by hydrolysis of urea. At some water treatment plants ammonia is added to react with chlorine to form a combined chlorine residual.

In the chlorination of wastewater effluents containing ammonia, virtually no free residual chlorine is obtained until the ammonia has been oxidized. Rather, the chlorine reacts with ammonia to form mono- and dichloramines. Ammonia concentrations encountered in water vary from less than 10µg ammonia nitrogen/L in some natural surface and groundwaters to more than 30 mg/L in some wastewaters.

In this discussion, organic nitrogen is referred to as organic N, nitrate nitrogen as NO_3–N, nitrite nitrogen as NO_2 - - N, and ammonia nitrogen as NH_3–N.

Total Kjeldahl nitrogen is defined as the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulfate $(NH_4)_2SO_4$, under the conditions of digestion described below.

Organic Kjeldahl nitrogen is defined as the difference obtained by subtracting the free-ammonia value from the total Kjeldahl nitrogen value. This may be determined directly by removal of ammonia before digestion.

2. Summary of Method

The organic nitrogen is converted to ammonia via heating in the presence of concentrated sulfuric acid, K_2SO_4, $HgSO_4$, and evaporated until SO_3 fumes are obtained and the solution becomes colorless or pale yellow. The residue is cooled, diluted, and treated and made alkaline with a hydroxide-thiosulfate solution. The digestate is distilled at high pH into a solution of boric acid. The ammonia in the distillate is determined colorimetrically by the phenate method.

The phenate method is based on the Berthelot reaction. Ammonia reacts with alkaline phenol, then with sodium hypochlorite to form indophenol blue. Sodium nitroprusside (nitroferricyanide) is added to enhance sensitivity. The absorbance of the reaction product is measured at 630nm, and is directly proportional to the ammonia concentration in the digestate.

2.1 Method Modifications from Reference

This method has been modified for soil digestion, Section 9.4.1.

3. Detection Limits

The RDL is determined to be 0.3 mg/L for liquid samples and 150 mg/Kg for soil or solid samples.

4. Interferences

4.1 Instrumental

Samples with a high concentration of TKN may carry-over into the next sample and therefore yield false high results in that next sample. If a sample with a low concentration follows a sample with a high concentration, re-analyze the low sample to ensure results are accurate.

4.2 Parameters

High nitrate concentrations (10X or more than the TKN level) result in low TKN values. The reaction between nitrate and ammonia can be prevented by the use of an anion exchange resin (chloride form) to remove the nitrate prior to the TKN analysis.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

> **NOTE:** Both Phenol and Mercury used in this method are hazardous and general laboratory safety practices must be observed. Due to the Mercury used in this procedure, digestion must be done under a hood.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

The most reliable results are obtained on fresh samples. Use plastic or glass containers.

6.2 Sample Preservation

Samples may be preserved by addition of 2mL of concentrated H_2SO_4 per liter if sample cannot be analyzed immediately. Refrigerate at 4ºC.

6.3 Sample Handling

Even when properly preserved, conversion of organic nitrogen to ammonia may occur. Therefore samples should be analyzed as soon as possible.

7. Equipment and Supplies

7.1 **Digestion apparatus:** Kjeldahl Digestion System 20, Model 1015 Digester. Follow the instrument manufacturer’s instructions.

7.2 **Distillation apparatus:** Tecator Instruments Automatic Distillation Unit: Follow the instrument manufacturer’s instructions for proper operation.

7.3 **Automated Ion Analyzer:** Lachat Instruments

7.4 **Disposable polypropylene cups**: 250mL with covers.

7.5 **Glass Tuttlecaps:** For digestion.

7.6 **Glass Pipets:** Various volumes.

7.7 **Auto-pipettor with tips:** For 10mL capability.

8. Standards and Reagents

8.1 Sodium Phenolate: CAUTION! Wear gloves. Phenol causes severe burns and is rapidly absorbed into the body through the skin. In a 1L volumetric flask, dissolve 88mL of 88% liquified phenol or 83g crystalline phenol (C_6H_5OH) in approximately 600mL DI water. While stirring, slowly add 32g sodium hydroxide (NaOH). Cool, dilute to the mark, and invert three times. Do **not** degas this reagent. Expires one month from date of preparation.

8.2 Sodium Hypochlorite (approximate 2.6%): In a 500mL volumetric flask, dilute 250mL Regular Chlorine bleach [5.25% sodium hypochlorite (NaOCl)] to the mark with DI water. Invert three times to mix. Expires one month from date of preparation.

8.3 Sodium Nitroprusside (coloring agent): In a 1L volumetric flask, dissolve 3.50g sodium nitroprusside (Sodium Nitroferricyanide $[Na_2Fe(CN)_5NO_2 \cdot H_2O]$) dilute to the mark with DI water. Degas with helium to prevent bubble formation. Use He at 140kPa (20 lb/in^2) through a helium degassing tube. Bubble He vigorously through the solution for one minute. Expires one month from date of preparation.

8.4 Boric 1.5% Boric Acid Solution: To a 1000mL volumetric flask add 15g Boric Acid. Dilute to the mark with DI water. Expires one month from date of preparation.

8.5 Mercuric Sulfate Solution: Dissolve 8g red mercuric oxide (HgO) in 50mL of l:4 sulfuric acid (10.0mL concentrated H_2SO_4 : 40mL distilled water) and dilute to 100mL with distilled water. Expires one month from date of preparation.

8.6 Digestion Solution (Sulfuric Acid-Mercuric Sulfate-Potassium Sulfate): Dissolve 267g K_2SO_4 in 1300mL distilled water and 400mL concentrated H_2SO_4. Add 50mL mercuric sulfate (Section 8.5) solution and dilute to 2L with distilled water. Expires one month from date of preparation.

8.7 Sodium Hydroxide-Sodium Thiosulfate Solution: Dissolve 500g NaOH and 25g $Na_2S_2O_3 \cdot 5H_2O$ in distilled water and dilute to 1L. Expires one month from date of preparation.

8.8 0.2% Boric Acid Solution (Carrier Solution): To a 2L volumetric flask, dissolve 4g Boric Acid (H_3BO_3) in DI water. Degas by bubbling vigorously with Helium for one minute. Expires one month from date of preparation.

8.9 Stock Standard, 1000ppm as NH_3 (for calibration solutions): Commercially prepared. Certificate of analysis is required.

8.9.1 Intermediate Calibration Stock Standard, 100ppm as NH_3: To a 100mL volumetric flask, add 10.0mL of Stock Standard (Section 8.9) and dilute to the mark with 0.2% Boric Acid solution (Section 8.8). Invert three times. Expires one month from date of preparation.

8.9.1.1 Nine Working Calibration Standards: Prepare the following standards in volumetric flasks:

8.9.1.1.1 20.0ppm: 40mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.2 10.0ppm: 20mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.3 8.00ppm: 8mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.4 **4.00ppm:** 8mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.5 **2.00ppm:** 2mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.6 **1.00ppm:** 1mL of 100ppm standard (Section 8.9.1) to 100mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.7 **0.400ppm:** 4mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Prepare fresh each day of use.

8.9.1.1.8 **0.200ppm:** 1mL of 20ppm standard (Section 8.9.1.1.1) to 100mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler. Prepare fresh each day of use.

8.9.1.1.9 **0.100ppm:** 1mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler. Prepare fresh each day of use.

8.9.1.1.10 **0.050ppm:** 20mL of 0.100ppm standard (Section 8.9.1.1.9) to 40mL with 0.2% Boric Acid solution (Section 8.8). Alternately, this standard may be prepared utilizing autodilution of the 20ppm standard on the autosampler. Prepare fresh each day of use.

8.9.1.2 Continuing Calibration Standards:

8.9.1.2.1 **0.400ppm Low CCV:** 4mL of 20ppm standard (Section 8.9.1.1.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.9.1.2.2 **4.00ppm Hi CCV:** 8mL of 100ppm standard (Section 8.9.1) to 200mL with 0.2% Boric Acid solution (Section 8.8).

8.10 Stock Standard, 1000ppm as TKN (for spike):

Commercially prepared. Certificate of analysis is required

8.10.1 Intermediate spike Stock Standard, 200ppm as TKN: To a 100mL volumetric flask, add 20.0mL of Stock Standard (Section 8.10) and dilute to the mark with 0.2% Boric Acid solution (Section 8.8). Invert three times. Expires one month from date of preparation.

8.11 Stock Standard Solution, 1000ppm as NH_3 (for ICV only):

Commercially prepared. Certificate of analysis is required. This must be from a different source than that used for Stock Standard (Section 8.9).

8.11.1 Initial Calibration Verification Standards (ICV):

8.11.1.1 Hi ICV, 10ppm: To a 100mL volumetric flask add 1mL of 1000ppm standard (Section 8.11). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation.

8.11.1.2 Hi ICV, 8.0ppm: To a 100mL volumetric flask add 0.8mL of 1000ppm standard (Section 8.11). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation.

8.11.1.3 Low ICV, 1.0ppm: To a 100mL volumetric flask add 10mL of 10ppm ICV (Section 8.11.1.1). Dilute to the mark with 0.2% Boric Acid Solution (Section 8.8). Expires one month from date of preparation.

8.12 Stock Standard Solution, 1000ppm as TKN (for LCS): Commercially prepared. Certificate of analysis is required. This must be from a different independent source than that used for Stock Standard (Section 8.10).

8.12.1 LCS solution, 200ppm as TKN: To a 100mL volumetric flask add 20mL of 1000ppm Stock Standard (Section 8.12) and dilute to the mark with DI water. Expires one month from date of preparation.

9. Procedure

9.1 SET-UP

9.1.1 Clean 250mL Tecator tubes by rinsing twice with approximately 0.5mL of 6N NaOH solution and 100mL RO water. Rinse twice again with DI water.

9.1.2 Rinse glass tuttlecaps under the hood in a 1000mL beaker with approximately 500mL DI and 1.0 mL NaOH. Allow to sit in this solution until use.

9.2 Initial Calibration

Calibrate the Lachat ion analyzer according to manufacturer's instructions.

9.2.1 Calibration

Two boards are used to calibrate the Lachat instrument. Each curve has 7 calibration points. The correlation coefficient of each curve must be $\geq$ 0.995, otherwise re-calibration is necessary. Prepare standard curves by plotting the peak areas of standards processed through the manifold against NH_3-N concentrations in standards.

9.2.1.1 Channel 1 is used to generate a calibration curve on the low range from 0.00 – 2ppm.

9.2.1.2 Channel 2 is used to generate a calibration curve on the high range from 0 – 20ppm.

Alternative method: One board can be used to calibrate the Lachat instrument. !0 point calibration curve will be used with calibration standards 10.0, 8.0,4.0,2.0,1.0,04, 0.2, 0.1 , 0.05 mg/l each and blank. The correlation coefficient must be $\geq$ 0.995, otherwise re-calibration is necessary. Prepare standard curves by plotting the peak areas of standards processed through the manifold against NH_3-N concentrations in standards

9.2.2 Initial Calibration Verification (ICV)

Prior to sample analysis, an ICV is analyzed at 1.0ppm (Section 8.10.1.2) to verify the low calibration curve on Channel 1. Another ICV is analyzed at 10ppm (Section 8.10.1.1) to verify the high calibration curve on Channel 2. Both ICVs must yield results ± 10% of their true value, otherwise re-calibration is necessary.

Note: if instrument is calibrated using one board calibration, then both ICV's (Low and High), will be evaluated and high ICV will be 8.0 mg/l ICV standard (Section 8.11.1.2)

9.2.3 Initial Calibration Blank (ICB)

Following the ICV is the analysis of an ICB. The ICB consists of an aliquot of 0.2% Boric Acid (Section 8.8). Results must be less than < 0.05mg/L.

9.3 Standardization (Continuing Calibration Verification)

Analyze the following after every 10 samples and at the completion of analysis:

0.400ppm Low CCV, (Section 8.9.1.2.1)

4.0ppm Hi CCV, (Section 8.9.1.2.2)

Blank, 0.2% Boric Acid Solution. (Section 8.8)

9.4 Equipment Operation and Sample Analysis

9.4.1 **Aqueous Sample Digestion:** Add 50mL of sample or a portion diluted to 50mL with DI water, to pre-washed Tecator tubes that are numbered to correspond with the samples.

Soil/Solid Sample Digestion: Weigh 0.1g of soil/solid sample and record the weight in the laboratory notebook. Transfer to a pre-washed, pre-numbered Tecator tube and add 50mL of DI water.

In a similar manner, for each matrix, prepare the QC samples to be digested with the batch (refer to Sections 10.2.1, 10.3.1, 10.7 and 10.8)

Then add approximately 1g of black boiling chips to each tube. Move to hood before adding 10mL of Digestion Solution (Section 8.6) to each tube with a calibrated pipettor.

Rinse glass tuttlecaps with DI and place one onto the top of each Tecator tube. Place Tecator tube rack onto Tecator digestion block and turn temperature control knob to “4” which represents approximately 250ºC. (Temperature should never exceed 300ºC.) Cook for approximately 2 hours to SO_3 fumes. The remaining mixture will be clear or pale yellow in color. Remove tube from digestion block and allow to cool to ~80 °C before adding DI to the 90mL mark on the tube.

9.4.2 **Distillation:** To minimize contamination, leave distillation apparatus assembled after steaming out and until just before starting sample distillation. Make the digestate alkaline by careful addition of 20mL of sodium hydroxide-thiosulfate solution (Section 8.7) without mixing. Do not mix until the digestion tube has been connected to the distillation apparatus. Connect the Tecator tube to the Tecator distillation unit’s stopper as defined in the manual. Distill for 3 minutes 40 seconds as defined in the manual and collect distillate in 20mL boric acid solution (Section 8.4). Distill at maximum rate with the tip of the delivery tube below the surface of boric acid receiving solution. Collect at least 90mL distillate. Dilute to 150mL with DI water. Refrigerate at 0-4ºC if Lachat analysis is delayed.

9.4.3 **Ammonia analysis of distillate:** Follow the manufacturer’s instructions for the proper operation of the ion analyzer. The following are specific notes for this analysis.

Sample throughput:	90 samples/hr; 40 sec/sample
Pump speed:	35
Cycle period:	40 s
Inject to start of peak period:	25 s
Inject to end of peak period:	63 s

9.4.4 System Notes:

9.4.4.1 Allow 15 minutes for heating unit to warm up to 60ºC.

9.4.4.2 System IV GAIN: 175 x 1.

9.4.4.3 If standards are not distilled, samples should be multiplied by procedure dilution (final volume 150mL) divided by initial volume.

9.4.4.4 If baseline drifts, peaks are too wide, or other problems with precision arise, clean the manifold by the following procedure:

9.4.4.4.1 Place all reagent lines in deionized water and pump to clear reagents (2-5 minutes).

9.4.4.4.2 Place reagent lines and carrier in 1M hydrochloric acid (1 volume concentrated HCl added to 11 volumes of deionized water) and pump for several minutes.

9.4.4.4.3 Place all lines in deionized water and pump until the HCl is thoroughly washed out.

9.4.4.4.4 Resume pumping reagents.

9.4.4.5 If samples are colored or are suspected to show a background absorbance, this interference should be subtracted. This can be done by diluting or by the following procedure:

9.4.4.5.1 Calibrate the system in the normal manner.

9.4.4.5.2 Disable the check standard or DQM features and analyze the samples.

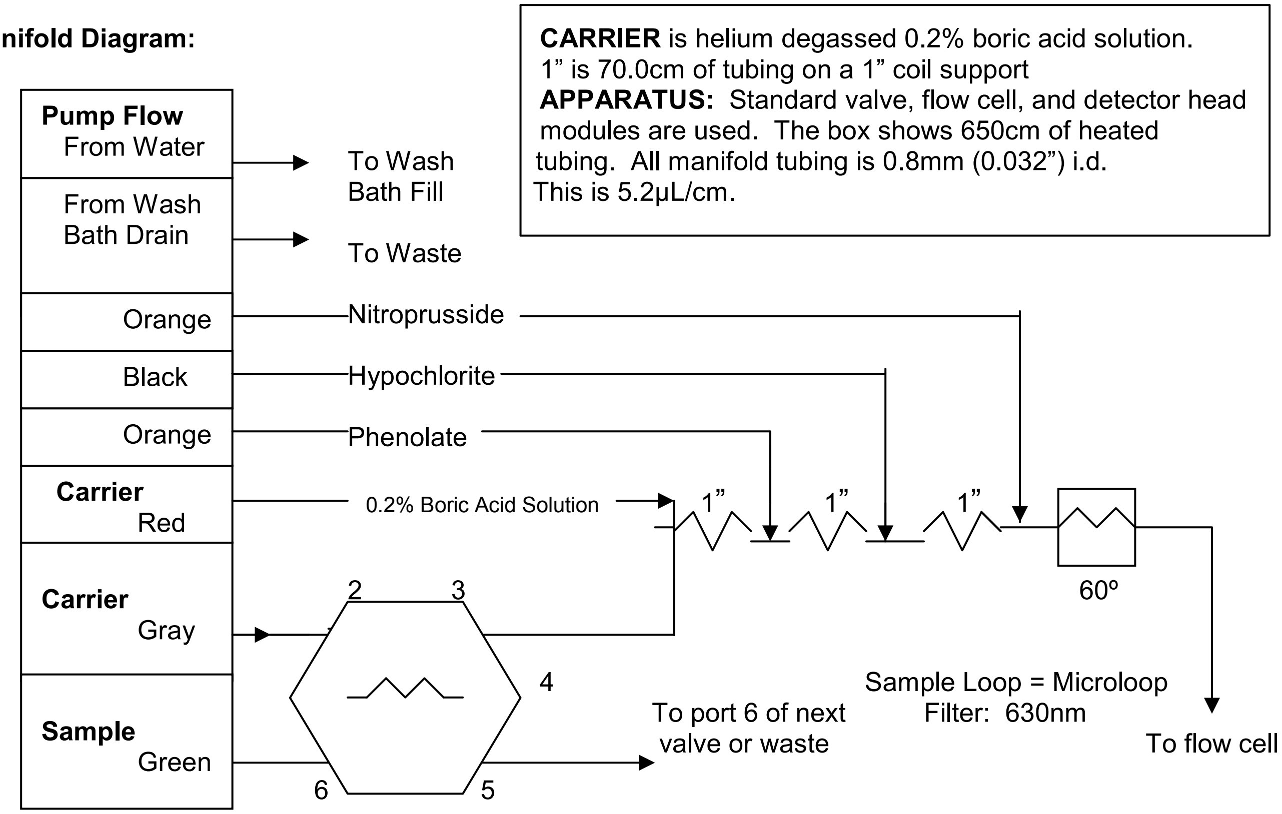
9.4.4.5.3 Place reagent and carrier lines in DI water and allow the baseline to stabilize.

9.4.4.5.4 Inject samples again without recalibrating.

9.4.4.5.5 Subtract the “background” concentration from the original concentration to give the corrected concentration.

Original Concentration – Background Concentration = Corrected Concentration.

Manifold Diagram:


CARRIER is helium degassed 0.2% boric acid solution.
1” is 70.0cm of tubing on a 1” coil support
APPARATUS: Standard valve, flow cell, and detector head modules are used. The box shows 650cm of heated tubing. All manifold tubing is 0.8mm (0.032”) i.d.
This is 5.2µL/cm.

9.5 Preventative Maintenance

9.5.1 All lines are flushed at the end of each run.

9.5.2 All equipment is kept clean.

9.6 Calculations

Prepare standard curves by plotting peak areas of standards processed through the manifold against NH_3 -N concentrations in standards. Compute sample NH_3 -N concentration by comparing sample peak areas with standard curve, as determined by the Lachat instrument software.

9.6.1 If the sample has a concentration of less than 2ppm, calculate results by using the low curve generated on Channel 1.

9.6.2 If the sample concentration is greater than 2ppm, calculate results by using the high curve generated on Channel 2.

To compute final results for aqueous samples, multiply the direct reading by the dilution factor based on the initial preparation volume.

TKN mg/L = mg/L direct reading x dilution factor

To compute results for soil/solid samples, multiply the direct reading by the extraction final volume (150mL) and then divide by the weight of the sample used for extraction (Section 9.4.1), and multiply by a dilution factor as necessary.

$$\text{TKN mg/Kg} = \left[\frac{\text{(mg/L direct reading) x extraction final volume (150mL)}}{\text{Sample weight (g)}}\right] \text{ x } \quad \text{dilution factor}$$

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test for failed parameters of the method.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test for all parameters listed in the method.

10.2 Blank

10.2.1 The Distillation Blank is 50mL of DI. Distill two per batch of 20 samples or less, but only the lowest is reported. Subtract any blank greater than 0.3mg/L from all samples and QC.

10.2.2 The Analytical Blank (ICB) for the Lachat analysis is not distilled and is 0.2% Boric Acid Solution (Section 8.8).

The ICB is run after the initial calibration verification standards (ICV) and another is run after the continuing calibration standards (CCV).

10.3 Laboratory Control Samples (LCS)

10.3.1 **Distillation:** Distill a Low and a Hi LCS with each batch of 20 samples or less. The results from the Hi LCS are reported for the batch. The Low LCS is used to verify the low curve, but is not reported.

10.3.1.1 **Low 4.0ppm LCS:** Add 1mL of 200ppm LCS solution (Section 8.10.2) to 50 mL DI. This is used for the Low 0 - 6 ppm curve.

10.3.1.2 **Hi 40ppm LCS:** Add 10mL of 200ppm LCS solution (Section 8.10.2) to 50 mL DI. This is used for the Hi 0 - 60 ppm curve.

10.4 Initial Calibration Verification Standards

10.4.1 **Lachat Analysis:** The ICVs are not distilled. Analyze the following after calibration of the Lachat instrument. Recoveries must be within 10% of the true value, otherwise recalibration of the instrument is necessary.

10.4.1.1 **Low ICV, 1.0ppm** (Section 8.10.1.2)

10.4.1.2 **Hi ICV, 10ppm** (Section 8.10.1.1); **HI ICV** will be 8.0 ppm (Section 8.10.1.2) in case of one board calibration.

10.5 Continuing Calibration Verification Standards

10.5.1 **Lachat Analysis:** The CCVs are not distilled. Analyze the following after every ten samples and at the completion of analysis. Recoveries must be within 10% of the true value.

If recoveries fall outside of this range, the cause for the failure is determined and corrected, and the instrument is recalibrated. All samples that were analyzed since the last CCV that was within range are reanalyzed.

10.5.1.1 **0.4ppm Low CCV** (Section 8.9.1.2.1)

10.5.1.2 **4.0ppm Hi CCV** (Section 8.9.1.2.2)

10.6 Interference Check Standards

None.

10.7 Matrix Spike

One per batch of 20 samples or less. Prior to distillation, add 2mL of 200ppm Spiking Solution (Section 8.9.2) per 50mL of sample.

10.8 Duplicates

Distill one duplicate sample per batch of 20 samples or less.

10.9 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained.

Control limits for the method parameters are generated by the QC staff. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.10 Analytical Sequences

10.10.1 Distillation Sequence:

3 Rinse tubes
Blank 1
Blank 2
Low LCS
Hi LCS
Rinse
Samples (each sample must be followed by rinse, except between sample and its spike or sample and its duplicate)
Duplicate
Spike
Rinse
Shut-down

10.10.2 Lachat Analytical Sequence:

Instrument Calibration
DQM = Hi 4.0ppm CCV
  Low 0.4ppm CCV
  CC Blank
Low 1.0ppm ICV
Hi 10ppm ICV or 8.0 ppm ICV
IC Blank
Samples
DQM : Run after every 10 samples and at completion of analysis
Rinse reagent lines with 1M HCl for 5 to 10 minutes
DI water rinse for 5 to 10 minutes
Air rinse 5 to 10 minutes.
Shut-Down.

11. Method Performance

11.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732 These studies performed by the laboratory are maintained on file for review.

11.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734, 1739 for further information regarding IDC/DOC Generation.

11.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

11.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

12. Corrective Actions

Holding time exceedence, improper preservation and observed sample headspace are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the CV or LCS recovery of any parameter falls outside the designated acceptance range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

See Chemical Hygiene Plan SOP/1728 for waste handling and disposal.

NOTE: TKN Lachat waste contains Mercury and must be deposited into TKN/Lachat waste stream in the Waste Room.

Total Cyanide

References: **Method 9010C / 9012B,** SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Revision 2 and Revision 3 2004

SM 4500CN-CE, Standard Methods for the Examination of Water and Wastewater, APHA AWWA-WPCF, 21st Edition, 1999.

Method 10-204-00-1-A, Lachat Instruments, 6645 West Mill Road, Milwaukee, WI 53218, 1992.

Method 9014 (Modified). SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997

1. Scope and Application

Matrices: This method is applicable to waters, liquids, solids, soils and sludges.

Definitions: See Alpha Laboratories Quality Manual Appendix A.

The following SOP is a reflux-distillation procedure used to extract soluble cyanide salts and many insoluble cyanide complexes from wastes and leachates. It is based on the decomposition of nearly all cyanides by a reflux distillation procedure using a strong acid and a magnesium catalyst. Cyanide, in the form of hydrocyanic acid (HCN) is purged from the sample and captured into an alkaline scrubber solution. The concentration of cyanide in the scrubber solution is then determined by flow injection analysis on a Lachat Analyzer.

This method was designed to address the problem of “trace” analyses (<1000ppm). The method may also be used for “minor” (1000ppm – 10,000ppm) and “major” (>10,000ppm) analyses by adapting the appropriate sample dilution. However, the amount of sodium hydroxide in the standards and the sample analyzed must be the same.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer

This method is restricted to use by or under the supervision of analysts experienced in the operation of the distillation unit and/or the Lachat Instrument, and in the interpretation of Lachat data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

The cyanide, as hydrocyanic acid (HCN), is released from samples containing cyanide by means of a reflux-distillation operation under acidic conditions and absorbed in a scrubber containing sodium hydroxide solution. The cyanide concentration in the absorbing solution is then determined colorimetrically by Lachat flow injection analysis.

2.1 Method Modifications from Reference

The sample size used is 50mL. The Midi distillation unit has demonstrated the ability to achieve the same RDL using 50mL instead of 500mL sample volume. Refer to EPA Method 335.4.

Modification for Method 9014: An automated determination of cyanide using the Lachat instrument is used instead of manual spectrophotometric determination.

3. Detection Limits

The Reported Detection Limit for aqueous samples is 0.005mg/L; soil and solid samples is 1mg/Kg.

4. Interferences

4.1 Instrumental

None.

4.2 Parameters

4.2.1 Interferences are eliminated or reduced by using the distillation procedure. However, chlorine and sulfide are interferences. Refer to Section 9.1.

4.2.2 High results may be obtained for samples that contain nitrate and/or nitrite. During the distillation, nitrate and nitrite will form nitrous acid, which will react with some organic compounds to form oximes. These compounds once formed will decompose under test conditions to generate HCN. The possibility of interference of nitrate and nitrite is eliminated by pretreatment with sulfamic acid just before distillation. Nitrate and nitrite are interferences when present at levels higher than 10mg/L and in conjunction with certain organic compounds.

4.2.3 Thiocyanate is reported to be an interference when present at very high levels. Levels of 10mg/L were not found to interfere.

4.2.4 Fatty acids, detergents, surfactants, and other compounds may cause foaming during the distillation when they are present in high concentrations. Add anti-foaming agent to the sample during the distillation procedure (Section 9.2).

4.2.5 Carbonates and aldehydes are possible interferences

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

The following chemicals have the potential to be highly toxic or hazardous. For detailed explanations consult the MSDS:

- Cyanide
- Sulfuric acid
- Pyridine
- Chloramine-T

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Samples are collected in plastic or glass containers. All containers must be thoroughly cleaned and rinsed.

Oxidizing agents such as chlorine decompose most cyanides. Testing for chlorine must be done in the field prior to sample preservation.

6.2 Sample Preservation

Prior to preservation, samples must be tested for chlorine (Section 6.1).

Aqueous samples are preserved with 50% sodium hydroxide in the field to a pH $\geq$ 12 at the time of collection.

Samples and distillates are stored in the refrigerator at 4 ±2 °C.

6.3 Sample Handling

When properly preserved, cyanide samples are stored for up to 14 days prior to sample preparation steps.

Distillates must be analyzed within 14 days of distillation. Samples must be analyzed within 14 days of receipt.

7. Equipment and Supplies

7.1 Cyanide Midi Distillation Unit: Lab Crest, BGL. With reaction vessels, collection vessels, cold fingers and impingers.

7.2 pH paper: Range 1-14

7.3 Lead Acetate Paper

7.4 Vacuum source / Chiller

7.5 50mL centrifuge tubes: New, plastic, with caps.

7.6 KI starch paper: Residual Chlorine sensitivity

7.7 Class A volumetric flasks: 25, 50, 100, 500 and 1000mL

7.8 Graduated cylinders: 50mL glass or plastic

7.9 Eppendorf pipettor or pipets: 0.5, 1, 2, and 5mL

7.10 Lachat 8000 Flow Analyzer: Including Quick Chem software, autosampler, pump and accessories.

7.11 Balance: Capable of weighing to 0.0001gram

7.12 Beakers: 100mL

7.13 Chiller

8. Standards and Reagents

Reagent grade chemicals are used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficient high purity to permit its use without lessening the accuracy of the determination.

8.1 Standards and Reagents for Distillation

8.1.1 Reagent Water: All references to water in this method refer to Deionized Water (DI) from Alpha's water treatment system.

8.1.2 Ascorbic Acid, $C_6H_8O_6$: Powder. Store at room temperature. Expires upon manufacturer's specified date.

8.1.3 **Sodium hydroxide solution (1N), NaOH:** In a 1L volumetric flask, dissolve 40g of NaOH. Bring to volume with DI water. Store at room temperature. Expires one month from date of preparation.

8.1.4 **Sulfamic acid (0.4N), H_2NSO_3H:** In a 1L volumetric flask, dissolve 40g H_2NSO_3H. Bring to volume with DI water. Store at room temperature. Expires 6 months from date of preparation.

8.1.5 **Sulfuric acid (1:1), H_2SO_4:** To a 1L volumetric flask, add 500mL DI water. Slowly and carefully add 500mL of concentrated H_2SO_4. Store at room temperature. Expires one month from date of preparation.

8.1.6 **Magnesium chloride solution (2.5M), $MgCl_2 \cdot 6H_2O$:** In a 1L volumetric flask, dissolve 510g of $MgCl_2 \cdot 6H_2O$. Bring to volume with DI water. Store at room temperature. Expires 6 months from date of preparation.

8.1.7 **LCS, 1000ppm cyanide stock solution:** Commercially available standard with a certificate of analysis and from a different source than the Lachat calibration standards. Purchased from Ricca, Catalog # 2543-32. Store refrigerated at 4 ± 2 °C. Expires upon manufacturer's specified date.

8.1.8 **LCS 10ppm cyanide working solution:** Pipet 1mL of 1000ppm cyanide stock solution(Section 8.1.7) into a 100mL volumetric flask. Add 10mL of 1N NaOH (Section 8.1.3). Bring to volume with DI water. Prepare each day of use.

8.1.9 **1000ppm Stock Spiking Solution:** 1000ppm cyanide standard available commercially with a certificate of analysis. This is from a different source than the LCS (8.1.7). Purchased from LabChem Inc., Catalog # LC13545. Store refrigerated at 4 ± 2 °C. Expires upon manufacturer's specified date.

8.1.10 **10ppm Working Cyanide Spiking Solution:** Pipet 1mL of the 1000ppm Stock Spiking Solution (Section 8.1.9) into a 100mL volumetric flask. Add 10mL 1N NaOH (Section 8.1.3). Bring to volume with DI water. Prepare fresh each day of use.

8.1.11 **pH 4 Acetate Buffer solution:** In a 500mL volumetric flask, dissolve 410g of sodium acetate trihydrate. Bring to volume with DI water. Adjust to pH of 4.5 with acetic acid (Section 8.1.13). Store at room temperature. Expires 6 months from date of preparation.

8.1.12 **Lead Carbonate Powder, [Pb (CO3)]**

8.1.13 **LCS 0.5 ppm Cyanide Working Solution:** Pipet 5mL of the 10ppm Working Cyanide Spiking Solution (Section 8.1.10) into a 100mL volumetric flask . Add 1mL of 10N NaOH (Section 8.1.16). Bring to volume with DI water. Prepare each day of use.

8.1.14 **Concentrated Acetic Acid:** Store at room temperature. Expires upon manufacturer's specified date.

8.1.15 **Ottawa Sand**

8.1.16 **Sodium hydroxide solution (10N), NaOH:** In a 1L volumetric flask, dissolve 400g of NaOH. Bring to volume with DI water. Store at room temperature. Expires 6 months from date of preparation.

8.1.17 **Total Cyanide SRM:** ERA catalog # 541. Store in room temperature. Expires upon manufacturer's specified date.

8.2 Standards and Reagents for Lachat Analysis

8.2.1 **Helium gas:** To prevent bubble formation, degas all solutions except the standards with helium. Use He at 140kPa (20 lb/in^2) through a helium degassing tube (Lachat part number 50100). Bubble He vigorously through the solution for one minute.

8.2.2 **Reagent 1. Carrier, 0.1N Sodium Hydroxide:** In a 1L plastic container add 10mL of 10N NaOH (Section 8.1.16). Bring to 1L volume with DI. Store at room temperature. Prepare fresh weekly.

8.2.3 **Reagent 2. Acetate Buffer, 2.68M:** In a 1L volumetric flask, dissolve 163g spdium acetate trihydrate (acetic acid, sodium salt trihydrate, $CH_3CO_2NA•H_2O$) in approximately 800mL of water. Add 40mL of acetic acid to solution. Dilute to the mark and invert to mix. Store at room temperature. Prepare fresh monthly.

8.2.4 **Reagent 3. Chloramine-T:** Dissolve 2.0g chloramine-T hydrate in 500mL DI. Prepare fresh daily.

8.2.5 **Reagent 4. Pyridine-Barbituric Acid Reagent:** Under a fume hood, place 15g barbituric acid in a 1L beaker and add 100mL water, rinsing down the sides of the beaker to wet the barbituric acid. Add 75mL pyridine (C_5H_5N) while stirring and mix until the barbituric acid dissolves. Add the 15mL concentrated hydrochloric acid (12M HCl) and mix. Store at room temperature. Prepare fresh weekly.

8.2.6 **0.5ppm Calibration standard:** Pipet 5mL of the 10ppm working cyanide spiking solution (Section 8.1.10) into a 100mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

8.2.7 **0.2ppm Calibration standard:** Pipet 2mL of the 10ppm working cyanide spiking solution (Section 8.1.10) into a 100mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

8.2.8 **0.1ppm Calibration standard:** Pipet 1mL of the 10ppm working cyanide spiking solution (Section 8.1.10) into a 100mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use. This calibration standard is also used as the Continuing Calibration Verification sample.

8.2.9 **0.04ppm Calibration standard:** Pipet 5mL of the 0.2ppm calibration standard (Section 8.2.7) into a 25mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

8.2.10 **0.02ppm Calibration standard:** Pipet 1mL of the 0.5ppm calibration standard (Section 8.2.6) into a 25mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

8.2.11 **0.01ppm Calibration standard:** Pipet 10mL of the 0.02ppm calibration standard (Section 8.2.10) and 10mL of 0.1N NaOH into a container and mix. Prepare each day of use.

8.2.12 **0.004ppm Calibration standard:** Pipet 5mL of 0.04ppm calibration standard (Section 8.2.9) into a 50mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

8.2.13 **0.1ppm ICV standard:** Pipet 1mL of the 10ppm LCS cyanide working solution (8.1.8) into a 100mL volumetric flask. Bring to volume with 0.1N NaOH. Prepare each day of use.

9. Procedure

9.1 Screening for Chlorine and Sulfide Interference

9.1.1 Chlorine Interference

Oxidizing agents, such as chlorine, decompose most cyanides. Test by placing a drop of sample on a strip of potassium iodide (KI) - starch paper previously moistened with acetate buffer solution, pH 4. If positive indication is noted, then treat an aliquot of sample with Ascorbic Acid (Section 8.1.2). Repeat this test until the KI paper is negative. Immediately inform the Department Supervisor of this interference.

Manganese dioxide, nitrosyl chloride, etc., if present also may cause discoloration of the test paper.

9.1.2 Sulfide Interference

Oxidized products of sulfide convert CN- to SCN- rapidly, especially at high pH. Test for S^{-2} by placing a drop of sample on lead acetate test paper previously moistened with acetic acid buffer solution, pH 4 (Section 8.1.11). Darkening of the paper indicates presence of S^{-2}. Add powdered lead carbonate [Pb (CO3)] in 1g increments to the whole sample volume. Re-test with acetate paper. Repeat test until a drop of treated sample no longer darkens the acidified lead acetate test paper. Record in the sample prep logbook the amount of lead carbonate added to the sample.

9.2 Distillation

9.2.1 Add 50mL of shaken liquid sample, or 1gram of a well-homogenized solid sample and 50mL of DI, to the 50mL reaction vessel.

9.2.2 For the Liquid High LCS, fill one 50mL reaction vessel with 50mL DI. For the soil High LCS, add 1g Ottawa Sand (Section 8.1.15) and 50mL of DI. After the system has been charged with air, add 1mL of 10ppm LCS cyanide working solution (8.1.8) to the closed system. (Final concentration equals 0.2mg/L.)

For the Liquid Low LCS, fill one 50mL reaction vessel with 50mL of DI. For a soil Low LCS, add 0.2-0.3 g of SRM (sec 8.1.17) and 50mL of DI. Record exact SRM weight.For liquid samples: After the system has been charged with air, add 0.5mL of 10ppm LCS cyanide working solution (Section 8.1.8) to the closed system. (Final concentration equals 0.1mg/L.) **Don't add liquid Cyanide Standard for soil samples!** Final LCS soil concentration will change based on SRM lot
Samples for Method 9010C/9012B: Prepare a LCS Duplicate along with the LCSs described above.

9.2.3 For the method blank for liquid samples, fill one 50mL reaction vessel with 50mL of DI. For the method blank for soil samples, fill a 50mL reaction vessel with 1g of Ottawa Sand (Section 8.1.15) and 50mL DI.

9.2.4 For the matrix spike, fill a 50mL reaction vessel with 50mL of sample that has been chosen to be spiked. For soil samples, use 1g of soil and add 50mL of DI water. After the system has been charged with air, add 1mL of 10ppm working cyanide spiking solution (8.1.10) to the closed system.

Samples for Method 9010C/9012B: Prepare a Matrix Spike Duplicate (MSD) in the same manner as the MS, as described above.

9.2.5 For the duplicate, fill a 50mL reaction vessel with a duplicate aliquot of 50mL, or 1g soil and 50mL DI water of a sample that has been chosen to be duplicated.

9.2.6 Into the receiver or scrubber tube add 5mL of a 1N NaOH solution and add 40mL of DI water.

9.2.7 Arrange tubes in the distillation unit noting in the logbook which sample is in which glassware. The glassware is numbered and consistently placed in the same position in the distillation unit.

9.2.8 Assemble the unit completely. Turn on the pump. There must be gas bubbling in each tube. Check to make sure all connections are tight and bubbles are flowing at an equal rate in each sample tube. If not, adjust flow rate with the knobs in front of each receiver tube and/or check lines to ensure they are not obstructed.

9.2.9 Add 5mL of 0.4N sulfamic acid (8.1.4) to each sample tube and rinse the closed 50mL reaction vessel with a squirt of DI. No residue is to be left of the vessel wall.

9.2.10 Add 5mL of 1:1 H_2SO_4 (8.1.5) to each sample tube and rinse the closed 50mL reaction vessel with a squirt of DI. No residue is to be left on the vessel wall. Turn on the heat. Samples are to come to a boil on all of the midi-still units.

9.2.11 After 2 minutes of heating, add 2mL of 2.5M $MgCl_2$ Solution (8.1.6) to each sample tube, followed by a rinse with DI. If foaming occurs, an additional 2mL of $MgCl_2$ Solution may be added. If foaming continues, stop the distillation for that sample and reduce the sample size by 2 – 5x (as determined by the severity of the foaming). Contact the Inorganics Supervisor for guidance.

9.2.12 Turn on the chiller.

9.2.13 Set the timer-dial on the distillation unit to “110”.

9.2.14 After 110 minutes the unit will shut off; leave the chiller running for an additional 30 minutes while the tubes cool down.

9.2.15 Pour contents of the scrubber tube into a new, labeled, centrifuge tube (Section 7.5). Carefully rinse the scrubber tube with DI water and add rinseate to the centrifuge tube to bring to 50mL volume. Cap and refrigerate for later analysis by the Lachat Instrument.

9.3 Initial Calibration of Lachat Instrument

9.3.1 Allow 15 minutes for heating unit to warm up to 60 °C.

9.3.2 Prepare a series of 7 calibration standards (Sections 8.2.6 – 8.2.12) and a 0.1N NaOH blank. Alternatively, calibration standards may be prepared by auto-diluting a 0.5ppm calibration standard (Section 8.2.6). Perform this function per the Lachat manufacturer's instructions for the Quick Chem 8000.

9.3.3 Set up manifold as shown in Table 1.

9.3.4 Input data system parameters as shown in Table 2.

9.3.5 Place standards and blank in the autosampler, per the manufacturer's instructions. Input the information required by the data system, such as concentration, replicates and QC scheme.

9.3.6 Inject the standards, per the manufacturer's instructions.

9.3.7 Prepare a standard curve by plotting instrument response against standard concentration values. A calibration curve is fitted to the calibration solution concentration/response data using the computer. The calibration coefficient of the curve must be greater than or equal to 0.995 before sample analysis can begin.

9.4 Standardization (Continuing Calibration Verification)

9.4.1 After the calibration has been established, it must be verified by the analysis of an Initial Calibration Verification Standard (ICV) (Section 8.2.13). The ICV of 0.1ppm must be made from a different source than the calibration standards. If the measurements exceed ±10% of 0.1ppm, the analysis is terminated. See Section 10.6 for Corrective Actions.

9.4.2 A Blank and a Continuing Calibration Verification (CCV) sample (Section 8.2.8) are analyzed after every 10 injections. The CCV measurements cannot exceed ±10% of the CCV value of 0.1ppm and the blank result must be less than the reporting limit of 0.005 mg/L. See Section 10.6 for CCV Corrective Actions and Section 10.2 for Blank corrective actions.

9.5 Lachat Analysis

9.5.1 Following initial calibration and standardization, (Section 9.3 and 9.4), place the samples in the autosampler, per the manufacturer's instructions. Input the information required by the data system, such as concentration, replicates and QC scheme.

9.5.2 Inject the samples, per the manufacturer's instructions.

9.5.3 The data system calculates sample concentration using the regression equation. Results are mg/L for Aqueous samples and mg/Kg for soil and solid samples.

9.5.4 If sample concentrations are greater than the highest calibration standard, the distilled sample is diluted with 0.1N sodium hydroxide (NaOH) diluent (Section 8.2.2), and reanalyzed. When the automated diluter is used, 0.1N NaOH is also used. **Do not dilute distilled samples or standards with DI water.**

9.6 Preventative Maintenance

Preventative maintenance is recorded in the instrument maintenance logbook and is performed on the Lachat instrument as follows:

Daily:

1) Clean the autosampler
2) Clean the surfaces on the auto-dilutor
3) Prime the dilutor with fresh DI water
4) Clean the pump surfaces
5) Clean the detector with DI and dry with Kim-Wipes
6) Clean the instrument surfaces with DI, wipe clean with a paper towel

Bi-weekly:

1) Clean the injection ports with DI. Take apart the injection valve and inspect it for corrosion. Make sure that the valve connectors are tight and the o-rings are not worn. If the O-rings look worn replace with new ones.
2) Perform a scan disk and disk de-fragmentation on the computer.

Monthly:

1) Using DI water, clean the unions and the tees that are associated with the manifold.
2) Delete Temporary files on the computer, and clear the hard drive of all unnecessary files.

Every 6 months:

1) Replace the o-rings in the injection valve.
2) Replace the o-rings in the manifold
3) Back up the files on the computer. Delete backed files on the hard drive.

9.7 Calculations

9.7.1 The Lachat data system calculates sample concentration using the regression equation.

9.7.2 Report only those values that fall between the lowest and the highest calibration standards.

9.7.3 Report results in mg CN/L for liquids and in mg CN/kg for soils.

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

Refer to Alpha SOP/ 1734 and 1739 for DOC information.

10.2 Blank

A minimum of one method blank is distilled and analyzed per batch of 20 or less samples. The Method Blank is utilized to determine if contamination or any memory effects are occurring. (Section 9.2.1) The blank result must be less than the reporting limit of 0.005 mg/L for liquids and 1 mg/kg for soils. If the blank result is outside of acceptance criteria, it is injected another time. If failure continues, sample analysis is terminated and the source of the problem is found and corrected. All samples analyzed since the last acceptable blank analysis must be reanalyzed.

10.3 Laboratory Control Samples (LCS) / Laboratory Control Sample Duplicate (LCSD)

Distill and analyze two LCSs per batch of 20 samples. A Low LCS is analyzed at 0.1mg/L and a high LCS is analyzed at 0.2mg/L. (Section 9.2.2)

LCS measurements for Method SM 4500 CN-CE must be within ±10%. For Method 9010C/9012B, the LCS measurements must be within ± 15% for liquids and +/- 20% for soils.

Samples for Method 9010C/9012B: LCSDs are distilled and analyzed along with the LCSs, as described above. The RPD between LCS and LCSD must be $\leq$ 20% for liquids and $\leq$35% for soils.
For soil samples: LCS and LCSD recovery must be within vendor specified acceptance criteria (it will be different for different lots of SRM)

If any LCS fails acceptance criteria for either % Recovery or RPD, analysis is terminated and samples are redigested and analyzed.

10.4 Matrix Spike

Distill and analyze one spike per batch of 20 samples. For Method 9010C/9012B distill and analyze one spike per batch of 10 samples.
For Method 9010C/9012B, the % Recovery must be within ±20% for liquids and ±35% for solids. For SM 4500CN-CE, the % Recovery must be within ±10%. (Section 9.2.4).

Samples for Method 9010C/9012B: A Matrix Spike Duplicate (MSD) is distilled and analyzed along with the MS, as described above. The RPD between MS and MCSD must be $\leq$ 20% for liquids and $\leq$35% for soils.

10.5 Duplicates

Analyze one duplicate sample for every 20 samples. A duplicate sample is a sample brought through the entire sample preparation and analytical process. (Section 9.2.5)

The RPD must be 20% or less for liquids and 35% or less for soils and solids. See Section 12 for Corrective Action if these criteria are not met.

10.6 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

The Initial Calibration Verification Standard (ICV) (Section 8.2.13) is analyzed immediately following the calibration to verify the curve. If the measurements exceeds ±10% of

0.1ppm, the analysis is terminated and recalibration must occur. An acceptable result for the ICV must be obtained prior to any sample analysis.

The Continuing Calibration Verification Standard (CCV) (Section 8.2.8) is analyzed after every 10 injections. The CCV measurements cannot exceed ±10% of the of 0.1ppm. If the CCV is not within acceptance criteria, the standard is injected again. If failure continues, sample analysis is terminated and the source of the problem is found and corrected. All samples analyzed since the last acceptable calibration verification must be reanalyzed.

10.7 Control Limits

Refer to SOP/ 1734.

10.8 Analytical Sequence

The analytical sequence is:

- Screening of samples for chlorine and sulfide
- Distillation:
    - Samples
    - LCS Low
    - LCS High
    - Blank
    - Matrix Spike
    - Duplicate
- Analysis:
    - Calibration and Standardization of Lachat Instrument
    - CCV
    - CCB
    - ICV
    - ICB
    - 10 samples
    - CCV
    - CCB
    - 10 samples
    - CCV
    - CCB
    - Calculation of sample cyanide concentration

11. Method Performance

Refer to SOP/ 1732 for MDL/LOD/LOQ information. Refer to SOP/ 1734 and 1739 for DOC information.

12. Corrective Actions

Holding time exceedence and improper preservation are noted on the nonconformance report form. The analyst narrates the nonconformance when the project is turned in for review. The narration must state what the nonconformance was and any corrective action taken.

Perform routine preventative maintenance according to Section 9.6. Record all maintenance in the instrument logbook. Notify the Department Manager if the instrument problems are not routine in nature. The Department Manager determines whether the problem can be corrected with in-house technical staff or if the instrument vendor should be contacted to schedule service. All service calls are documented in the Instrument logbook, and a copy of the service report is given to the Department Manager.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. If any part of batch quality control does not meet acceptance criteria, the Department Manager is notified. If enough sample remains and holding time has not expired, then the batch is redistilled and reanalyzed. If there is not sufficient sample remaining to allow redistillation, then that analysis is repeated and both sets of data are reported., with the nonconformance narrated on the final report.

If either the ICV, ICB, Method Blank, LCS, LCSD, CCV, or CCB recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form.

Immediate corrective action for a failing CCV/CCB includes reanalyzing the failing standard. If the standard passes the second time then the analysis may be continued. The raw data is noted. If the standard fails again, the problem must be found and corrected. The CCV/CCB standard is remade and reanalyzed. If the standard passes, all samples analyzed since the previous passing standard are reanalyzed. The raw data is noted and all data associated with the failing standard must have one line drawn through the data, indicating its unusability.

If the standard fails after instrument maintenance, the instrument is recalibrated. A new ICV/ICB is performed, and all samples analyzed since the previous passing CCV/CCB are reanalyzed.

If following reanalysis of the LCS, it is found to still be outside acceptance criteria, the entire sample batch must be redistilled and reanalyzed. If the %RPD between the LCS/LCSD fails after reinjection, then the entire sample batch must be redistilled and reanalyzed.

If the Method Blank fails it is re-poured and reinjected. If failure continues, the associated sample data is evaluated as follows: Sample results below the detection limit may be reported with a narrative included. If samples have positive results, and the results are greater than 10x the concentration found in the method blank, the data may be reported with a narrative included. Any positive samples with results less than 10x the concentration found in the method blank must be redistilled and reanalyzed.

If the Matrix Spike recovery does not meet acceptance criteria, and the LCS recovery is acceptable, matrix interference may be assumed. The associated data may be reported with a narrative included.

If sample Duplicates are outside of the acceptance criteria, the analyst examines the sample for homogeneity. If the sample is not homogenous, this is narrated on the final report. Clean, homogenous samples are redistilled and reanalyzed within holding time.

Sample nonconformance regarding a Matrix Spike recovery or a duplicate %RSD is narrated on the final report along with the corrective action(s) taken.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

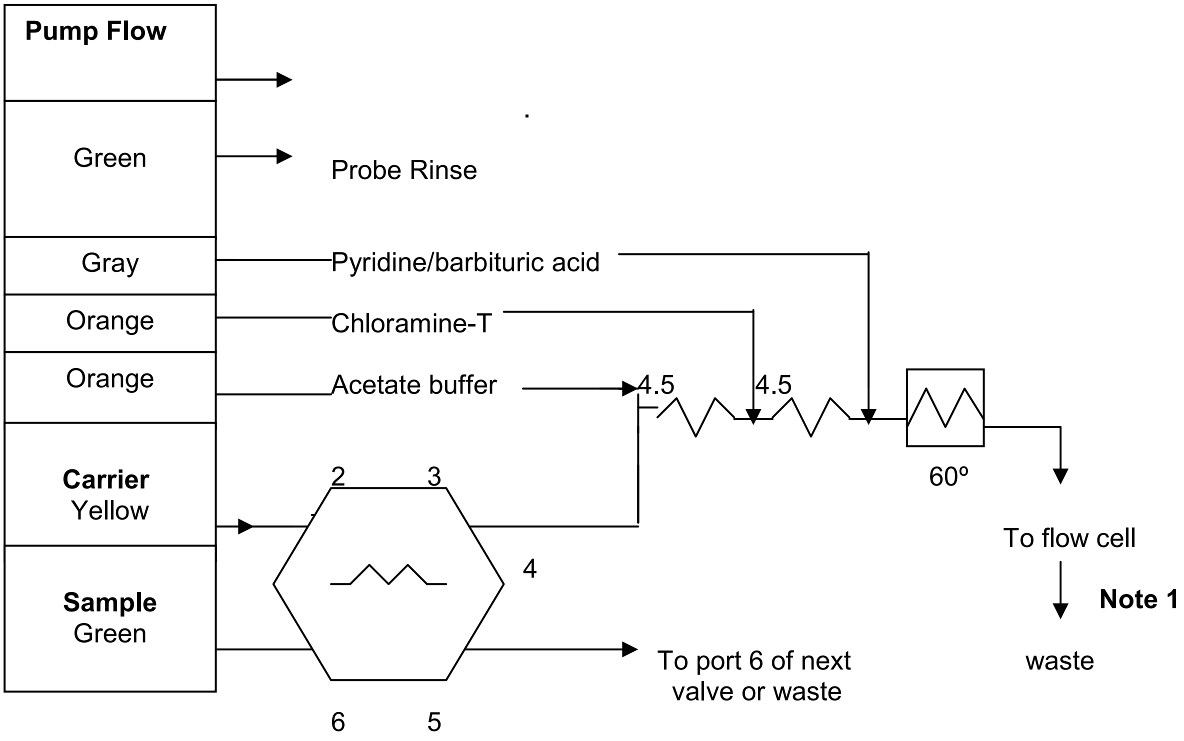
See Chemical Hygiene Plan for waste handling and disposal.

15. Attachments

TABLE 1: Cyanide Manifold Diagram

TABLE 2: Data System Parameters for QC 8000

TABLE 1
Cyanide Manifold Diagram



Sample Loop = 150cm x 0.8mm i.d. Interference Filter = 570nm
QC8000 Sample loop = 150cm x 0.8mm i.d.

CARRIER is 0.1 N sodium hydroxide solution.

All manifold tubing is 0.8mm (0.030 in) i.d. This is 5.2µL/cm.

4.5 is 70.0cm of tubing on a 4.5cm coil support

APPARATUS: An injection valve, flow cell, a 10mm path length flow cell, and a colorimetric detector module are required.

The box  shows 650cm of tubing wrapped around the heater block at the specified temperature.

Note 1: 2 meter back pressure loop, 0.52mm i.d.

TABLE 2
Data system Parameters for QC 8000

The timing values listed below are approximate and will need to be optimized using graphical events programming.

Sample Throughput:	80 samples/hour, 45 s/sample
Pump Speed:	35
Cycle Period:	45

Analyte Data:

Concentration Units:	mg CN^-/L
Peak Base Width:	39 s
% Width Tolerance:	100
Threshold:	25000
Inject to Peak Start:	42 s
Chemistry:	Direct

Calibration Data:

Levels	1	2	3	4	5	6	7	8
Concentration ug/50mL	25	10	5	2	1	0.5	0.2	0

Calibration Fit Type:	1st Order Polynomial
Calibration Rep. Handling:	Replace
Weighting Method:	1/X
Concentration Scaling:	None
Force Through Zero:	No

Sampler Timing:

Min. Probe in Wash Period:	14 s
Probe in Sample Period:	20 s

Valve Timing:

Load Time:	0.0 s
Load Period:	20 s
Inject Period:	25 s

Total Organic Carbon (TOC)
Dissolved Organic Carbon (DOC)
Total Inorganic Carbon (TIC)

Persulfate – Ultraviolet Oxidation Method

References: **SM Method 5310 C,** Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 2000.

EPA Method 9060 A, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997.

1. Scope and Application

Matrices: This method may be applied to water and wastewater samples containing minimum amounts of particulates and phase-separated organics.

Definitions: See Alpha Laboratories Quality Manual Appendix A

The organic carbon in water and wastewater is composed of a variety of organic compounds in various oxidation states. Some of these carbon compounds can be oxidized further by biological or chemical processes, and the bio-chemical oxygen demand (BOD) and chemical oxygen demand (COD) may be used to characterize these fractions. The presence of organic carbon that does not respond to either the BOD or COD test makes these methods unsuitable for the measurement of total organic carbon. Total organic carbon (TOC) is a more convenient and direct expression of total organic content than either BOD or COD, but does not provide the same kind of information. If a repeatable empirical relationship is established between TOC and BOD or COD, then TOC can be used to estimate the accompanying BOD or COD. This relationship must be established independently for each set of matrix conditions, such as various points in a treatment process. Unlike BOD or COD, TOC is independent of the oxidation state of the organic matter and does not measure other organically bound elements, such as nitrogen and hydrogen, and inorganics that can contribute to the oxygen demand measured by BOD and COD. TOC measurement does not replace BOD and COD testing.

To determine the quantity of organically bound carbon, the organic molecules must be broken down to single carbon units and converted to a single molecular form that can be measured quantitatively. TOC methods utilize heat and oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants to convert organic carbon to carbon dioxide (CO_2). Within this method, the CO_2 is measured directly by a nondispersive infrared analyzer.

The methods and instruments used in measuring TOC analyze fractions of total carbon (TC) and measure TOC by two or more determinations. These fractions of total carbon are defined as:

- Inorganic carbon (IC) - the carbonate, bicarbonate, and dissolved CO_2 total organic carbon (TOC) - all carbon atoms covalently bonded in organic molecules.
- Dissolved organic carbon (DOC) - the fraction of TOC that passes through a 0.45µm filter.
- Particulate organic carbon (POC) – also referred to as nondissolved organic carbon, the fraction of TOC retained by a glass fiber filter.

- Volatile organic carbon (VOC) also referred to as purgeable organic carbon, the fraction of TOC removed from an aqueous solution by gas stripping under specified conditions.
- Nonpurgeable organic carbon (NPOC) the fraction of TOC not removed by gas stripping.

In most water samples, the IC fraction is many times greater than the TOC fraction. Eliminating or compensating for IC interferences requires multiple determinations to measure true TOC. IC interference can be eliminated by acidifying samples to pH 2 or less to convert IC species to CO_2. Subsequently, purging the sample with a purified gas removes the CO_2 by volatilization. Sample purging also removes POC so that the organic carbon measurement made after eliminating IC interferences is actually an NPOC determination; determine VOC to measure true TOC. In many surface and ground waters, the VOC contribution to TOC is negligible. Therefore, in practice, the NPOC determination is substituted for TOC.

Alternatively, IC interferences may be compensated for by separately measuring total carbon (TC) and inorganic carbon. The difference between TC and IC is TOC.

The purgeable fraction of TOC is a function of the specific conditions and equipment employed. Sample temperature and salinity, gas-flow rate, type of gas diffuser, purging-vessel dimensions, volume purged, and purging time affect the division of TOC into purgeable and nonpurgeable fractions. When separately measuring VOC and NPOC on the same sample, use identical conditions for purging during the VOC measurement as in purging to prepare the NPOC portion for analysis. Consider the conditions of purging when comparing VOC or NPOC data from different laboratories or different instruments.

Many instruments utilizing persulfate oxidation of organic carbon are available. They depend on ultraviolet irradiation activation of the reagents. The persulfate-ultraviolet oxidation method is a rapid, precise method for the measurement of trace levels of organic carbon in water and is of particular interest to the electronic, pharmaceutical, and steam-power generation industries where even trace concentrations of organic compounds may degrade ion-exchange capacity, serve as a nutrient source for biological growth, or be detrimental to the process for which the water is being utilized.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the TOC Analyzer and in the interpretation of TOC data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or laboratory Director on a case-by-case basis.

2. Summary of Method

Organic carbon is oxidized to carbon dioxide, CO_2 by persulfate in the presence of ultraviolet light. The CO_2 produced may be measured by a nondispersive infrared analyzer.

The TOC Analyzer utilizes an ultraviolet lamp submerged in a continuously gas-purged reactor that is filled with a constant-feed persulfate solution. The samples are introduced serially into the reactor by an autosampler. The CO_2 produced is sparged continuously from the solution and is carried in the gas stream to an infrared analyzer that is specifically tuned to the absorptive wavelength of CO_2. The instrument's microprocessor calculates the area of the peaks produced by the analyzer, compares them to the peak area of the calibration standard stored in its memory, and prints out a calibrated organic carbon value in milligrams per liter.

2.1 Method Modifications from Reference

2.1.1 Method 9060 requires that samples be analyzed in quadruplicate. Alpha analyzes samples in duplicate with a %RSD required to be $\leq$10%.

2.1.2 Method 9060 requires a duplicate and spike to be analyzed after every 10 samples. Alpha analyzes a duplicate and spike after every 10 samples per matrix for method 9060 and for every 20 samples for method 5310 C. A CCV/CCB pair is analyzed after every 10 samples.

3. Detection Limits

The Reported Detection Limit for TOC is 0.5mg / L and for DOC is 1.0mg/L.

4. Interferences

4.1 Instrumental

The intensity of the ultraviolet light reaching the sample matrix may be reduced by highly turbid samples or with aging of the ultraviolet source, resulting in sluggish or incomplete oxidation. Large organic particles or very large or complex organic molecules such as tannins, lignins, and humic aid may be oxidized slowly because persulfate oxidation is rate-limited.

4.2 Parameters

Excessive acidification of sample, producing a reduction in pH of the persulfate solution to 1 or less, can result in sluggish and incomplete oxidation of organic carbon.

Persulfate oxidation of organic molecules is slowed in samples containing significant concentrations of chloride by the preferential oxidation of chloride; at a concentration of 0.1% chloride, oxidation of organic matter may be inhibited completely.

With any organic carbon measurement, contamination during sample handling and treatment is a likely source of interference. This is especially true of trace analysis. Take extreme care in sampling, handling, and analysis of samples with TOC below 1mg/L.

Removal of carbonate and bicarbonate by acidification and purging with purified gas results in the loss of volatile organic substances. The volatiles also can be lost during sample blending, particularly if the temperature is allowed to rise. Another important loss can occur if large carbon-containing particles fail to enter the needle used for injection. Filtration, although necessary to eliminate particulate organic matter when only DOC is to be determined, can result in loss or gain of DOC, depending on the physical properties of the carbon-containing compounds and the adsorption of carbonaceous material on the filter, or its desorption from it. Check filters for their contribution to DOC by analyzing a filtered blank. Note that any contact with organic material may contaminate a sample. Avoid contaminated glassware, plastic

containers, and rubber tubing. Method Blanks are analyzed with each batch to verify a clean system.
The presence of large amounts of particulate material will cause problems with the determination of carbon. The Phoenix 8000 TOC analyzer is not equipped for the analysis of samples with large amounts of particulate matter. Small amounts may be compensated for by dilution (refer to Section 11.2.2).

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Collect samples in two 40mL amber vials with Teflon septa. Minimum headspace is desirable.

6.2 Sample Preservation

6.2.1 If samples are to be analyzed for Dissolved Organic Carbon (DOC), they must be filtered prior to preservation. Refer to Section 10.1.1 for filtration procedure.

6.2.2 Within two hours of sampling, the samples are preserved with 1:1 H_2SO_4 to a pH $\leq$2, and refrigerated at 4 ± 2 ºC until analysis.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Samples to be filtered by the laboratory for DOC analysis, must be filtered upon receipt at the laboratory.

Preserved samples must be analyzed within a 28-day holding time.

7. Equipment and Supplies

7.1 AAL: "TOC-1": Phoenix 8000 Total Organic Carbon Analyzer: with autosampler.

7.1.1 Computer and related accessories capable of running associtated software: TOC Talk ver. 3. c1998 by Tekmar-Dohrmann

7.2 Filtering Apparatus.

7.3 0.45 µm Filters.

7.4 40mL Amber Glass Vials: with Teflon septa.

7.5 Glass Syringes: 50µL, 200µL and 1mL volumes.

7.6 Pipetter: 1-5mL, with disposable tips.

7.7 AAL: "TOC-3": Shimadzu TOC-V wp Total Organic Carbon Analyzer with autosampler.

7.7.1 Computer and related accessories capable of running associtated software: TOC-Control V ver. 1.07.00. c2000-2004 by Shimadzu Corp.

8. Standards and Reagents

8.1 Reagent Water: Deionized water (DI).

8.2 10% Persulfate + 5% Phosphoric Acid Reagent Mixture: Measure 50g 98^{+}% sodium persulfate ($Na_2S_2O_8$) into a rinsed bottle. Add 18mL of 85% phosphoric acid (H_3PO_4). Add 426mL of reagent water (DI). Mix well. This mixture must be prepared monthly. Label bottle with date made, date of expiration, reagent lot number, and store at room temperature.

8.3 21% Acid Reagent: Measure 74mL of 85% phosphoric acid (H_3PO_4) into a rinsed bottle. Add 376mL of reagent water (DI). Mix well. This mixture must be prepared monthly. Label bottle with date made, date of expiration, and reagent lot number and store at room temperature.

8.4 2000ppm Organic Carbon Stock Calibration Standard: In a 1L volumetric flask, add 4.25g of Potassium Hydrogen Phthalate (KHP) and 1mL H_3PO_4. Bring to volume with DI and agitate to mix well. Transfer to a 1L Amber glass bottle. Prepare every six months. Label bottle with standard lot number, date made, and date of expiration. Store at 4 ± 2 °C.

8.4.1 50ppm Calibration Standard: To a 100mL volumetric flask, add 2.5mL of 2000ppm stock standard (Section 8.4) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.2 10ppm Calibration Standard: To a 100mL volumetric flask, add 0.5mL of 2000ppm stock standard (Section 8.4) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.3 5.0ppm Calibration Standard: To a 100mL volumetric flask, add 10mL of 50ppm calibration standard (Section 8.4.1) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.4 2.0ppm Calibration Standard: To a 100mL volumetric flask, add 4mL of 50ppm calibration standard (Section 8.4.1) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.5 1.0ppm Calibration Standard: To a 100mL volumetric flask, add 2mL of 50ppm calibration standard (Section 8.4.1) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.6 0.5ppm Calibration Standard: To a 100mL volumetric flask, add 1mL of 50ppm calibration standard (Section 8.4.1) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.4.7 0.2ppm Calibration Standard: To a 100mL volumetric flask, add 2.0mL of 10ppm calibration standard (Section 8.4.2) and bring to volume with DI. Prepare fresh for each calibration curve generated.

8.5 2000ppm Organic Carbon Stock Check Standard:

In a 1L volumetric flask, add 4.25g of Potassium Hydrogen Phthalate (KHP) and 1mL H_3PO_4. Bring to volume with DI and agitate to mix well. Transfer to a 1L Amber glass bottle. Prepare every six months. Label bottle with standard lot number, date made, and date of expiration. Store at 4 ± 2 °C.

The KHP used for this solution must be from a different source and lot number than that used in Section 8.4.

8.5.1 Calibration Verification Standard

2.0ppm ICV/CCV: To a 100mL volumetric flask, add 100µL of 2000ppm stock check standard (Section 8.5) and bring to volume with DI. Prepare fresh on each day of use.

8.5.1.1 In the case of DOC, the 2.0ppm ICV/CCV is prepared as above (Section 8.5.1) using DI that has been filtered through a 0.45µm filter (Section 7.3).

8.6 400ppm TOC IC Stock Standard:

To a 100mL volumetric flask, add 0.3545g sodium carbonate (Na2CO3) anhydrous powder. Bring to volume with DI water. Store at 4 ± 2°C. Prepare annually or as needed.

8.6.1 10ppm TOC IC Working Check Standard (Negative LCS): Into a 100mL volumetric flask, add 2.5mL of 400ppm TOC IC Stock Standard. Bring to volume with DI water. Store at room temperature. Prepare weekly or as needed.

8.6.1.1 2ppm TIC Working Check Standard: Into a 100ml volumetric flask, add 20ml of 10ppm TOC IC Working Check Standard. Bring to volume with DI water. Store at room temperature. Prepare as needed. Note: Also referred to as the 10ppm “IC CK STD” (Inorganic Check Standard).

8.7 Purging / Carrier Gas:

Nitrogen, ultra-high purity.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

9.1.1 Method Blank or Initial Calibration Blank (ICB)

One ICB is analyzed per batch of 10 samples or less. The ICB consists of 40mL of DI. The DI must be from the same source as was used to prepare the Calibration Verification samples. Results must be < 0.5mg/L, but preferably ≤ 0.2mg/L. If this criterion is not met, the instrument must be internally cleaned again (Refer to Section 10.1.4) in order to ensure that the system is clean prior to sample analysis.

In the case of DOC, the ICB consists of DI that was filtered through a 0.45µm filter (Section 7.3). Results must be <1.0mg/L. If this criterion is not met, the instrument must be internally cleaned again (Refer to Section 10.1.4) in order to ensure that the system is clean prior to sample analysis.

9.2 Laboratory Control Sample (LCS)

9.2.1 The 2.0ppm ICV is reported as the LCS for each batch of 20 or less samples (per instrument and per day). Therefore, a new ICV should be analyzed for each additional batch of 20 or less samples, when multiple batches are run on the same instrument and daily analytical sequence. Refer to Section 9.3

9.2.2 **Negative LCS Standard (LCSN):** A negative LCS (LCSN) is analyzed following the Calibration Blank (ICB) to demonstrate that there is no Inorganic Carbon contribution to the Organic Carbon analysis. The analysis of the 10ppm LCSN (8.6.1) must yield a result of < 0.5mg/L.

If the LCSN fails this criteria, the data is inspected to determine the cause of the failure. The standard is reanalyzed. If failure continues, the standard is remade and reanalyzed. If failure continues, there is a system malfunction and sample analysis cannot take place. The following instrument parameters are investigated: UV Lamp function, sparger function and acid delivery to the sparger. If the problem persists, contact the Department Supervisor. Analysis cannot begin until the 10ppm LCSN is within acceptance criteria.

Note: Also referred to as the 10ppm “IC CK STD” (Inorganic Check Standard).

9.3 Initial Calibration Verification (ICV)

An ICV is analyzed at the beginning of the analytical sequence, at a concentration of 2.0ppm. (For preparation instructions, refer to Section 8.5.1.)

The ICV must be recovered within ± 10% of the true value. If this criterion is not met, the system must be cleaned again, and the Blank and ICV must be re-analyzed. If failure continues, remake the ICV (Section 8.5.1) and/or generate a new calibration curve (Section 10.1.6). Sample analysis cannot proceed until an acceptable ICV/LCS is obtained.

9.4 Continuing Calibration Verification (CCV)

9.4.1 A Continuing Calibration Verification standard is analyzed after every 10 or less samples (inclusive of the duplicate and matrix spike samples). This CCV is at a concentration of 2.0ppm TOC (Section 8.5.1), and must be recovered within ±10% of the true value. If the CCV fails this criterion, it is re-made and re-analyzed. If failure continues, all samples analyzed since the last valid CCV, are considered invalid and must be re-analyzed. However, prior to re-analysis, a new calibration curve must be generated. (Refer to Section 10.1.6.)

If all of the samples analyzed since the last acceptable CCV have results that are below the reporting limit, the data may be reported and a narrative submitted for inclusion on the final report.

9.4.2 Continuing Calibration Blank (CCB)

A Continuing Calibration Blank is analyzed after every 10 samples (inclusive of the duplicate and matrix spike samples). This CCB consists of 40mL DI water and must be recovered below the detection limit. If the CCB fails this criterion, it is re-poured and re-analyzed. If failure continues, all samples analyzed since the last valid CCB, are considered invalid and must be re-analyzed. However, prior to re-analysis, a new calibration curve must be generated. (Refer to Section 10.1.6.)

If all of the samples analyzed since the last acceptable CCB have results that are below the reporting limit, the data may be reported and a narrative submitted for inclusion on the final report.

9.5 Matrix Spike

One Matrix Spike (MS) is analyzed per batch of 20 samples or less (per batch of 10 samples or less for TOC-9060). Measure 40mL of the well-homogenized sample to be spiked into a 40mL amber glass vial with Teflon cap. Using a glass syringe, add 80µL of the 2000ppm Stock Check Standard (Section 8.5). Invert to mix. The true value of the spike prepared accordingly, is 4ppm. The matrix spike must be recovered within 80 – 120% of the true value.

If the matrix spike recovery is outside of acceptance criteria, the sample and its MS are reanalyzed upon dilution with DI water for TOC analysis, or with filtered DI water for DOC analysis. If failure repeats, the data is reported and a narrative submitted for inclusion on the Client report.

9.6 Laboratory Duplicate

One Duplicate sample is analyzed per batch of 20 samples or less (per batch of 10 samples or less for TOC-9060). Samples are routinely collected in two 40mL amber glass vials; therefore the second vial may be used as the sample duplicate. It must, however, be analyzed as if it were a separate sample. The %RPD between the sample and its duplicate must be <20%.

If the % RPD is outside of acceptance criteria, the duplicate is reanalyzed. If failure repeats, the data is reported and a narrative submitted for inclusion on the Client report.

9.7 Method-specific Quality Control Samples

Refer to Section 9.2.2.

9.8 Method Sequence

- TOC-1 only: Prime System TOC-3 only: Rinse water
- TOC-1 only: Cleaning Procedure
- TOC-1 & TOC-3:
- Calibration curve generation (if necessary)
- DI water
- 10ppm Negative LCS (IC CK STD)
- 2.0ppm ICV
- ICB
- Samples 1-10
- 2.0ppm CCV
- CCB

If Method 5310, then proceed with samples 11-20 (dup/spk required per 20 samples)

- 2.0ppm CCV
- CCB
- Duplicate

- Matrix Spike 4ppm
- 2.0ppm CCV
- CCB
- Shut down

If Method 9060, then proceed with dup and spk (dup/spk required per 10 samples)
Duplicate
Matrix Spike 4ppm

- 2.0ppm CCV
- CCB
- Shut down

10. Procedure

10.1 Equipment Set-up

10.1.1 Sample Preparation for Dissolved Organic Carbon (DOC) Analysis

Prior to preservation, samples to be analyzed for dissolved organic carbon (DOC) are filtered through a 0.45µm filter (Section 7.3) as follows:

- Prior to filtration of the sample, filter 500mL of DI through a 0.45µm filter and discard.
- Filter 100mL of sample through the same 0.45µm filter.
- Transfer filtered sample to two 40mL amber vials and preserve accordingly.
- Prepare a DOC method blank following the same procedure listed above. Filter enough to fill a 40mL amber vial and extra to allow for possible sample dilutions.

Another method of filtration of DOC samples can be the following: Use 0.45 µm filtering discs with a 10 or 20mL disposable syringe. Record necessary information in the filtration logbook (sample ID, date and time of filtration, analyst's initials, the lot number of the vials used, and the preservative used).

10.1.2 Instrument Set-Up

Follow the manufacturer's instructions for proper instrument set-up procedures. For TOC-3 instrument, refer to Table A.

10.1.3 Reagent Preparation

10.1.3.1 Verify that the reagents (Sections 8.2 and 8.3) have not expired and that there is adequate Nitrogen gas supply. If necessary, prepare reagents and/or change gas cylinder.

10.1.3.2 Ensure that the DI supply to the instrument is fresh for each day of analysis.

10.1.3.3 Prepare the 2.0ppm ICV/CCV standard (Section 8.5.1) each day of analysis.

10.1.4 Instrument Preparation

10.1.4.1 (TOC-1)

Prior to analysis of either standards or samples, program the instrument to perform the following:

♦ Prime System:	1 Rep
♦ Cleaning Procedure:	2 Reps

10.1.4.2 (TOC-3)

Set instrument to analysis 1 vial of DI water, entitled “Rinse water” to ensure system is stable and clean before analyses.

Proceed to section 10.1.5

10.1.5 If a valid calibration curve is already in place, proceed to Section 10.2.

10.1.6 Calibration Curve Generation

A new calibration curve is generated every six months. However, if there has been a major change to the system, a new calibration curve must be generated following the change and prior to sample analysis.

Prepare six calibration standards per Section 8.4.2 through Section 8.4.7 and two DI water blanks.

Analyze the six calibration standards and blanks:

(TOC-1) with the TOC Talk Software range set at “0.1 – 10ppm TOC”, per the manufacturer’s instructions and the TOC Talk Software instructions.

(TOC-3) with the TOC Shimadzu TOC-V wp software program, Set the range at 0.1 – 10ppm for TOC.

After analysis, the TOC Talk Software for TOC-1, or the software program for TOC-3, will allow the user to select the calibration standards and blank desired to include in the calibration curve calculation. All of the standards must be chosen, and also the second blank (the first blank is considered a rinse). The correlation coefficient (r) must be $\geq$ 0.995. If this criterion is not met, the calibration standards are re-made and the calibration curve is re-analyzed.

Samples and QC samples may not be analyzed until a valid Calibration Curve is obtained.

10.2 Initial Calibration

10.2a Before any analyses, verify that the system is clean.

10.2b Run one DI sample to check for system stability. (Note: Only at initial instrument startup. This also acts as a TOC water screen to ensure the lab water being used is acceptable (resulting value is below the reporting limit of 0.5ppm for TOC and 1.0ppm for DOC) prior to use).

Per the manufacturer’s instructions, set up the autosampler to analyze the following:

♦ TOC-1= DI water, TOC-3= Rinse water (DI)

10.2.1 Negative LCS Standard (LCSN): Prior to sample analysis and following the ICV and ICB, a negative LCS (LCSN) is analyzed to demonstrate that there is no Inorganic Carbon contribution to the Organic Carbon analysis. The analysis of the 10ppm LCSN (8.6.1) must yield a result of < 0.5mg/L.

If the LCSN fails this criteria, the data is inspected to determine the cause of the failure. The standard is reanalyzed. If failure continues, the standard is remade and reanalyzed. If failure continues, there is a system malfunction and sample analysis cannot take place. The following instrument parameters are investigated: UV Lamp function, sparger function and acid delivery to the sparger. If the problem persists, contact the Department Supervisor. Analysis cannot begin until the 10ppm LCSN is within acceptance criteria.

10.2.2 Initial Calibration Verification (ICV) and Initial Calibration Blank (ICB)

Prior to sample analysis, the calibration curve must be verified.

Analyze an ICV and an ICB to confirm stability and cleanliness.

- 2.0ppm ICV (Section 8.5.1)
- ICB (DI water)

The ICV must have a % Recovery ± 10% of the true value. The results for the ICB must be less than 0.5mg/L, but preferably less than or equal to 0.2mg/L. If these criteria are not met, the system must be cleaned again (Section 10.1.4) and the ICV and ICB must be re-analyzed. If failure continues, remake the ICV (Section 8.5.1) and/or generate a new calibration curve (Section 10.1.6).

10.3 Equipment Operation and Sample Processing

10.3.1 Samples and QC samples are analyzed according to the manufacturer's instructions and the TOC Talk Software (TOC-1), or TOC Shimadzu TOC-V wp software program (TOC-3) instructions, using the valid calibration curve in the TOC Talk Software or TOC Shimadzu TOC-V wp software program range of "0.1 – 20ppm TOC". (As generated in Section 10.1.6).

10.3.1.1 Dissolved Organic Carbon: If samples are to be analyzed for DOC, the same procedure is followed as for TOC. However, while setting up the batch in TOC Talk, the analyst must include "DOC" in the Sample ID field.

10.3.1.2 Total Inorganic Carbon: (Applies only to TOC-1 instrument): If samples are to be analyzed for TIC (logged in under SPECWC product), the procedure is as follows:

10.3.1.2.1 Switch the ultraviolet lamp to standby mode.

10.3.1.2.2 Below the ultraviolet protection hood of the instrument, unplug the small tubing attached to the top of the mix/sparge glass tube. (It may make a slight "pop" sound when doing so). After doing this, switch the ultraviolet lamp back to ready mode to begin sample analysis.

10.3.1.2.3 Create a 2ppm ICV/CCV working standard by using 20ml of the 10ppm working TIC standard (refer to section 8.6) and filling this to 100ml DI in a clean 100ml volumetric flask.

10.3.1.2.4 Analyze all samples in the same manner as is followed for TOC/DOC. However, the acceptable range for ICV/CCV/Duplicate % recovery is within 20%. There is no matrix Spike analysis.

10.3.1.2.5 When all sample analysis for TIC has been completed, switch the ultraviolet lamp back to standby mode, CAREFULLY & GENTLY (it is easily breakable!) replug the small tubing to the top of the mix/sparge glass tube. When the red stopper on the small tubing is halfway back into the top of the mix/sparge glass tube, the system should be secure. Switch the ultraviolet lamp back to ready mode.

10.3.1.2.6 Analyze two vials of DI as if they are regular TOC samples to clean the system following its use for TIC analysis before shutdown.

10.3.1.2.7 (Important note: It is highly recommended (whenever possible) that TIC analysis be done at the end of the day's run, to enable the red stopper to dry and remain secure in the system. It has been determined that too much TOC analysis right after TIC analysis causes the small tubing to pop back out and therefore disrupt TOC analysis).

10.3.2 The samples to be analyzed must have a minimum amount of sediment. Initial dilution of samples with sediment may be necessary to facilitate analysis. by either instrument. Dilutions are prepared volumetrically with DI water. However, prior to dilution, consider the history of the samples and the detection limit requirements of the client. If questions arise due to sample matrix, consult with the Department Supervisor and/or the Laboratory Director before proceeding with analysis.

10.3.3 Samples are to be analyzed with 2 Reps each. The TOC Software will calculate the standard deviation, the %RSD, and the mean. The %RSD must be $\leq$ 10%. If this criterion is not met, the sample must be re-analyzed with 2 Reps. If failure continues, consult with the Department Supervisor and/or the Laboratory Director before proceeding.

10.3.4 Similarly, a duplicate sample and a matrix spike sample are to be analyzed in replicate. Prepare the duplicate and matrix spike samples according to Sections 9.6 and 9.5.

10.3.4.1 For Method 5310, a duplicate and matrix spike is required for every **20** samples or less in a batch.

10.3.4.2 For Method 9060, a dupldate and matrix spike is required for every **10** samples or less in a batch.

10.3.5 If the sample results are above 10mg/L TOC, they are above the high end of the calibration curve. In this instance, the sample must be manually diluted volumetrically with DI water and re-analyzed. A timeout message or baseline drift might also necessitate a dilution of the sample even if the sample is < 10mg/L.

While setting up the diluted sample in the batch, the analyst must include the dilution factor in the Sample ID field.

10.4 Continuing Calibration

10.4.1 Continuing Calibration Verification (CCV) and Continuing Calibration Blank (CCB)

A Continuing Calibration Verification standard and a Continuing Calibration Blank pair are analyzed after every 10 samples (inclusive of the duplicate and matrix spike samples).

10.4.1.1 The CCV is at a concentration of 2.0ppm TOC (Section 8.5.1), and must be recovered within ±10% of the true value. If the CCV fails this criterion, it is re-made and re-analyzed. If failure continues, all samples analyzed since the last valid CCV, are considered invalid and must be re-analyzed. However, prior to re-analysis, a new calibration curve must be generated. (Refer to Section 10.1.6.)

10.4.1.1.1 If all of the samples analyzed since the last acceptable CCV have results that are below the reporting limit, the data may be reported and a narrative submitted for inclusion on the final report.

10.4.1.2 The results for the CCB must be less than 0.5mg/L, but preferably less than or equal to 0.2mg/L. If the CCB fails this criterion, it is reanalyzed. If failure continues, all samples analyzed since the last valid CCB, are considered invalid and must be re-analyzed. However, prior to re-analysis, a new calibration curve must be generated. (Refer to Section 10.1.6.)

10.4.1.2.1 If all of the samples analyzed since the last acceptable CCB have results that are below the reporting limit, the data may be reported and a narrative submitted for inclusion on the final report.

10.5 Preventive Maintenance

The instrument is primed and cleaned internally prior to analysis. Tubing, copper/tin scrubber, and autosampler syringe are inspected routinely to ensure they are in proper working order. The external autosampler is kept clean and free of dust. Extra parts are kept on hand in the event they are necessary. All instrument maintenance is recorded in the Instrument Maintenance Logbook.

If continual bubbling in the gas/liquid separator tube occurs during analysis, lift the back, right cover of the instrument body (carefully so as not to disturb any connected fan wiring), and gently tap the line from the separator tube until all the bubbles are released. Any sample currently running may need reanalysis due to failed detection. (i.e. instrument message “no sample detected”.)

11. Data Evaluation, Calculations and Reporting

The TOC Talk Software (TOC-1) or TOC Shimadzu TOC-V wp software program calculates the area of the peaks produced by the analyzer, compares them to the peak area of the calibration standard stored in its memory, and calculates a mean TOC value in mg/L.

If the sample was manually diluted prior to analysis, the calculated mean must be manually multiplied by the dilution factor. The Reported Detection Limit is also multiplied by the same dilution factor.

If the sample result is <0.5mg/L for TOC, it is reported as ND (Not Detected). Likewise, if the sample result is <1.0mg/L for DOC, it is reported as ND (Not Detected).

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Refer to Section 9 for corrective actions.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1739 IDC/DOC Generation

SOP/1728 Waste Management and Disposal SOP

16. Attachments

Table A: TOC-VW (TOC 3 INSTRUMENT)

Table A:

TOC-VW (TOC 3 INSTRUMENT)

STARTING THE INSTRUMENT:

Turn on nitrogen ultra pure nitrogen gas tank.

Push the on/off button on the bottom right front of the instrument to on (green light will be visible).

With the computer on, use the mouse to double click on the TOC-CONTROL V icon on the desktop.

Double click on “Sample Table Editor”

Enter user’s initials, hit OK

At Sample Table page:

Go to File “New”

Double click on “Sample Run”

Select System “TOC-VW”, hit OK

At Save As page:

For File name, overwrite existing to say current date as month/day/year (00/00/0000), hit SAVE

At Dated Run page:

Click on yellow lightning bolt icon @ top to connect to system

At Parameter Confirmation Dialog page:

Click on “Use Settings on PC”

At Sequence Box page:

Wait for system to initialize (page box will disappear once initialized)

Once initialized, click on white square box @ top (just left of yellow lightning bolt), to see Background Monitor

Wait for NDIR: baseline pos., baseline fluc., and baseline noise -> all 3 items should have a green checkmark before instrument can run analyses.

When all 3 items are green, close this box by clicking on the “X” on the top right of the box.

At the Dated Run page again:

Adjust columns to include: Analysis//Sample Name//Result//Status//Date/Time//Vial

NOTE: Prior to analyzing samples, generate a new Calibration Curve according to the Instrument’s User Manual,

TO SET UP AN ANALYSIS RUN:

At top of Dated Run page:

Go to Insert, Autogenerate

Sample group wizard (page 1): sample source:

Bullet calibration curve, push rectangular button w/ dots within it

Next to file name, type toc3curve120211a

Select current dated curve from choices below

Hit OPEN

Then hit NEXT

Sample group wizard (page 2):

Number of samples = enter number of samples to analyze

Start vial = vial number to begin analyzing

Erase sample name/leave blank, hit NEXT

Page 3: hit NEXT

Page 4: hit NEXT

Page 5: hit FINISH

Sparging/acid addition with autosampler pie display, hit OK

Back at Dated Run page:

Type in information for each sample name in the appropriate column

TO BEGIN ANALYSIS:

Click on the green stoplight icon at top of screen:

Standby box should have “keep running” bullet

Hit Standby button

Then hit OK on sparging/acid addition autosampler pie display page

Then @ start ASI measurement box, UNCHECK the external acid addition box, hit START

TO TURN OFF INSTRUMENT AFTER ANALYSIS IS COMPLETED:

At the end of the run, hit the round clock icon at the top of the screen

Mare sure “shut down instrument” is bulleted

Hit “standby”

Turn off instrument power button so that the green light is now off.

Turn off gas tank.

TO PRINT ANALYSIS PAPERWORK:

File, Print, sample report

Close all pages on screen by hitting the “X” at the top right of each page.

Total Dissolved Solids Dried at 180ºC

Total Volatile Dissolved Solids at 550°C

References: **SM 2540 C (TDS) and E (TVDS)**, Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 20th Edition (SDWA) and 21st Edition (CWA).

1. Scope and Application

Matrices: This method is suitable for the determination of Total Dissolved Solids (TDS) and Total Volatile Dissolved Solids (TVDS) in potable, surface, and saline waters, as well as domestic and industrial wastewaters.

Definitions: Refer to Alpha Analytical Quality Manual.

"Solids" refer to matter suspended or dissolved in water or wastewater. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavorable physiological reaction in the transient consumer. For these reasons, a limit of 500mg dissolved solids/L is desirable for drinking waters. Highly mineralized waters also are unsuitable for many industrial applications. Waters high in suspended solids may be esthetically unsatisfactory for such purposes as bathing. Solids analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with regulatory agency wastewater effluent limitations.

"Total solids" is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature. Total solids include "total suspended solids," the portion of total solids retained by a filter, and "total dissolved solids," the portion that passes through the filter.

"Fixed solids" is the term applied to the residue of total, suspended, or dissolved solids after heating to dryness for a specified time at a specified temperature. The weight loss on ignition is called "volatile solids." Determinations of fixed and volatile solids do not distinguish precisely between inorganic and organic matter because the loss on ignition is not confined to organic matter. It includes losses due to decomposition or volatilization of some mineral salts

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

A well-mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180ºC. The increase in dish weight represents the total dissolved solids. The filtrate from the total suspended solids determination (refer to SOP ID 2220) may be used for determination of total dissolved solids. Samples submitted for Total Volatile Dissolved Solids analysis are also dried at a higher temperature to a constant weight.

2.1 Method Modifications from Reference

Method specify that duplicate determination should agree within 5% of their average weight; Alpha is using in-house control limits.

3. Reporting Limits

The RDL is 10mg/L using a 100mL sample and analytical balance sensitive to 0.1mg, with an upper limit of 2000mg/L. A lower RDL may be achieved by using a larger sample (repeated evaporation of 100mL aliquots) or the use of a more sensitive balance.

4. Interferences

4.1 Highly mineralized water with a significant concentration of calcium, magnesium, chloride, and/or sulfate may be hygroscopic and require prolonged drying, proper desiccation and rapid weighing.

4.2 Samples high in bicarbonate require careful and possibly prolonged drying at 180ºC to ensure complete conversion of bicarbonate to carbonate.

4.3 Exclude large, floating particles or submerged agglomerates of non-homogeneous materials from the sample if it is determined that their inclusion is not desired in the final result.

4.4 Disperse visible floating oil and grease with a blender before withdrawing a sample portion for analysis.

4.5 Because excessive residue in the dish may form a water-trapping crust, limit sample to no more than 200mg residue.

4.5.1 For samples high in dissolved solids, thoroughly wash the filter to ensure removal of dissolved material. Mix small samples with a magnetic stirrer. If suspended solids are present, pipet with wide-bore pipets. If part of a sample adheres to the sample container, consider this in evaluating and reporting results. Some samples dry with the formation of a crust that prevents water evaporating; special handling is required. Avoid using a magnetic stirrer with samples containing magnetic particles.

4.5.2 Prolonged filtration times resulting from filter clogging may produce high results owing to increased colloidal materials captured on the clogged filter.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Use resistant-glass or plastic bottles, provided that the material in suspension does not adhere to container walls. Sampling, subsampling, and pipetting two-phase or three-phase samples may introduce serious errors. Make and keep such samples homogeneous during transfer. Use special handling to ensure sample integrity when subsampling.

6.2 Sample Preservation

None.

6.3 Sample Shipping

No specific requirements.

6.4 Sample Handling

Begin analysis as soon as possible because of the impracticality of preserving the sample. Refrigerate sample at 4 ±2 ºC up to the time of analysis to minimize microbiological decomposition of solids. In no case hold sample more than 7 days. Bring samples to room temperature before analysis.

7. Equipment and Supplies

7.1 Glass-Fiber Filter Disks: 47mm diameter, without organic binder, Type A/B, size 1.0um.

7.2 Filtration Apparatus: With a membrane filter funnel.

7.3 Side-arm Flask: Of sufficient capacity for sample size selected.

7.4 Evaporation Dishes: 100mL, porcelain, 90mm diameter.

7.5 Dessicator: With a dessicant containing a color indicator of moisture concentration or an instrumental indicator.

7.6 Drying Oven: 75 - 80ºC.

7.7 Drying Oven: 180ºC ± 2ºC.

7.8 Analytical Balance: Capable of weighing to 0.1mg.

7.9 Magnetic Stirrer: With TFE stirring bar.

7.10 Wide-bore Pipets.

7.11 Graduated Cylinders: 100mL, plastic or glass.

7.12 Wax Crayon or Sharpie pen

7.13 Muffle Furnace: Capable of 550°C.

8. Reagents and Standards

8.1 Reagent Water: Deionized (DI) water.

8.2 LCS Solution: To a 1L volumetric flask, add 0.5g of K_2SO_4. Bring to volume with DI water. Transfer the solution to a 1L plastic bottle that is labeled with the contents, preparation date, expiration date, and the initials of the preparer. Solution is stored at room temperature. The LCS Solution is valid for 1 year.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank

Filter one blank of DI water per batch of 20 samples or less. Results must be less than the Reporting Limit (RL). If Blank results are less than 10 times the RL and the sample results are greater than 10 times the RL, the data is reported. If Blank results are greater than 10 times the RL, and there is sufficient sample volume remaining, the entire batch is reset and reanalyzed. A narrative is included with the report.

9.2 Laboratory Control Sample (LCS)

Filter one LCS per batch of 20 samples or less. Results must be within ± 20% of the true value. If acceptance criteria are not met then the entire sample batch must be reset. If there is insufficient sample volume remaining, the data is submitted and a narrative is included with the final report.

9.3 Initial Calibration Verification (ICV)

Not Applicable.

9.4 Continuing Calibration Verification (CCV)

Not Applicable.

9.5 Matrix Spike

Not Applicable.

9.6 Laboratory Duplicate

Filter one duplicate sample per batch of 10 samples or less. Duplicate determinations should be within in-house control limits. If acceptance criteria are not met, and there is sufficient sample volume remaining and sample is within holding time, the sample is reset. Otherwise, the data is submitted and a narrative is included with the final report.

9.7 Method-specific Quality Control Samples

None.

9.8 Method Sequence

- Prepare the evaporation dishes.
- Weigh the clean evaporation dishes.
- Filter the appropriate volumes of sample, and QC samples.
- Rinse the filter with DI water.
- Transfer the filtrate into a clean, pre-weighed evaporation dish, and rinse the filter flask.
- Evaporate the filtrate in a 75 - 80°C oven.
- Once dry, transfer the dishes into the 180°C oven.
- Dry for a minimum of 2 hours in a 180°C oven.
- Cool in a dessicator until temperature is constant.
- Weigh the dishes until the weight change is less than 4% of the previous weight or 0.5mg, whichever is less.
- Total Volatile Suspended Solids are also dried for a minimum of 2 hours in a 550 °C muffle furnace.
- Cool in a dessicator until temperature is constant.
- Weigh the dishes until the weight change is less than 4% of the previous weight or 0.5mg, whichever is less.
- Calculate results.

10. Procedure

10.1 Equipment Set-up

10.1.1 Preparation of Evaporation Dishes

10.1.1.1 Label evaporating dishes with a unique ID using a wax crayon or Sharpie pen.

10.1.1.2 Bake clean evaporating dishes to 180 ± 2ºC for at least two hours in an oven, but preferably overnight for the greatest stability.

10.1.1.3 Store the evaporation dishes in a dessicator until needed.

10.2 Initial Calibration

Not Applicable.

10.3 Equipment Operation and Sample Processing

10.3.1 Filtration

10.3.1.1 Remove the evaporating dishes from the dessicator and weigh them immediately before use. Record the weight on the computer worksheet. Also record the date/time/analyst's initials for the analysis on the Excel sheet in the required areas.

10.3.1.2 Insert a glass-fiber filter disk (Section 7.1) with wrinkled side up in the filtration apparatus. Attach a side-arm flask.

Note: Record the manufacturer and lot number of the filter used in the logbook.

10.3.1.3 Apply vacuum, and wash the disk with three successive 20mL portions of DI water.

10.3.1.4 Continue suction to remove all traces of water, and discard washings.

10.3.1.5 **Selection of Sample Size:** Choose a sample volume to yield 200mg dried residue. Generally a 100mL sample volume is used. When very low dissolved solids are encountered (less than 100mg/L), less dried residue may be collected. Compensate for this by using a high-sensitivity balance (0.001mg) or by increasing the amount of sample volume.

10.3.1.6 **Samples**

10.3.1.6.1 Apply vacuum.

10.3.1.6.2 Pour 100mL of sample (or selected sample volume, Section 10.3.1.5) into a clean 100mL graduated cylinder. Pour this volume into the filtering apparatus.

10.3.1.6.3 If the sample contains sediment, oil, or any other substance, stir the sample using a magnetic stirrer, and while stirring, pipet a measured volume onto the seated filter.

10.3.1.7 **Quality Control Samples**

10.3.1.7.1 **LCS**

Using a 100mL graduated cylinder, measure 50mL of the LCS Solution (Section 8.2) and pour into the filtering apparatus.

10.3.1.7.2 Blank

Using a 100mL graduated cylinder, measure 100mL of DI water and pour into the filtering apparatus.

10.3.1.8 Rinse the filter with three successive 10mL volumes of DI water, allowing complete drainage between washings, and continue suction for about 3 minutes after filtration is complete.

10.3.1.9 Transfer the total filtrate (with washings) to a weighed evaporating dish and evaporate to dryness in an oven at 75 - 80ºC. Record the date, time in, and the oven temperature in the laboratory notebook.

10.3.1.10 Then, transfer the samples to dry for at least two hours in an oven at 180 ±2ºC.

- Following removal from the drying oven (Section 10.3.1.9), record the date, time out, and the oven temperature in the laboratory notebook.
- Following the placement of the samples and QC samples in the 180 ±2ºC oven (Section 10.3.1.10), record the date, time in, and the oven temperature in the laboratory notebook.

10.3.1.11 Remove the dishes from the oven and cool them in a dessicator to constant temperature. Record the date, time out, and the oven temperature in the laboratory notebook.

10.3.1.12 Record the weight of the dishes on the computer worksheet.

10.3.1.13 Repeat drying cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until the weight change is less than 4% of the previous weight or 0.5mg, whichever is less.

10.3.1.14 Total Volatile Dissolved Solids

10.3.1.14.1 If TVDS analysis is requested, transfer the crucible to a muffle furnace at 550°C. Record the date, time in, and the oven temperature in the laboratory notebook.

10.3.1.14.2 Dry the crucible for a minimum of 2 hours at 550°C and cool in a dessicator to a constant room temperature.

- Following placement of the samples and QC samples in the furnace, record the date, time in, and the furnace temperature in the laboratory notebook.
- Following the placement of the samples and QC samples in the dessicator, record the date, time out, and the furnace temperature in the laboratory notebook.

10.3.1.14.3 Using an analytical balance, weigh the crucible and record the weight on the computer worksheet.

10.3.1.14.4 Repeat the cycle of drying, cooling, dessicating and weighing until a constant weight is obtained or until the weight change is less than 4% of the previous weight, or 0.5mg, whichever is less. Record each weight on the computer worksheet.

10.4 Continuing Calibration

Not Applicable.

10.5 Preventive Maintenance

10.5.1 Prior to each use, the filtering apparatus is rinsed thoroughly with DI water.

10.5.2 As needed, the filtering apparatus is washed in the industrial dishwasher.

10.5.3 As necessary, wipe the inside of the filtering apparatus with a paper towel and then rinse thoroughly with DI water

10.5.4 Ensure that there is an adequate supply of oil in the vacuum pump

10.5.5 The temperature of the laboratory ovens is recorded constantly on a data logger system.

10.5.6 The data logger system and the laboratory ovens are calibrated on an annual basis by an instrument service company. Certificates are kept on file in the QA Department.

11. Calculations

$$\text{mg TDS/L} = \frac{(\mathbf{A} - \mathbf{B}) \times 1000}{\text{sample volume, (mL)}}$$

where:

A = Final weight (weight of dish + dried residue, g)
B = Initial weight (weight of clean dish, g)

$$\text{mg TVDS / L} = \frac{(\mathbf{G} - \mathbf{N}) \times 1000}{\text{sample volume, (mL)}}$$

where:

G = Final Weight at 105 °C (weight of dish + dried residue, g)
N = Weight at 550 °C (weight of dish + dried residue, g)

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Holding time exceedence and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance as outlined in Section 10.5.

Review of blanks and LCS for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the LCS recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734 and 1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1734, 1739 IDC/DOC Generation

SOP/1728 Waste Management and Disposal SOP

16. Attachments

None.

Total Phenol - SEAL Method

Reference Methods: **EPA 9065**, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997.

EPA 420.1, Methods for the Chemical Analysis of Water and Wastes, EPA 600/ 4-82-055, 1982.

AQ2 method EPA-117-A Rev. 8

1. Scope and Application

Matrices: This method is applicable to the analysis of ground water, drinking, surface, and saline waters, domestic and industrial wastes, and soils.

Definitions: Refer to Alpha Analytical Quality Manual.

Phenols, defined as hydroxy derivatives of benzene and its condensed nuclei, may occur in domestic and industrial wastewaters and in drinking water supplies. Chlorination of such waters may produce odoriferous and objectionable-tasting chlorophenols, which may include o-chlorophenol, p-chlorophenol, 2,6-dichlorophenol, and 2,4-dichlorophenol. Phenol removal processes in water treatment include superchlorination, chlorine dioxide or chlorine ammonia treatment, ozonation, and activated carbon adsorption.

This method uses the 4-aminoantipyrine colorimetric method that determines phenol, the ortho- and metasubstituted phenols, and, under proper pH conditions, those parasubstituted phenols in which the substitution is a carboxyl, halogen, methoxyl, or sulfonic acid group.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the distillation apparatus, the SEAL Instrument and in the interpretation of data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

The phenols are distilled at a more or less constant rate from the nonvolatile impurities. The rate of volatilization of the phenols is gradual, so that the volume of the distillate must equal that of the sample being distilled. The acidic solution also prevents the precipitation of cupric solution hydroxide, which acts as an oxidizing agent toward phenols.

The steam-distilled phenols react with 4-aminoantipyrine at a pH of 10.0 in the presence of potassium ferricyanide to form a colored antipyrine dye. This dye is kept in an aqueous solution and the absorbance is measured at 505nm. *.*

2.1 Method Modifications from Reference

The aqueous sample size has been reduced from 500mL to 50mL using midi-distillation. Consequently, the volume of reagents added for distillation has been reduced.

3. Reporting Limits

The Reported Detection Limit for this analysis is 0.03mg phenol/L for liquids and 0.75mg/Kg for soils.

4. Interferences

4.1 Instrumental

Distillate turbidity will interfere with analyzer reading. Refer to Section 10.3.1.3.

4.2 Parameters

4.2.1 Domestic and industrial wastewaters may contain such interferences as phenol-decomposing bacteria, oxidizing and reducing substances, and alkaline pH values. Biological degradation is inhibited by the addition of $CuSO_4$ to the sample. Acidification with H_2SO_4 assures the presence of the copper ion and eliminates any chemical changes resulting from the presence of strong alkaline conditions.

4.2.2 Some of the treatment procedures used for the removal of interferences before analysis may result in an unavoidable loss of certain types of phenols. Consequently, some highly contaminated wastewaters may require specialized screening techniques for elimination of interferences and for quantitative recovery of the phenolic compounds.

4.2.3 Color response of phenolic materials with 4-aminoantipyrine is not the same for all compounds. Because phenolic-type wastes usually contain a variety of phenols, it is not possible to duplicate a mixture of phenols to be used as a standard. For this reason phenol has been selected as a standard and any color produced by the reaction of other phenolic compounds is reported as phenol. This value will represent the minimum concentration of phenolic compounds present in the sample.

4.2.4 Interferences from sulfur compounds are eliminated by acidifying the sample to a pH of 4 with H_2SO_4 and aerating briefly by stirring.

4.2.5 Oxidizing agents such as chlorine, detected by the liberation of iodine upon acidification in the presence of potassium iodide, are removed immediately after sampling by the addition of an excess of ferrous ammonium sulfate. If chlorine is not removed, the phenolic compounds may be partially oxidized and the results may be low.

4.2.6 Oils and tars contain phenol, and if present in the sample would cause interference. Refer to the original method for guidance in the extraction of oils and tars from the sample.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Collect aqueous samples in a 1L Amber Glass bottle and soil samples in an 8-ounce glass jar.

6.2 Sample Preservation

Phenols in concentrations usually encountered in wastewaters are subject to biological and chemical oxidation. If analysis cannot be done within 4 hours after collection, acidify to a pH 4 with H_2SO_4. If H_2S or SO_2 is known to be present, briefly aerate or stir the sample with caution.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Keep the sample refrigerated at 4±2ºC. Analyze the preserved aqueous samples and soil samples within 28 days after collection.

Soil distillates must be analyzed within 24 hours of distillation. Soil distillates are kept refrigerated at 4±2ºC if not immediately analyzed.

7. Equipment and Supplies

7.1 Distillation apparatus: All glass, consisting of 50mL Pyrex distilling beakers with condenser and heating apparatus. Steam cleaned, per Section 10.1.1.

7.2 pH paper: Range 2-14 pH units

7.3 Volumetric Pipettes: 0.25ml 1mL 10mL

7.4 Volumetric Flasks: 100mL, 200mL, 500ml, 1000ml

7.5 Transfer Pipettes

7.6 Chiller.

7.7 Boiling Chips.

7.8 Analytical Balance.

7.9 SEAL AQ2

7.10 2ml Sample Cups

7.11 Reagent Containers with Caps

7.12 Reaction Segments

8. Reagents and Standards

8.1 DI Water.

8.2 1000ppm LCS Stock Phenol Solution: Commercially available with a certificate of analysis. Store at room temperature. Expires upon manufacturer's specified date.

8.2.1 200ppm LCS Working Solution: Dilute 20mL of 1000ppm LCS Stock Phenol Solution (Section 8.2) to 100mL with DI. Store at room temperature. Expires 3 months from date of preparation.

8.3 1000ppm Stock Calibration Standard: Commercially available with a certificate of analysis; must be purchased from a different source than the 1000ppm LCS Stock Phenol Solution (Section 8.2). Store at room temperature. Expires upon manufacturer's specified date.

8.3.1 200ppm Spiking Solution: Pipet 20mL of the 1000ppm Stock Calibration Standard (Section 8.3) into a 100mL volumetric flask and bring to volume with DI. Store at room temperature. Expires 3 months from date of preparation.

8.4 0.4 mg/l CCV Solution: Pipet 2 mL intermediate phenol standard (20 mg Phenol/L) (Section 8.5) to a 100 mL volumetric flask. Dilute to the mark with working acid diluent (Section 8.10). Mix well and store at 4 °C in a glass bottle. Prepare fresh every week or as needed.

8.5 INTERMEDIATE PHENOL STANDARD (20 mg Phenol/L, 0.005 N sulfuric acid) Pipet 2 mL stock standard (1000 mg Phenol/L) to a 100 mL volumetric flask. Dilute to the mark with working acid diluent (above). Mix well and store at 4 °C in a glass bottle. Prepare fresh every two weeks or as needed.

8.6 PHENOL TOP STANDARD (0.25 mg Phenol/L, 5.0E-05 N sulfuric acid) Pipet 5 mL intermediate phenol standard (25 mg Phenol/L) to a 500 mL volumetric flask. Dilute to the mark with working acid diluent (above). Mix well and store at 4 °C in a glass bottle.

8.7 Sulfuric acid, H_2SO_4: Concentrated

8.8 Sulfuric Acid, 5 normal: Slowly add 70ml of sulfuric acid concentrated to about 400ml deionized water, Caution container will become very warm, cool to room temperature and dilute to 500ml deionized water This solution is stable for one year.

8.9 Initial Acid Diluent , 0.005 N Sulfuric Acid: Pipet 5ml , 5 normal, to a 1 L volumetric flask and dilute to the mark with deionized water and mix well. This solution is stable for one year.

8.10 Working Acid Diluent 0.00005 N Sulfuric Acid: Pipet 10ml initial acid diluent**,** 0.005N to a 1L volumetric flask and dilute to the mark with deionized water and mix well. This solution is stable for one year.

8.11 1N Sodium Hydroxide 20 g sodium hydroxide diluted to 500 mL last 3 months

8.12 Buffered Potassium Ferricyanide Solution: Transfer 2.5 g boric acid, 0.9 g sodium hydroxide pellets, 3.0 g potassium chloride and 1.5 g potassium ferricyanide in 400 mL deionized water in an Erlenmeyer flask. Stir to dissolve. Adjust to pH of 10.3 with 1 N sodium hydroxide and dilute to 500 mL. Store in refrigerator, prepare every two weeks or as needed

8.13 Aminoantipyrine solution: Dissolve 0.15g of 4-aminoantipyrine (4-AAP) in DI and dilute to 100mL. Prepare a fresh solution on each day of use.

8.14 Semivolatile Blank Soil: Commercially available; Expires upon manufacturer's specified date.

8.15 Antifoam.

8.16 SEAL Cuvette Cleaning Solution (p/n 5676)

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

One distillation blank per batch of 10 samples or less. A Distillation Blank will determine if any contamination has occurred. (Section 10.1.2.2)

9.2 Laboratory Control Sample (LCS)

Analysis of a LCS/ICV takes place after the spectrophotometer is set to zero using a Blank. One LCS is run per batch of 10 samples or less. (Section 10.1.2.3)

The LCS recovery must be within ± 30% for aqueous samples and ± 35% for solid samples. If LCS recovery is outside acceptance criteria, the entire batch is re-distilled and reanalyzed.

The ICV must be within +/- 10% of the true value before reading any sample on the spectrophotometer. If the ICV recovery is not within the limits, then a new calibration curve is generated.

9.3 Initial Calibration Verification (ICV)

Refer to Section 9.2.

9.4 Continuing Calibration Verification (CCV)

After every 10 or less samples, or for every hour of continuous analysis, verify the calibration curve by coloring and reading the absorbance of an undistilled phenol standard (CCV). The CCV must recover within +/- 10% of the true value. If the CCV recovery is not within the limits, CCV is re-poured and re-analyzed. If the CCV failure continues, then a new calibration curve is generated (Section 10.2.1).

9.5 Matrix Spike

One per batch of 10 samples or less. (Section 10.1.2.4) The spike recovery for aqueous samples must be within ± 30% and within ± 35% for solid samples. If recovery is outside of the acceptance criteria, the matrix spike is re-distilled and reanalyzed to confirm matrix interference. If interference is confirmed, a narrative is submitted to be included on the Client report.

9.6 Laboratory Duplicate

One per batch of 10 samples or less. (Section 10.1.2.5) The %RPD for aqueous samples must be within ± 20% and within ± 30% for solid samples. If %RPD is outside of acceptance criteria, the sample and its duplicate are re-distilled and reanalyzed. If failure continues, a narrative is submitted to be included on the Client report.

9.7 Method-specific Quality Control Samples

Not applicable.

9.8 Method Sequence

- Glassware preparation
- Distillation
- SEAL AQ2 preparation
- Calibration curve generation
- Coloring
  - ICV
  - ICB
  - Method Blank
  - LCS
  - Samples and QC Samples
  - CCV (every 10 samples and at the end of the run)
  - CCB (every 10 samples and at the end of the run)
- Reading of absorbances
- Calculations

10. Procedure

10.1 Equipment Set-up

10.1.1 Preparation of Distillation Glassware

Prior to use, steam clean the distillation apparatus using 50mL of DI water plus 0.4mL concentrated H_2SO_4. Add boiling chips and assemble the stills. Turn on the chiller and heating units. Distill over about 40mL distillate. After stills cool, discard the distillate appropriately, then rinse the flask, the arm, and the column with DI.

10.1.2 Distillation Set-up

10.1.2.1 Samples

10.1.2.1.1 Liquid Samples

Pipette 50ml of sample into a beaker. Adjust pH to 4 with NaOH [1+9] or with Sulfuric Acid [1+9]. Transfer to the skirted Reaction Tube. Add a pinch of boiling chips. Repeat for all samples to be distilled up to a maximum of 10.

10.1.2.1.2 Solid Samples

For soil samples, weigh 2g or less into beaker and 50 ml reagent water. Adjust pH to 4 with NaOH [1+9] or sulfuric acid [1+9] while stirring and transfer to the skirted Reaction Tube. Add a pinch of boiling chips. Repeat for all samples to be distilled up to a maximum of 10.

10.2 Initial Calibration

10.2.1 **Calibration Curve Generation**: A calibration curve is prepared fresh on each day of analysis, with five calibration standards and a blank.

10.2.1.1 Preparing the Standards

Using the Phenol Top Standard(Section 8.5), fill a 2ml sample cup and place in cup position 2 in the SEAL AQ2 sample tray. Before analysis, click to select auto-standardize on the menu. SEAL will generate curve AQ2 software provides automated calibration, via preparation of user-specified blends of phenol top standard with working acid diluent.

10.3 Equipment Operation and Sample Processing

10.3.1 Turn on the tap water to cool the Cold Finger after ensuring all tubing connections are tight. Check for leaks.

10.3.2 Turn power ON and set heater block temperature to 190 °C.

10.3.3 Pipette 50mL of sample into a beaker. Adjust pH to 4 with NaOH (1+9) or with Sulfuric Acid (1+9). Transfer to the skirted Reaction tube. For soil samples, weigh 2g or less into a beaker and 50mL reagent water. Adjust pH to 4 with NaOH (1+9) or sulfuric acid (1+9) while stirring and transfer to the skirted Reaction Tube. Add a pinch of boiling chips.

10.3.4 Repeat 10.3.3 for all samples to be distilled up to a maximum of 10 samples.

10.3.5 When approximately 45mL of sample is distilled, add 5mL of reagent water . When 50mL of sample is collected in the Receiver Tube, remove by unscrewing the cap containing the Short Stem.

10.3.6 When all samples have distilled, turn the power OFF.

10.3.7 Add 5ml increments of reagent water to the Reaction Tube. Since the heater block is still hot, the distillation process will continue. Place a collection tray or beakers to catch any further distillate.

10.3.8 After each use, clean exterior with a damp sponge.

10.3.9 When the heater temperature falls below 100 °C, the next run can be started.

NOTE: If boil over occurs, add 2-3 drops of Anti-foam Agent to the sample prior to distillation.

10.3.10 Assemble the stills; turn on the chiller and heating units and collect 50mL of distillate into each glass beaker. Record the distillate volume in the laboratory notebook**.**

NOTE: At this point the distillate can be covered and refrigerated until the next day for the coloring procedure, if desired.

10.3.11 Turbid Distillate

Initial distillation should purify the sample adequately. Occasionally, however, the distillate is turbid.

NOTE: In this case, notify the Department Supervisor before proceeding. Refer to the original method for guidance in removing turbidity from the distillate.

10.3.12 Coloring Procedure

Transfer distillate into a 2ml reaction cup. Prepare standards and reagents. Any reagents having visible particulates should be filtered.

Pour calibration standard, quality control solutions and samples into sample cups and 45 mL reagent wedges, according to the user-defined wordlist. AQ2 software provides automated calibration, via preparation of user-specified blends of phenol top standard with working acid diluent.

Before running the analysis batch, check the analyzer for sufficient reagent water, fresh reaction segments, correct location of reagent vessels and a waste collection bottle in place.

After phenolics analyses are finished for the day, clean the cuvette to remove deposits. Fill a reagent wedge with SEAL Cuvette Cleaning Solution (p/n 5676) and place it in position 1 of the reagent tray. Within SEAL discrete analyzer software, open Maintenance–Wash the Cuvette and select Extra Wash.

10.4 Continuing Calibration

The concentration of the calibration verification standard is varied daily. (i.e. Day 1: analyze a low-range standard; Day 2: analyze a mid-range standard; Day 3: analyze a high-range standard.) This will ensure that the range of the curve is verified on a regular basis.

After every 10 or less samples, or for every hour of continuous analysis, verify the calibration curve by coloring and reading the absorbance of an undistilled phenol standard (as in Section 10.2.1.2).New Jersey requires a constant calibration verification standard, using only the midrange value.

10.5 Preventive Maintenance

The SEAL is calibrated on a semi-annual basis by an instrument service company. These records are kept on file.

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11. Data Evaluation, Calculations and Reporting

11.1 Calculate the concentration value of the sample directly from the standard curve. (Section 10.2.1.3).

$$\text{Phenol (mg/L)} = \frac{\text{absorbance} - \text{y-intercept}}{\text{slope}} \times \text{Dilution factor}$$

11.2 For liquid samples, calculate mg/L phenol as follows:

$$\text{mg/L phenol} = \mathbf{A} \times \frac{\mathbf{50}}{\mathbf{B}}$$

where:

A = mg/L phenol, from calibration curve (Section 11.1)
B = mL original sample.

11.3 For solid samples, calculate mg/kg phenol as follows:

$$\text{mg/kg phenol} = \mathbf{A} \times \frac{\mathbf{50}}{\mathbf{B}}$$

where:

A = mg/L phenol, from calibration curve (Section 11.1)
B = g original sample.

All calculations are done electronically by SEAL software; data will be electronically transferred to LIMS system

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Holding time excedence and improper preservation are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the LCS recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

13. Method Performance

13.1 Detection Limit Study (DL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the DL, LOD, and/or LOQ as outlined in Alpha SOP ID 1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP ID 1732 Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)

SOP ID 1739 IDC/DOC Generation

SOP ID 1728 Waste Management and Disposal SOP

16. Attachments

SEAL method parameters:

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PARAMETER	**AQ2 SETTING**
Test name	PHENOLICS 0.25
Units	mg Phenol/L
Decimals	3
Test type	End Point
Sample volume (L)	450
Water volume (L)	30
Number of mixes	1
Cuvette primes	5
Cuvette washes	2
Baseline on Wash	Ticked
Reaction time (seconds)	450
Wavelength (nm)	505
Polynomial order	1
Number of reagents	2
1. 4-Aminoantipyrine (L)	28
2. Buffered Potassium Ferricyanide (L)	35
Advanced Test Parameters	Eliminate Air from Test Transfer Eliminate Air from Cuvette Wash Extra Debubbling Action

Inductively Coupled Plasma - Atomic Emission Spectrometry

Reference Method No.: **Method 6010C** SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update IV, February 2007.

SM 2340B, Hardness by Calculation, Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WPCF, 21st Edition, 1997.

1. Scope and Application

Matrices: Digestates from all matrices.

Definitions: See Alpha Laboratories Quality Manual Appendix A

Inductively coupled plasma-atomic emission spectrometry (ICP-AES) determines trace elements, including metals, in solution. The method is applicable to all of the elements listed in Table 1. All matrices, excluding filtered groundwater samples but including ground water, aqueous samples, TCLP and EP extracts, industrial and organic wastes, soils, sludge, sediments, and other solid wastes, require digestion prior to analysis. Groundwater samples that have been prefiltered and acidified will not need acid digestion unless chemical interferants are suspected. Samples which are not digested must either use an internal standard or be matrix matched with the standards. Refer to Metals Preparation SOPs for the appropriate digestion procedures.

Table 1 lists the elements for which this method is applicable. Detection limits, sensitivity, and the optimum and linear concentration ranges of the elements can vary with the wavelength, spectrometer, matrix and operating conditions. Table 1 lists the recommended analytical wavelengths for the elements in clean aqueous matrices. Table 3 lists the Reported Detection Limits. The reported detection limit data may be used to estimate instrument and method performance for other sample matrices. Elements other than those listed in Table 1 may be analyzed by this method if performance at the concentration levels of interest (see Section 9) is demonstrated.

Users of the method should state the data quality objectives prior to analysis and must document and have on file the required initial demonstration performance data described in the following sections prior to using the method for analysis.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is made by one of the following laboratory personnel before performing the modification: Area Supervisor, Metals Manager, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer.

Use of this method is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences described in this method. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and Laboratory Director on a case-by-case basis.

2. Summary of Method

Prior to analysis, samples must be solubilized or digested using appropriate Sample Preparation Methods. When analyzing groundwater samples for dissolved constituents, acid digestion is not necessary if the samples are filtered and acid preserved prior to analysis.

This method describes multielemental determinations by ICP-AES using sequential or simultaneous optical systems and axial or radial viewing of the plasma. The instrument measures characteristic emission spectra by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the emission lines are monitored by photosensitive devices. Background correction is required for trace element determination. Background must be measured adjacent to analyte lines on samples during analysis. The position selected for the background-intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the analyte line. In one mode of analysis the position used must be as free as possible from spectral interference and must reflect the same change in background intensity as occurs at the analyte wavelength measured. Background correction is not required in cases of line broadening where a background correction measurement would actually degrade the analytical result. The possibility of additional interferences named in Section 4.0 must also be recognized and appropriate corrections made; tests for their presence are described in Section 9.4.4. Alternatively, users may choose multivariate calibration methods. In this case, point selections for background correction are superfluous since whole spectral regions are processed.

This SOP includes the manual calculations for Total Hardness and Calcium Hardness, according to SM 2340B.

2.1 Method Modifications from Reference

None.

3. Reporting Limits

Refer to Table 3 for method Reporting Limits.

4. Interferences

4.1 Spectral

Spectral interferences are caused by background emission from continuous or recombination phenomena, stray light from the line emission of high concentration elements, overlap of a spectral line from another element, or unresolved overlap of molecular band spectra.

4.1.1 Background emission and stray light can usually be compensated for by subtracting the background emission determined by measurements adjacent to the analyte wavelength peak. Spectral scans of samples or single element solutions in the analyte regions may indicate when alternate wavelengths are desirable because of severe spectral interference. These scans will also show whether the most appropriate estimate of the background emission is provided by an interpolation from measurements on both sides of the wavelength peak or by measured emission on only one side. The locations selected for the measurement of background intensity will be determined by the complexity of the spectrum adjacent to the wavelength peak. The locations used for routine measurement must be free of off-line spectral interference (interelement or molecular) or adequately corrected to reflect the same change in background intensity as occurs at the wavelength peak. For multivariate methods using whole spectral regions, background scans must be included in the correction algorithm. Off-line spectral interferences are handled by including spectra on interfering species in the algorithm.

4.1.2 To determine the appropriate location for off-line background correction, the user must scan the area on either side adjacent to the wavelength and record the apparent emission intensity from all other method analytes. This spectral information must be documented and kept on file. The location selected for background correction must be either free of off-line interelement spectral interference or a computer routine must be used for automatic correction on all determinations. If a wavelength other than the recommended wavelength is used, the analyst must determine and document both the overlapping and nearby spectral interference effects from all method analytes and common elements and provide for their automatic correction on all analyses. Tests to determine spectral interference must be done using analyte concentrations that will adequately describe the interference. Normally, 100 mg/L single element solutions are sufficient; however, for analytes such as iron that may be found at high concentration, a more appropriate test would be to use a concentration near the upper analytical range limit.

4.1.3 Spectral overlaps may be avoided by using an alternate wavelength or can be compensated by equations that correct for interelement contributions. Instruments that use equations for interelement correction require the interfering elements be analyzed at the same time as the element of interest. When operative and uncorrected, interferences will produce false positive determinations and be reported as analyte concentrations. More extensive information on interferant effects at various wavelengths and resolutions is available in reference wavelength tables and books. Users may apply interelement correction equations determined on their instruments with tested concentration ranges to compensate (off line or on line) for the effects of interfering elements. For multivariate methods using whole spectral regions, spectral interferences are handled by including spectra of the interfering elements in the algorithm. The interferences listed are only those that occur between method analytes. Only interferences of a direct overlap nature are listed. These overlaps were observed with a single instrument having a working resolution of 0.035 nm.

4.1.4 When using interelement correction equations, the interference may be expressed as analyte concentration equivalents (i.e. false analyte concentrations) arising from 100 mg/L of the interference element. For example, assume that As is to be determined (at 193.696 nm) in a sample containing approximately 10 mg/L of Al. 100 mg/L of Al would yield a false signal for As equivalent to approximately 1.3 mg/L. Therefore, the presence of 10 mg/L of Al would result in a false signal for As equivalent to approximately 0.13 mg/L. The user is cautioned that each instrument may exhibit somewhat different levels of interference. The interference effects must be evaluated for each individual instrument since the intensities will vary.

Major known interferences are Fe, Al, Ca, Mg, V, Ni, Cu, and Cr. To minimize any of these interferences, every analyte is analyzed on each instrument at or near its linear range and corrected for these interferences. This is done on an annual basis, and data is kept on file.

4.1.5 Interelement corrections will vary for the same emission line among instruments because of differences in resolution, as determined by the grating, the entrance and exit slit widths, and by the order of dispersion. Interelement corrections will also vary depending upon the choice of background correction points. Selecting a background correction point where an interfering emission line may appear must be avoided when practical. Interelement corrections that constitute a major portion of an emission signal may not yield accurate data. Users must not forget that some samples may contain uncommon elements that could contribute spectral interferences.

4.1.6 The interference effects must be evaluated for each individual instrument whether configured as a sequential or simultaneous instrument. For each instrument, intensities will vary not only with optical resolution but also with operating conditions (such as power, viewing height and argon flow rate). When using the recommended wavelengths, the analyst is required to determine and document for each wavelength the effect from referenced interferences as well as any other suspected interferences that may be specific to the instrument or matrix. The analyst is encouraged to utilize a computer routine for automatic correction on all analyses.

4.1.7 The primary wavelength for each analyte is based upon the instrument manufacturer’s recommendations. An alternate wavelength is chosen if there is an indication of elevated background or overlap of another spectral wavelength. The wavelength for each analyte must be as free from interferences as possible.

4.1.8 If the correction routine is operating properly, the determined apparent analyte(s) concentration from analysis of each interference solution must fall within a specific concentration range around the calibration blank. The concentration range is calculated by multiplying the concentration of the interfering element by the value of the correction factor being tested and divided by 10. If after the subtraction of the calibration blank the apparent analyte concentration falls outside of this range in either a positive or negative direction, a change in the correction factor of more than 10% should be suspected. The cause of the change must be determined and corrected and the correction factor updated. The interference check solutions must be analyzed more than once to confirm a change has occurred. Adequate rinse time between solutions and before analysis of the calibration blank will assist in the confirmation.

4.1.9 When interelement corrections are applied, their accuracy must be verified, daily, by analyzing spectral interference check solutions. If the correction factor or multivariate correction matrices tested on a daily basis (by running a check solution on each analytical run) are found to be within 20% criteria for 5 consecutive days, analysis may be extended to a weekly basis. Also, if the nature of the samples analyzed is such that they do not contain concentrations of the interfering elements greater than the reported detection limit, daily verification is not required. All interelement spectral correction factors or multivariate correction matrices are verified and updated on an annual basis or when an instrumentation change, such as in the torch, nebulizer, injector, or plasma conditions occurs. The standard solution must be inspected to ensure that there is no contamination that may be perceived as a spectral interference.

4.1.10 When interelement corrections are not used, verification of absence of interferences is required.

4.1.10.1 One method is to use a computer software routine for comparing the determinative data to limits, files for notifying the analyst when an interfering element is detected in the sample at a concentration that will produce either an apparent false positive concentration, (i.e., greater than) the analyte instrument detection limit, or false negative analyte concentration, (i.e., less than the lower control limit of the calibration blank defined for a 99% confidence interval).

4.1.10.2 Another method is to analyze an Interference Check Solution(s) which contains similar concentrations of the major components of the samples (>10 mg/L) on a continuing basis to verify the absence of effects at the wavelengths selected. These data must be kept on file with the sample analysis data. If the check solution confirms an operative interference that is >20% of the analyte concentration, the analyte must be determined using (1) analytical and background correction wavelengths (or spectral regions) free of the interference, (2) by an alternative wavelength, or (3) by another documented test procedure.

4.2 Physical

Physical interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved solids or high acid concentrations. If physical interferences are present, they must be reduced by diluting the sample, using a peristaltic pump, use of an internal standard or by using a high solids nebulizer. Another problem that can occur with high dissolved solids is salt buildup at the tip of the nebulizer, affecting aerosol flow rate and causing instrumental drift. The problem can be controlled by wetting the argon prior to nebulization, using a tip washer, using a high solids nebulizer or diluting the sample. Also, it has been reported that better control of the argon flow rate, especially to the nebulizer, improves instrument performance: this may be accomplished with the use of mass flow controllers. The test described in Section 10.3.4.1 will help determine if a physical interference is present.

4.3 Chemical

Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally, these effects are not significant with the ICP technique, but if observed, can be minimized by careful selection of operating conditions (incident power, observation position, and so forth), by buffering of the sample, by matrix matching, and by standard addition procedures. Additionally, if filtered samples are found to have an organic or sulfur like odor they are processed by heating after the addition of the acids to matrix match. Chemical interferences are highly dependent on matrix type and the specific analyte element.

4.4 Memory

Memory interferences result when analytes in a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the uptake tubing to the nebulizer and from the build up of sample material in the plasma torch and spray chamber. The site where these effects occur is dependent on the element and can be minimized by flushing the system with a rinse blank between samples. The possibility of memory interferences must be recognized within an analytical run and suitable rinse times must be used to reduce them. The rinse times necessary for a particular element must be estimated prior to analysis. This may be achieved by aspirating a standard containing elements at a concentration ten times the usual amount or at the top of the linear dynamic range. The aspiration time for this sample must be the same as a normal sample analysis period, followed by analysis of the rinse blank at designated intervals. The length of time required to reduce analyte signals to within a factor of two of the method detection limit must be noted. Until the required rinse time is established, this method suggests a rinse period of at least 60 seconds between samples and standards. If a memory interference is suspected, the sample must be reanalyzed after a rinse period of sufficient length. Alternate rinse times may be established by the analyst based upon their DQOs.

4.5 Other Interferences

4.5.1 Users are advised that high salt concentrations can cause analyte signal suppressions and confuse interference tests. If the instrument does not display negative values, fortify the interference check solution with the elements of interest at 0.5 to 1 mg/L and measure the added standard concentration accordingly. Concentrations must be within 20% of the true spiked concentration or dilution of the samples will be necessary. In the absence of measurable analyte, overcorrection could go undetected if a negative value is reported as zero.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Samples are collected in plastic bottles.

6.2 Sample Preservation

Samples for Total Metals are preserved with 1:1 Nitric acid to a pH of <2.

If samples are for Soluble Metals, they must not be preserved prior to filtration. They are preserved with 1:1 Nitric acid to a pH of <2 post-filter.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Samples to be analyzed for soluble metals, that have not been filtered, must be filtered and preserved within 24 hours of sample collection.

Preserved samples have a hold time of 6 months, and are stored at ambient temperature.

7. Equipment and Supplies

7.1 Inductively coupled argon plasma emission spectrometer:

- **Thermo Scientific ICAP Duo 6500 (Trace4, Trace5, Trace6)**

7.1.1 Computer-controlled emission spectrometer with background correction.

7.1.2 Radio-frequency generator compliant with FCC regulations.

7.1.3 Optional mass flow controller for argon nebulizer gas supply.

7.1.4 Optional peristaltic pump.

7.1.5 Optional Autosampler.

7.1.6 Argon gas supply - high purity.

7.2 Volumetric flasks of suitable precision and accuracy.

7.3 Volumetric pipets of suitable precision and accuracy.

8. Standards and Reagents

Reagent semiconductor and/or trace grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. If the purity of a reagent is in question, analyze for contamination. If the concentration of the contamination is less than the MDL then the reagent is acceptable.

8.1 Hydrochloric acid (conc), HCl. Stored at room temperature in acid resistant cabinet. Expiration date if defined by vendor.

8.2 Hydrochloric acid (1:1), HCl. Add 500 mL concentrated HCl to 400 mL DI water and dilute to 1 liter in an appropriately sized beaker. Stored at room temperature in polypropylene bottle, expiration date if defined by vendor..

8.3 Nitric acid (conc), HNO_3. Stored at room temperature in acid resistant cabinet. Expiration date if defined by vendor.

8.4 Nitric acid (1:1), HNO_3. Add 500 mL concentrated HNO_3 to 400 mL DI water and dilute to 1 liter in an appropriately sized beaker. Stored at room temperature in polypropylene bottle, expiration date if defined by vendor..

8.5 Reagent Water. All references to water in the method refer to reagent water unless otherwise specified. Reagent water will be interference free. Refer to Chapter One for a definition of reagent water.

8.6 Standard stock solutions may be purchased or prepared from ultra- high purity grade chemicals or metals (99.99% pure or greater). All stock standards are ordered through ISO and American Association for Lab Accreditation vendors. All standards are in aqueous solutions and are generally at concentrations of 1000ppm and 10,000ppm.

8.7 Mixed calibration standard solutions

Prepare mixed calibration standard solutions by combining appropriate volumes of the stock solutions in volumetric flasks. Add the appropriate types and volumes of acids so that the standards are matrix matched with the sample digestates. Care must be taken when preparing the mixed standards to ensure that the elements are compatible and stable together. Transfer the mixed standard solutions to FEP fluorocarbon or previously unused polyethylene or polypropylene bottles for storage. Fresh mixed standards must be prepared, as needed, with the realization that concentration can change on aging.

NOTE: If the addition of silver to the recommended acid combination results in an initial precipitation, add 15 mL of water and warm the flask until the solution clears. Cool and dilute to 100 mL with water. For this acid combination, the silver concentration must be limited to 2 mg/L. Silver under these conditions is stable in a tap-water matrix for 30 days. Higher concentrations of silver require additional HCl.
Additionally, sulfur standards are stand-alone single element standards and therefore are not to be combined in a mixed calibration standard solution.

8.8 Blanks

Two types of blanks are required for the analysis for samples. The calibration blank is used in establishing the analytical curve, and the method blank is used to identify possible contamination resulting from varying amounts of the acids used in the sample processing.

8.8.1 The calibration blank is prepared by acidifying reagent water to the same concentrations of the acids found in the standards. Prepare a sufficient quantity to flush the system between standards and samples. The calibration blank will also be used for all initial (ICB) and continuing calibration blank (CCB) determinations (see Sections 10.2 and 10.4). Refer to Section 10.4.1.2 for acceptance criteria and/or corrective actions.

8.8.2 The method blank must contain all of the reagents in the same volumes as used in the processing of the samples. The method blank must be carried through the complete procedure and contain the same acid concentration in the final solution as the sample solution used for analysis. Refer to Section 9.1 for acceptance criteria and/or corrective actions.

8.9 The Initial Calibration Verification Standard (ICV) and the Continuing Calibration Verification Standard (CCV)

These ICV is prepared by the analyst by combining compatible elements from a standard source different than that of the calibration standard. The CCV is prepared from the same source as the calibration standards and must be at a concentration near the mid-point of the calibration curve. At the laboratory's discretion, an ICV may be used in lieu of the continuing calibration verifications. If used in this manner, the ICV must be at a concentration near the mid-point of the calibration curve.

8.9.1 Low Level Initial Calibration Verification Standard (LLICV) and the Low Level Continuing Calibration Verification Standard (LLCCV)

These standards are actually a series of standards (typically 3) that are at or below the RL for the respective elements included in the calibration sequence. They are prepared from the same source as the calibration standards but at the laboratory's discretion may be from a second source from the calibration.

8.10 Interference Check Solution

These solutions are prepared to contain known concentrations of interfering elements that will provide an adequate test of the correction factors. Spike the sample with the elements of interest. In the absence of measurable analyte, overcorrection could go undetected because a negative value could be reported as zero. If the particular instrument will display overcorrection as a negative number, this spiking procedure will not be necessary.

8.11 CRI

The CRI is an ICP standard that is analyzed at a concentration of 2 - 5 times each element's RDL. The CRI must be recovered within 70-130% of its true value. If the CRI does not meet these criteria, it is remade and reanalyzed. If the CRI fails a second time, the analysis is terminated, the problem determined and corrected. The instrument is then recalibrated.

CRI solutions are made for each type of instrument.

8.11.1 CRI Stock Standard Solution, for the TJA Trace instruments

To a 500mL volumetric flask, add 200mL DI water and 50mL of 1:1 HNO_3. Add the following volumes of each certified 1000ppm stock standard:

Pb	0.9 mL	Ni	1.6 mL
Se	0.4 mL	Ag	0.4 mL
Sb	2.0 mL	Tl	0.4 mL
As	0.4 mL	V	2.0 mL
Ba	0.8 mL	Zn	0.8 mL
Be	0.2 mL	Al	8.0 mL
Cd	0.2 mL	Ca	8.0 mL
Co	2.0 mL	Mg	8.0 mL
Cr	0.4 mL	B	2.0 mL
Cu	1.0 mL	Sr	0.4 mL
Fe	4.0 mL	Ti	0.4 mL

Mn	0.6 mL	Sn	0.4 mL
Mo	2.0 mL		

And the following volumes of each certified 10000ppm stock standard:

K	10.0 mL
Na	10.0 mL
Si	2.0 mL
S	2.0 mL

Bring to volume of 500mL with DI water. This solution expires 12 months after the date of preparation.

8.11.1.1 CRI Working Standard Solution

To a 1L volumetric flask, add 25mL of CRI Stock Standard Solution (Section 8.11.1). Bring to volume with DI water. This solution will contain elements in the following concentrations:

Pb	0.045 ppm	Ag	0.02 ppm
Se	0.02 ppm	Tl	0.02 ppm
Sb	0.10 ppm	V	0.10 ppm
As	0.02 ppm	Zn	0.04 ppm
Ba	0.04 ppm	Al	0.40 ppm
Be	0.01 ppm	Ca	0.40 ppm
Cd	0.01 ppm	Mg	0.40 ppm
Co	0.10 ppm	B	0.10 ppm
Cr	0.02 ppm	Sr	0.02 ppm
Cu	0.05 ppm	Ti	0.02 ppm
Fe	0.20 ppm	Sn	0.02 ppm
Mn	0.03 ppm	K	5.0 ppm
Mo	0.10 ppm	Na	5.0 ppm
Ni	0.08 ppm	Si	1.0 ppm
S	1.0 ppm		

8.12 Reporting Limit (RL) Verification Standard (LLICV/LLCCV)

The RL standard consists of a series of standards that are analyzed after the initial calibration verification (LLICV) and at the end of each run (LLCCV). Optionally, the LLCCV may be run every 10 samples with the CCV, CCB pair to eliminate the need for excessive reruns when low level instrument stability is questioned. These standards are at or below the RL included in the multi-point calibration sequence. The acceptance criteria are 70-130% to establish the RL for each analyte. The following standards are analyzed.

0.005 mg/L	Ag, As, Be, Cd
0.010 mg/L	B, Ba, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sn, Sr, Ti, Tl, V
0.050 mg/L	Al, Sb, Fe, Zn, Ca, Mg, K, Na

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

Employ a minimum of one method blank per sample batch to determine if contamination or any memory effects are occurring. A method blank is a volume of reagent water carried through the same preparation process as a sample.

The method blank results must be less than the reported detection limit (RDL) for all analytes of concern. If the results of the method blank exceed the RDL for any analyte, perform re-analysis of a new aliquot of the method blank.

If the results continue to exceed the RDL, proceed as follows:

If all of the samples for the analyte are non-detected, and the method blank is at or above the RDL, no action is required.

If one or more associated samples for that analyte have positive results at or above the RDL, those samples must be considered to be out of control, and are re-digested and reanalyzed.

9.2 Laboratory Control Sample (LCS)

Analyze one LCSW/SRM per sample batch. A LCS/SRM sample is a spiked volume of reagent water that is brought through the entire preparation and analytical process. The LCSW must have a % Recovery of ± 20% within the actual value or within vendor control limits (95% confidence limits) for the solid SRM.

If the LCSW or SRM % Recovery is outside the acceptable limits as stated in Table 2, or outside any vendor control limits, the LCS is rerun once. If upon reanalysis the LCS is still out of control, the failed analytes are re-prepped and re-analyzed. Otherwise, a nonconformance report form is raised to document the exact problem and this form is then authorized by the QA/QC Director and/or the Laboratory Manager(s).

9.3 Initial Calibration Verification (ICV)

For all analytes and determinations, the laboratory must analyze an ICV (Section 8.9), and a calibration blank (ICB, Section 8.8.1), immediately following daily calibration. The results of the ICV are to agree within 10% of the expected value; if not, re-analyze once, if still failing terminate the analysis, correct the problem, and recalibrate the instrument.

9.4 Continuing Calibration Verification (CCV)

A calibration blank (CCB, Section 8.8.1) and a calibration verification standard (CCV, Section 8.9) must be analyzed after every tenth sample and at the end of the sample run. Analysis of the calibration verification (CCV) must verify that the instrument is within 10% of the calibration with the relative standard deviation < 5% from replicate (minimum of two) integrations.

Immediate corrective action for a failing CCV/CCB includes reanalyzing the failing standard. If the standard passes the second time then the analysis may be continued. The batch sheet is noted. If the standard fails again, instrument maintenance must be performed and the CCV/CCB standard is reanalyzed. If the standard passes, then all samples run after the last passing CCV/CCB pair must be re-analyzed.

If the standard fails after instrument maintenance, the instrument is recalibrated. A new ICV/ICB is performed, and all previous data after the last passing CCV/CCB is reanalyzed.

9.5 Matrix Spike

Analyze matrix spike samples at a frequency of one per matrix batch. A matrix spike sample is a sample brought through the entire sample preparation and analytical process.

9.5.1 The percent recovery is to be calculated as follows:

$$\% \text{ Recovery} = \frac{\text{MS} - \text{S}}{\text{C}} \times 100$$

where:

MS = Matrix Spike value
S = Sample value.
C = Concentration of the Spiking solution.

9.5.2 If the Matrix Spike falls outside of the limits as stated in Table 2, or outside any historical documentation for analytes of interest a post analytical spike is performed for the failed analytes. The same sample from which the MS/MSD aliquots were prepared should be spiked with a post digestion spike at a minimum level of 10 times and a maximum of 100 times the lower limit of quantitation. The acceptable % Recovery of the post analytical spike is 80-120%. A nonconformance is noted in the LIMS and approved in secondary peer review and/or by the Metals Manager.

9.5.3 If the Post Spike fails the dilution test should be performed**.** If the analyte concentration is sufficiently high (minimally, a factor of 10 above the lower limit of quantitation after dilution), an analysis of a 1:5 dilution should agree within ± 10% of the original determination. If not, then a chemical or physical interference effect should be suspected.

9.6 Laboratory Duplicate

A duplicate sample is analyzed once per matrix batch. This sample is brought through the entire sample preparation and analytical process.

9.6.1 The relative percent difference between duplicate determinations is to be calculated as follows:

$$\text{RPD} = \frac{| D, - D_2 |}{(| D, + D_2 |) / 2} \times 100$$

where:

RPD = relative percent difference.
D, = first sample value.
D_2 = second sample value (replicate).

9.6.2 If the Duplicate falls outside of the limits as stated in Table 2, or outside any historical documentation and the concentrations of the failing analytes are less than 5x the RL or a matrix interference is found a nonconformance is noted in the LIMS and approved in secondary peer review and/or by the Metals Manager.

9.7 Method-specific Quality Control Samples

9.7.1 Interference Check Standards

A check solution is analyzed once daily. One solution (ICSA) has only elevated concentrations of Fe, Al, Ca, Mg to ensure no interferences occur. The concentrations of the analytes of interest must have an absolute value of <2X RL. The other check solution (ICSAB) is the same solution spiked with a known amount of each analyte. These solutions are analyzed at the beginning of the first analytical run of the day.

If the analytes of interest in the ICSAB solution falls outside the acceptable limits of 80 – 120% of the true value, the solutions may be rerun once. The high level interferences are not evaluated for recovery just as in the ICSA. If the problem persists take corrective action which may include re-evaluation of the inter-element correction values (IECs). The instrument calibration routine must then be performed and confirmed by the ICV/ICB pair and the ICSA/ICSAB re-analyzed before proceeding with analysis. Otherwise, the nonconformance issue is raised to the Department Supervisor and/or the QA Department.

9.7.2 Reporting Limit (RL) Verification Standard (LLICV/LLCCV)

The RL standards are actually a series of standards that are analyzed at the beginning and at the end of each run. The lowest of the RL standards may be used to evaluate the sensitivity of reportable elements under method 6010C. This may be a low level client-specific analysis, or it may be the standard reporting limits for an aqueous sample or a soil/solid material. The standards must have a percent recovery of 70-130%. If an element fails the acceptance criteria to establish a specific RL, the RL standard may be re-analyzed. If the element failure continues, then either re-calibrate the instrument and rerun the affected samples or analyze the affected samples on another instrument with a passing RL verification standard for the element(s) of interest.

9.8 Method Sequence

- Calibration of instrument
- Initial Calibration Verification Standard
- Initial Calibration Blank
- LLICV
- Interference Check Solution A
- Interference Check Solution AB
- CRI
- Continuing Calibration Verification Standard
- Continuing Calibration Blank
- samples
- Continuing Calibration Verification Standard
- Continuing Calibration Blank
- Samples
- LLCCV
- Continuing Calibration Verification Standard
- Continuing Calibration Blank

10. Procedure

10.1 Equipment Set-up

10.1.1 Sample Preparation

Preliminary treatment of most matrices is necessary because of the complexity and variability of sample matrices. Groundwater samples which have been prefiltered and acidified will not need acid digestion. Samples which are not digested must either use an internal standard or be matrix matched with the standards.

10.1.2 Instrument Set-Up

Set up the instrument with proper operating parameters established as detailed below. The instrument must be allowed to become thermally stable before beginning (usually requiring at least 30 minutes of operation prior to calibration).

Startup Procedures

For iCAP Duo 6500

- Turn on power to the chiller
- Click on ThermoSpec Icon; enter analyst initials in login screen
- Click on Plasma icon to start instrument
- Allow to warm up for 30 minutes
- Enter analytical workgroup number (obtained from LIMS) globally under the Instrument menu by selecting Tools, then Options, then Analyst.
- Click on the Sequence tab and enter the sequence by selecting New Autosampler Table, Add Sequence, Add # of spaces.
- Enter the sample locations and IDs
- Press Run Auto-Session button (►) in menu bar.

10.1.2.1 Specific wavelengths are listed in Table 1. Other wavelengths may be substituted if they can provide the needed sensitivity and are corrected for spectral interference. The instrument and operating conditions utilized for determination must be capable of providing data of acceptable quality to the program and data user.

Operating conditions for axial plasma will vary from 1100 – 1500 watts forward power, 15-19 Liters/min argon coolant flow, 0.5 – 0.7 L/min argon nebulizer flow, 140 – 200 rpm pump rate and a default 1 minute preflush time and 10 second measurement time is recommended for all simultaneous instruments.

10.1.2.2 The plasma operating conditions need to be optimized prior to use of the instrument. This routine is not required on a daily basis, but only when first setting up a new instrument or following a change in operating conditions. The following procedure is recommended or follow manufacturer's recommendations. The purpose of plasma optimization is to provide a maximum signal to background ratio for some of the least sensitive elements in the analytical array.

The use of a mass flow controller to regulate the nebulizer gas flow or source optimization software greatly facilitates the procedure.

10.1.2.2.1 The Thermo ICP's typically use a Meinhard Nebulizer. The nebulizer flow for each instrument is 1.0 +/- 0.2 mL/min.

10.1.2.2.2 The 6500 Duo instruments automatically perform a wavelength check at start up without user interaction.

10.1.2.2.3 The instrument operating condition finally selected as being optimum must provide the lowest reliable instrument detection limits and method detection limits.

10.1.2.2.4 If either the instrument operating conditions, such as incident power or nebulizer gas flow rate are changed, or a new torch injector tube with a different orifice internal diameter is installed, the plasma and argon pressures must be reoptimized.

10.1.2.2.5 After completing the initial optimization of operating conditions, but before analyzing samples, the laboratory must establish and initially verify an interelement spectral interference correction routine to be used during sample analysis. A general description concerning spectral interference and the analytical requirements for background correction in particular are discussed in the section on interferences. Criteria for determining an interelement spectral interference is an apparent positive or negative concentration for the analyte that falls within ± the RDL. The upper control limit is the analyte instrument detection limit. Once established, the entire routine is periodically verified annually. In between that time, IEC's are done on a need be basis per analyte. Only a portion of the correction routine must be verified more frequently or on a daily basis. Initial and periodic verification of the routine must be kept on file. Special cases where continual verification is required are described elsewhere.

10.1.2.3 Sensitivity, instrumental detection limit, precision, linear dynamic range, and interference effects must be established for each individual analyte line on each particular instrument. All measurements must be within the instrument linear range where the correction equations are valid.

10.1.2.3.1 Method detection limits must be established for all wavelengths utilized for each type of matrix commonly analyzed. The matrix used for the MDL calculation must contain analytes of known concentrations within 3-5 times the anticipated detection limit.

10.1.2.3.2 Determination of limits using reagent water MDLs represent a best case situation and do not represent possible matrix effects of real world samples.

10.1.2.3.3 If additional confirmation is desired, reanalyze the seven replicate aliquots on two more non-consecutive days and again calculate the method detection limit values for each day. An average of the three values for each analyte may provide for a more appropriate estimate.

10.1.2.3.4 The upper limit of the linear dynamic range must be established for each wavelength utilized by determining the signal responses from a minimum for three, preferably five, different concentration standards across the range. One of these must be near the upper limit of the range. The ranges which may be used for the analysis of samples must be judged by the analyst from the resulting data. The data, calculations and rationale for the choice of range made must be documented and kept on file. The upper range limit must be an observed signal no more than 10% below the level extrapolated from lower standards. Determined analyte concentrations that are above the upper range limit must be diluted and reanalyzed. The analyst must also be aware that if an interelement correction from an analyte above the linear range exists, a second analyte where the interelement correction has been applied may be inaccurately reported. New dynamic ranges must be determined whenever there is a significant change in instrument response. The linear dynamic range is checked on an annual basis. For those analytes that are known interferences, and are present at above the linear range, the analyst must ensure that the interelement correction has not been inaccurately applied.

NOTE: Many of the alkali and alkaline earth metals have non-linear response curves due to ionization and self-absorption effects. These curves may be used if the instrument allows; however the effective range must be checked and the second order curve fit must have a correlation coefficient of 0.995 or better. Third order fits are not acceptable. These non-linear response curves must be revalidated and recalculated every six months. These curves are much more sensitive to changes in operating conditions than the linear lines and must be checked whenever there have been moderate equipment changes.

10.1.2.4 The analyst must (1) verify that the instrument configuration and operating conditions satisfy the analytical requirements and (2) maintain quality control data confirming instrument performance and analytical results.

10.2 Initial Calibration

Calibrate the instrument according to the instrument manufacturer's recommended procedures, using the typical mixed calibration standard solutions described in Section 8.7. Flush the system with the calibration blank (Section 8.8.1) between each standard or as the manufacturer recommends. (Use the average intensity of multiple exposures for both standardization and sample analysis to reduce random error.) The calibration curve consists of a calibration blank, RL standard and a high level standard. Calibration curve verification is accomplished through the analysis of the ICV, LLICV and CRI standards.

10.3 Equipment Operation and Sample Processing

10.3.1 For all analytes and determinations, the laboratory must analyze an ICV (Section 8.9), and a calibration blank (ICB, Section 8.8.1), immediately following daily calibration.

A calibration blank (CCB, Section 8.8.1) and a calibration verification standard (CCV, Section 8.9) must be analyzed after every tenth sample and at the end of the sample run. Analysis of the calibration verification (CCV) must verify that the instrument is within 10%

of the calibration with the relative standard deviation < 5% from replicate (minimum of three) integrations.

If the calibration cannot be verified within the specified limits, the sample analysis must be discontinued, the cause determined and the instrument recalibrated. All samples following the last acceptable ICB, ICV, CRI, CCV or CCB must be reanalyzed. The analysis data for the calibration blank, check standard, and ICV or CCV must be kept on file with the sample analysis data.

10.3.2 Rinse the system with the calibration blank solution (Section 8.8.1) before the analysis of each sample. The suggested default rinse time is one minute. Each ICP instrument may establish a reduction in this rinse time through a suitable demonstration.

10.3.3 Dilute and reanalyze samples that exceed the linear calibration range or use an alternate, less sensitive line for which quality control data is already established.

10.3.4 If less than acceptable accuracy and precision data are generated a series of tests are performed prior to reporting concentration data for analyte elements. At a minimum, these tests should be performed with each batch of samples prepared/analyzed with corresponding unacceptable data quality results. These tests, as outlined in Sections 10.3.4.1 and 10.3.4.2, will ensure that neither positive nor negative interferences are operating on any of the analyte elements to distort the accuracy of the reported values.

10.3.4.1 Post Digestion Spike Addition: If the matrix spike recoveries are unacceptable an analyte spike added to a portion of a prepared sample, or its dilution, must be run, recovery limits equal to 80% to 120% of the known spike value. The spike addition must produce a minimum level of 10 times and a maximum of 100 times the instrumental detection limit. If the spike is not recovered within the specified limits, a dilution test (10.3.4.2) should be performed. If both the MS/MSD and post spike fail then a matrix effect must be suspected.

10.3.4.2 Dilution Test: If the analyte concentration is sufficiently high (minimally, a factor of 10 above the lower limit of quantitation after dilution), an analysis of a 1:5 dilution must agree within ± 10% of the original determination. If not, a chemical or physical interference effect must be suspected.

10.3.5 **CAUTION:** If spectral overlap is suspected, use of computerized compensation, an alternate wavelength, or comparison with an alternate method is recommended.

10.4 Continuing Calibration

10.4.1 Check calibration with an ICV following the initial calibration (Section 8.9). Verify calibration with the Continuing Calibration Verification (CCV) Standard (Section 8.9) at the end of the initial calibration sequence (ICV, ICB, ICSA, ICSAB, CRI, project specific RDL standards), after every ten samples, and at the end of an analytical run. At the laboratory's discretion, an ICV may be used in lieu of the continuing calibration verifications. If used in this manner, the ICV must be at a concentration near the mid-point of the calibration curve. Use a calibration blank (Section 8.8.1) immediately following daily calibration, after every 10 samples and at the end of the analytical run.

A CRI (Section 8.11) must be analyzed after the ICSAB. The concentration of the CRI is 2 – 5 times that of each element’s RDL. The linearity of the instrument is confirmed on an annual basis by an LDR standard at +/-10% recovery.

10.4.1.1 The results of the ICV are to agree within 10% of the expected value, and CCVs are to agree within 10% of the expected value; if not, terminate the analysis, correct the problem, and recalibrate the instrument.

10.4.1.2 The results of the calibration blank are to agree within three times the IDL. If not, repeat the analysis two more times and average the results. If the average is not within three standard deviations of the background mean, terminate the analysis, correct the problem, recalibrate, and reanalyze the previous 10 samples. If the blank is less than 1/10 the concentration of the action level of interest, and no sample is within ten percent of the action limit, analyses need not be rerun and recalibration need not be performed before continuation of the run.

10.4.1.3 The results of the CRI must be within 30% of the true value. If they are not, correct the problem and recalibrate the instrument. (Any element may be analyzed on a different ICP that has passed the CRI.)

10.4.2 Verify the interelement and background correction factors at the beginning of each analytical run. Do this by analyzing the ICSA/ICSAB (Section 8.10). Results must be within 80 – 120% of the true value for the analytes of interest in the ICSAB.

10.4.3 When low-level sensitivity is required, a check standard at the requested limit of quantitation is analyzed to confirm the reported detection limit (RDL). This is performed on a project-by-project basis.

10.5 Preventive Maintenance

Whenever instrument maintenance is performed, it is noted in the instrument's Maintenance Logbook.

10.5.1 Daily

Inspect the nebulizer pump tubing from the Autosampler to the Nebulizer. Replace if necessary.

10.5.2 Monthly or as needed

Remove the torch, "shot glass", nebulizer and spray chamber. Clean each with 10% Nitric Acid and rinse with tap water. Coat the inside of the spray chamber and shot glass with concentrated Sulfuric Acid and soak for one hour, then rinse well with DI water. Soak the torch and nebulizer in aqua regia overnight, then rinse with DI water.

10.5.3 Every 6 months

Preventive Maintenance is performed by the Vendor or in-house personnel as follows:

- check the cooling system
- flush/refill the chiller with distilled water and antibacterial conditioner
- clean the instrument to regain intensity
- clean/replace air filters.

11. Data Evaluation, Calculations and Reporting

11.1 If dilutions were performed, the appropriate factors must be applied to sample values. All results must be reported with up to three significant figures.

11.2 Soil samples

Soil samples are calculated as follows:

$$\mathbf{A} = \frac{\text{Sample weight (grams)}}{\text{Final Volume (mL)}}$$

$$\mathbf{B}\ \text{(concentration in mg/Kg)} = \frac{\text{Concentration of analyte (mg/L)}}{\mathbf{A}}$$

11.2.1 Dry weight correction

The LIMS calculates the dry weight correction, however it is calculated as follows:

$$\text{Final concentration in mg/Kg dry weight} = \frac{\mathbf{B}}{\text{\% Solids}}$$

11.3 Liquid samples

Liquid samples are calculated as follows:

$$\text{Dilution Factor} = \frac{\text{Final Volume (mL)}}{\text{Sample Volume (mL)}}$$

$$\text{Final concentration in mg/L} = \text{Concentration of analyte (mg/L)} \times \text{Dilution Factor}$$

11.4 Calculations for Hardness

The method for determining hardness is to compute it from the results of separate determinations of Calcium and Magnesium on aqueous samples.

11.4.1 Total Hardness

Total Hardness, mg equivalent $CaCO_3$/L = [2.497 (Ca, mg/L)] + [4.118 (Mg, mg/L)]

11.4.2 Calcium Hardness

Calcium Hardness, mg equivalent $CaCO_3$/L = [2.497 (Ca, mg/L)]

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Also refer to Section 9 for Quality Control and acceptance criteria.

If the ICSA or ICSAB is outside of the 80 – 120% recovery window, then the standard is reanalyzed. If the standard failure continues, the IECs for the element/elements in question are reviewed and recalculated if necessary.

Immediate corrective action for a failing CCV/CCB includes reanalyzing the failing standard. If the standard passes the second time then the analysis may be continued. The raw data is noted. If the standard fails again, the problem must be found and corrected. The CCV/CCB standard is remade and reanalyzed. If the standard passes, then the data that had failed up to the previous passing standard is reanalyzed.

If the standard fails after instrument maintenance, the instrument is recalibrated. A new ICV/ICB is performed, and all previous data that had failed up to the previous passing CCV/CCB is reanalyzed.

The procedure outline above is also conducted for a failing LCS or Method Blank.

If the Matrix Spike does not meet acceptance criteria, a Post Spike is performed. The recovery must be within 80-120% of the true value for aqueous samples and within 80-120% of the true value for soil samples. If these criteria are met, then the Matrix Spike data is reported, with the post spike narrated on the final report. If the post spike fails the acceptance criteria, the Department Manager is notified to determine what type of matrix interference is present, and whether a serial dilution must be performed.

If sample Duplicates are outside of the acceptance criteria, the analyst examines the sample for homogeneity. If the sample is not homogenous, this is narrated on the final report. Clean, homogenous samples are redistilled and reanalyzed within holding time.

Sample nonconformance regarding a Matrix Spike recovery or a duplicate %RSD is narrated on the final report along with the corrective action(s) taken.

If the ICSA or the ICSAB are outside of the 80-120% window then the standard in question must be re-analyzed. If the standard failure continues, then check the IECs for the element(s) in question and re-calculate and recalibrate the instrument. The instrument is recalibrated, verified with the ICV/ICB and the ICSA/ICSAB are then re-analyzed. If the standard failure repeats, then a fresh standard is prepared and re-analyzed. If failure continues notify the Department Supervisor.

The RL standards must have a % Recovery of 70-130%. If an element fails the acceptance criteria, the RL standards may be re-analyzed if the element must be included in the analytical event. If the element failure continues, then either re-calibrate the instrument and rerun the affected samples or analyze the sample on another instrument.

If the CRI (low level check standard), is recovered outside of the 70-130% window, the standard may be re-analyzed if the element must be included in the analytical event. If the element failure continues, then either re-calibrate the instrument or analyze the sample on another instrument.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/08-05. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/08-12 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha’s Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP #1732 MDL/LOD/LOQ Generation

SOP# 1739 IDC/DOC Generation

SOP# 1728 Waste Management and Disposal

16. Attachments

TABLE 1: Element Wavelengths

TABLE 2: Precision and Accuracy Acceptance Criteria

TABLE 3: Reporting Limits

TABLE 1
ELEMENT WAVELENGTHS

Element	**6500 Duo wavelength (nm)**
Pb	220.3
Se	196.0
Sb	206.8
As	189.0
Ba	455.4
Be	313.0
Cd	214.4
Co	228.6
Cu	324.7
Cr	267.7
Fe	259.9
Mn	257.6
Mo	202.0
Ni	231.6
Ag	328.0
Tl	190.8
V	292.4
Zn	206.2
Al	396.1
Ca	315.8
Mg	279.0
B	208.9
Si	212.9
Sn	189.9
Sr	421.5
Ti	334.9
Bi	223.0
Na	589.5
K	766.4
S	180.7

TABLE 2
PRECISION AND ACCURACY ACCEPTANCE CRITERIA

	% Recovery LCS		Aqueous % Recovery MS		Soil % Recovery SRM		Duplicate	
Element	**Lower Control Limit**	**Upper Control Limit**	**Lower Control Limit**	**Upper Control Limit**	**Lower Control Limit**	**Upper Control Limit**	**Aqueous %RPD**	**Soil %RPD**
Aluminum	80	120	75	125	29	171	20	20
Antimony	80	120	75	125	4	196	20	20
Arsenic	80	120	75	125	81	119	20	20
Barium	80	120	75	125	83	118	20	20
Beryllium	80	120	75	125	83	117	20	20
Boron	80	120	75	125	70	129	20	20
Cadmium	80	120	75	125	82	117	20	20
Calcium	80	120	75	125	83	117	20	20
Chromium	80	120	75	125	80	119	20	20
Cobalt	80	120	75	125	83	117	20	20
Copper	80	120	75	125	83	117	20	20
Iron	80	120	75	125	51	150	20	20
Lead	80	120	75	125	80	120	20	20
Magnesium	80	120	75	125	74	126	20	20
Manganese	80	120	75	125	83	117	20	20
Molybdenum	80	120	75	125	81	119	20	20
Nickel	80	120	75	125	82	117	20	20
Potassium	80	120	75	125	74	126	20	20
Sulfur	80	120	75	125	NA	NA	20	20
Selenium	80	120	75	125	80	120	20	20
Silica (SiO_2)	80	120	75	125	NA	NA	20	20
Silver	80	120	75	125	66	134	20	20
Sodium	80	120	75	125	74	127	20	20
Strontium	80	120	75	125	80	120	20	20
Thallium	80	120	75	125	79	120	20	20
Tin	80	120	75	125	69	131	20	20
Titanium	80	120	75	125	82	118	20	20
Vanadium	80	120	75	125	79	121	20	20
Zinc	80	120	75	125	82	119	20	20

TABLE 3
REPORTING LIMITS

Element	**Aqueous (mg/L)**	**Soil (mg/Kg)**
ALUMINUM	0.10	4.0
ANTIMONY	0.05	2.0
ARSENIC	0.005	0.40
BARIUM	0.01	0.40
BERYLLIUM	0.005	0.20
BORON	0.03	1.2
CADMIUM	0.005	0.40
CALCIUM	0.10	4.0
CHROMIUM	0.01	0.40
COBALT	0.02	0.80
COPPER	0.01	0.40
IRON	0.05	2.0
LEAD	0.01	2.0
MAGNESIUM	0.10	4.0
MANGANESE	0.01	0.40
MOLYBDENUM	0.05	2.0
NICKEL	0.025	1.0
POTASSIUM	2.5	100
SULFUR	0.25	10
SELENIUM	0.01	0.80
SILICON	0.50	20
SILVER	0.007	0.40
SODIUM	2.0	80
STRONTIUM	0.01	2.0
THALLIUM	0.02	0.80
TIN	0.05	4.0
TITANIUM	0.01	0.40
VANADIUM	0.01	0.40
ZINC	0.05	2.0

Inductively Coupled Plasma - Mass Spectrometry

Reference Methods: **Method 6020,** Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update II, September 1994.

Method 6020A, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Draft Update IVA, May 1998.

1. Scope and Application

Matrices: Groundwaters, aqueous samples, industrial waste, soils, sludges, sediments, and other solid wastes.

Definitions: See Alpha Laboratories Quality Manual Appendix A

Inductively coupled plasma-mass spectrometry (ICP-MS) is applicable to the determination of sub µg/L concentrations of a large number of elements in water samples, waste extracts or digestates.

ICP-MS has been applied to the determination of over 60 elements in various matrices. Elements for which EPA has determined the acceptability of Method 6020 in a mulit-laboratory study on solid wastes are listed below and in Table 1.

If method 6020 is used to determine any analyte not listed in Table 1 below, it is the responsibility of the analyst to demonstrate the accuracy and precision of the method in the waste to be analyzed. The analyst is always required to monitor potential sources of interferences and take appropriate action to ensure data of known quality.

Use of this method is restricted to spectroscopists who are knowledgeable in the recognition and in the correction of spectral, chemical, and physical interferences in ICP-MS.

An appropriate internal standard is required for each analyte determined by ICP-MS. Recommended Internal standards are ^{6}Li, ^{45}Sc,^{89}Y,^{103}Rh,^{115}In,^{159}Tb,^{165}Ho, and ^{209}Bi. The Lithium internal standard must have an enriched abundance of 6Li, so that interference from Lithium native to the sample is minimized. Other elements may need to be used as internal standards when samples contain significant amounts of the recommended internal standards. The internal standard used in this method is as follows: ^{6}Li,^{45}Sc, ^{74}Ge,^{115}In, ^{209}Bi

TABLE 1

Parameter	CAS
Aluminum	7429-90-5
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Calcium	7440-70-2
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Iron	7439-89-6
Lead	7439-92-1

Parameter	CAS
Magnesium	7439-95-4
Manganese	7439-96-5
Mercury	7439-97-6
Molybdenum	7439-98-7
Nickel	7440-02-0
Potassium	7440-09-7
Selenium	7782-49-2
Silver	7440-22-4
Sodium	7440-23-5
Thallium	7440-28-0
Vanadium	7440-62-2
Zinc	7440-66-6

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Metals Manager, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the ICP-MS and in the interpretation of ICP-MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

When dissolved constituents are required, samples must be filtered and acid-preserved prior to analysis. No digestion is required prior to analysis for dissolved elements in water samples. Acid digestion prior to filtration and analysis is required for groundwater, aqueous samples, industrial waste, soils, sludge’s, sediments, and other solid wastes for which total (acid-leachable) elements are required.

Method 6020 describes the multi-elemental determination of analytes by ICP-MS. The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and introduced, by means of an interface, into the mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratio and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate a problem. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

2.1 Method Modifications from Reference

This method is performed in a 1% Nitric Acid matrix for the calibration curve and standards and a 2% Nitric Acid matrix for the rinse.

3. Detection Limits

The laboratory follows the procedure found in 40CFR Part 136 to determine the MDL on an annual basis. The method detection limits determined by the laboratory are on file for review.

Instrument detection limits, sensitivities, and linear ranges will vary with the matrices, instrumentation and operating conditions. In relatively simple matrices, detection limits will generally be below 20 µg/L.

4. Interferences

4.1 Isobaric Elemental Interference

Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z). A data system must be used to correct for these interferences. This involves determining the signal for another isotope of the interfering element and subtracting the appropriate signal from the analyte isotope signal. Since commercial ICP-MS instruments nominally provide unit resolution at 10% of the peak height, very high ion currents at adjacent masses can also contribute to ion signals at the mass of interest. Although this type of interference is uncommon, it is not easily corrected, and samples exhibiting a significant problem of this type could require resolution improvement, matrix separation, or analysis using another verified and documented isotope, or use of another method.

4.2 Isobaric Molecular and Doubly Charged Ion Interference

Isobaric molecular and doubly-charged ion interferences in ICP-MS are caused by ions consisting of more than one atom or charge, respectively. Most isobaric interferences that could affect ICP-MS determinations have been identified in the literature. Examples include $ArCl^+$ ions on the ^{75}As signal and MoO^+ ions on the Cadmium isotopes. While the approach used to correct for molecular isobaric interferences is demonstrated below using the natural isotope abundances form the literature, the most precise coefficients for an instrument can be determined form the ratio of the net isotope signals observed for a standing solution at a concentration providing suitable (<1 percent) counting statistics. Because the ^{35}Cl natural abundance of 75.77 percent is 3.13 times the ^{37}Cl abundance of 24.23 percent, the chloride correction for arsenic can be calculated (approximately) as follows (where the $^{38}Ar^{37}Cl^+$ contribution at m/z 75 is a negligible 0.06 percent of the $^{40}Ar^{35}Cl^+$ signal):

Corrected arsenic signal (using natural isotopes abundances for coefficient approximations) = (m/z 75 signal) – (3.13) (m/z 77 signal) + (2.73) (m/z) (82 signal), (where the final term adjust for any selenium contribution at 77 m/z)

Note: Arsenic values can be biased high by this type of equation when the net signal at m/z 82 is caused by ions other than $^{82}Se^+$, (e.g. $^{81}BrH^+$ from bromine waste)

Similarly, corrected cadmium signal (using natural isotopes abundances for coefficient approximations) = (m/z 114 signal) – (0.027) (m/z 118 signal) – (1.63) (m/z 108 signal), (where the last two terms adjust for any tin or MoO^+ contributions at m/z 114).

> **Note:** Cadmium values will be biased low by this type of equation when $^{92}ZrO^+$ ions contribute at m/z 108, but use of the m/z 111 for Cd is even subject to direct ($^{94}ZrOH^+$) and indirect ($^{90}ZrO^+$) additive interferences when Zr is present.
>
> **Note**: As for the arsenic equation above, the coefficients in the Cd equation are for only illustrative purposes. The most appropriate coefficients for an instrument can be determined from the ratio of the net isotope signals observed for a standard solution at a concentration providing suitable (<1 percent) counting precision.

The accuracy of these types of equations is based upon the constancy of the OBSERVED isotopic ratios for the interfering species. Corrections that presume a constant fraction of a molecular ion relative to the "parent" ion have not been found to be reliable, e.g. oxide levels can vary. If a correction for an oxide ion is based upon the ratio of parent –to-oxide ion intensities, the correction must be adjusted for the degree of outside formation by the use of an appropriate oxide internal standard previously demonstrated to form a similar level of oxide as the interferant. This type of correction has been reported for oxide-ion corrections using ThO^+/Th for the determination of rare earth elements. The use of aerosol desolvation and/or mixed plasmas has been shown to greatly reduce molecular interferences. These techniques can be used provided that method detection limits, accuracy, and precision requirements for analysis of the samples can be met.

4.3 Physical Interference

Physical interferences are associated with the sample nebulization and transport processes as well as with ion-transmission efficiencies. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. Changes in matrix composition can cause significant signal suppression or enhancement. Dissolved solids can deposit on the nebulizer tip of a pneumatic nebulizer and on the interface skimmers (reducing the orifice size and the instrument performance). Total solid levels below 0.2% (2,000mg/L) have been currently recommended to minimize solid deposition. An internal standard can be used to correct for the physical interferences, if it is carefully matched to the analyte so that the two elements are similarly affected by the matrix change. When the intensity level of an internal standard is less than 30 percent or greater than 120 percent of the intensity of the first standard used during calibration, the sample must be reanalyzed after a fivefold (1+4) or greater dilution has been performed.

4.4 Memory Interference

Memory interferences can occur when there are large concentration differences between samples or standards which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type of nebulizer affect the extent of the memory interferences which are observed. The rinse period between samples must be long enough to eliminate significant memory interferences.

5. Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, and Handling

6.1 Sample Collection

Only Polyethylene or fluorocarbon (PFA or TFE) containers are recommended. Alpha uses polyethylene bottles. 0.5L is the recommended size.

6.2 Sample Preservation

Samples for total metals are preserved with (1:1) Nitric Acid to a pH<2.

Samples for soluble metals must be preserved with (1:1) Nitric Acid to a pH of <2 **after** filtration through a 0.45 um filter.

6.3 Sample Handling

Samples that are to be analyzed for soluble metals, and have not been field filtered, must be filtered through a 0.45um filter as soon as possible. Samples are then preserved with 1:1 Nitric Acid to a pH<2, and then held for 18 hours. After the 18 hours the pH must be re-checked. If after 18 hours the pH is still >2, then the sample must be re-acidified and held again for 18 hours. If the pH is till >2 after this 18 hour period , then the Inorganics Manager must be told.

Samples preserved with Nitric Acid to a pH<2, and are not being analyzed for Mercury, have a hold time of 6 months.

Samples are stored at room temperature.

7. Equipment and Supplies

7.1 Agilent 7500a ICP-MS:

The ICP features a wide-diameter ICP torch injector for improved resistance to clogging with samples containing high dissolved solids levels. A high energy 27.12 MHz plasma, a solid state RF generator. Torch alignment is performed by auto-tuning software. The sample is introduced using an Agilent High Solids Nebulizer.

The MS features dual extraction lenses and a compound ion lens system that ensures a mass range from Li-U (masses 6-240). It also features the enhanced Omega II off-axis ion lens which gives mean random background of typically <2cps. The quadrapole rods produce an ideal true hyperbolic field, with digitally synthesized drive circuits to ensure faster scan speeds and greater stability to operate at high frequency –3MHz. The detector is a new electron multiplier operating simultaneously in pulse counting mode and analog mode. The log amplifier circuit extends dynamic range to 9 orders of magnitude with a high speed analog mode (minimum dwell time 100µsec) designed specifically for transient signal analysis. The software is ChemStation, it controls all instrument operations including tuning, data question, data analysis and reporting. The software provides the capability for qualitative, semiquantitive and quantitive analysis, as well as time-resolved, isotope ratio and isotope dilution analysis. A comprehensive array of autotune functions provide hands-free optimization of torch alignment, ion lenses, mass calibration and resolution, and detector calibration.

7.2 CETAC ASX-510 Autosampler: Delivers sample and internal standard to the torch

7.3 Thermo X-series II ICP-MS

The Innovative Protective Ion Extraction and Infinity II ion optics, based upon a hexapole design with chicane ion deflector, provides low background specification coupled with a user-interchangeable Xt interface and Xs interface. High-performance quadrupole analyzer is pumped by a novel split flow turbo pump backed by a single rotary. Simultaneous analog/PC detector with real time multi-channel analyzer electronics provides >8 orders of dynamic range suitable for both steady state and transient signal analysis. Instrument and accessories are fully computer controlled by the PlasmaLab software. Peltier spray chamber cooling provides enhanced performance for outstanding signal /background.

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7.4 ESI Autosampler with fast rinse system

Software driven sample delivery system with add gas system for added sensitivity.

7.5 Edwards E2M18 and E2M28 Rotary Pumps: Creates the necessary vacuum to operate the MS

7.6 Neslab M-75 Chiller: Cools the torch and the MS

7.7 Eppendorf pipets: Accurate means to make trace standards

8. Standards and Reagents

8.1 Nitric Acid (HNO_3), Trace metals grade: 18M Concentrated

8.2 1% Nitric Acid (v/v): 10mL of 18M HNO_3 diluted to 1L using Type I water

8.3 Type I De-Ionized Water

8.4 Calibration Standard: Multiple Element Standard, purchased (Table 4) and diluted. Store at room temperature. Expires upon manufacturer's specified date.

8.5 Internal Standard: Multiple Element Standard, purchased (Table 8). Store at room temperature. Expires upon manufacturer's specified date.

8.6 Tune Stock: Multiple Element Standard, purchased (Table 9). 100.0 ug/L solution of each ^{7}Li ^{9}Be, ^{58}Ce ^{59}Co, ^{115}In, ^{137}Ba and ^{208} Pb, and ^{238}U.

8.7 ICV/CCV: Multiple Element Standard, second source from calibration standard (Section 8.4) purchased and diluted (Table 10).

8.8 ICSA: High-Purity Standards Cat. #ICP-MS-ICS-2 A stock. Dilute 5 mL to 50 mL (Table 11). Store at room temperature.

8.9 ICSB: High-Purity Standards Cat. #ICP-MS-ICS-2 B. Dilute 0.5 mL to 50mL (Table 11). Store at room temperature.

8.10 ICSAB: Dilute 30 uL of ICSB stock in 3.0 mL of working ICSA solution (Table 11). Store at room temperature.

8.11 Argon Gas: 0.9995 or better grade. High capacity tank plumbed into the lab.

9. Procedure

9.1 Set-Up

9.1.1 Sample Preparation

Prior to analysis, samples which require total (acid-leachable) values must be digested using appropriate sample preparation methods, such as Methods 3005A, 3015, 3051 and 3050B.

9.1.2 Turning the instrument on from Stand By

- Tighten the peristaltic pump windings for the sample, Internal standard and spray chamber drain.
- Turn on the Argon gas supply and chiller.

Agilent 7500A:

- Turn on the computer, monitor. Once the computer has booted, the Agilent ICP-MS top page will be shown. At this page select "**Instrument control**" (Note: Standby mode is indicated here and also by a yellow light on the front of the instrument.) From the "**Instrument control**" select "**Plasma**". From "**Plasma**" select "**Plasma On**".
- The instrument will start automatically and go into **"Analysis Mode"** which will be indicated on the instrument control page and on the instrument when the yellow light turns green. The autosampler probe should be in the autosampler rinse at position #1, and the internal standard should be blank. The autosampler can be positioned by selecting **"ALS"** from the **"Instrument control"**.

Thermo X-series II:

- Turn on the computer and monitor. Start the Plasmalab software. On the front instrument tab select the ON button. A message box will ask if to advance from vacuum to start up, select OK. The fully automatic system will advance to ignition, torch box alignment and start the sample introduction system.
- Allow the instrument to warm up for **30 minutes**.

9.2 Tuning

9.2.1 After the 30 minute warm up period has passed, a daily tune must be performed and a report generated.

Agilent 7500A:

This tuning solution (Section 8.6) must be analyzed **four** times with relative standard deviations of **less than or equal to 5%** for the analytes contained in the tuning solution (^{7}Li, ^{89}Y, ^{205}Tl). The tuning solution also acts as a **Daily Performance Check Solution**, and serves as a **check on oxide interferences and double charged ion interferences; the criteria is <3%** **Note**: Precautions must be taken to protect the channel electron multiplier from high ion currents. The channel electron multiplier suffers from fatigue after being exposed to high ion currents. This fatigue can last form several seconds to hours depending on the extent of exposure. During this time period, response factors are constantly changing, which invalidates the calibration curve, causes instability, and invalidates sample analysis.

9.2.2 The mass calibration and resolution check is also performed during the tuning. The mass calibration and resolution parameters are required criteria which must be met prior to any samples being analyzed. If the mass calibration differs more than 0.1 amu from the true value, then the mass calibration must be adjusted to the correct value. The resolution must also be verified to be less than 0.9 amu full width at 10 percent peak height.

9.2.3 The stock tune solution (Section 8.6) is a 10 µg/L solution of **Li, Y, Ce** and **Tl** and is located at position #3 on the **"ALS"** which is accessed from the **"Instrument control"**

9.2.3.1 When the solution has been introduced to the plasma, select **"Instrument Control"** and then **"Tune".**

9.2.4 The **Sensitivity Tuning Page** will come up on the screen showing masses **7, 89** and **205**. Click **"START"** to begin the tuning. ***Caution:*** Typical tune parameters and a sample tune report are shown below to be an example. However, a detailed explanation of the tuning is found in the Agilent Users Manual pages 4.2 through 4.19. This chapter introduces the theory and mechanics of the tune. The physics involved in the tune and the effects of the tune on the calibration. This chapter must be read and understood by any operator before going any further. This manual will be found next to the computer near the spectrophotometer. When the analyst is satisfied that the tune has passed all of the quality control measures, then a tune report is generated and kept on file. To generate the report do the following from the **"Instrument Control"** page: go to **"Tune"** and then to **"Autotune"** and then **"Run"**. Make sure that these items are selected for the report: EM, ADJUST DISCRIMINATOR, RESOLUTION / AXIS, TUNING REPORT. The remaining autotune parameters such as TORCH VERTICAL / HORIZONTAL and LENS / PLASMA are easier to perform manually prior to running autotune and must not be selected.

9.2.5 The Analytical Sequence can now be started. In most instances, an analytical sequence will be set up and run automatically from an autosampler table and will consist of the following blocks: **CALIBRATION**: for the calibration standards. **SAMPLES:** Unknown samples with periodic QC checks (ICV, ICB, ICSA, ICSB, CCV, CCB). **TERM:** Termination block which instructs the instrument to perform certain functions when the analysis is complete. Usually this will consist of a final CCV/CCB and either shutdown or wait for further instruction.

9.2.6 When an acceptable tune has been achieved, a **pulse/analog** tune must be performed. This helps prevent damage to the detector by establishing the switching point between pulse mode and the analog mode. This tune is also necessary to achieve accurate quantification of result. From the **ALS** page move the autosampler to the 100 µg/L Calibration Standard. The internal standards must be present. From **"Instrument Tune"** select **"P/A Factor"** then select **"Run".** A new list of factors will be shown on the monitor. Close this screen and it will ask if you would like to save these new factors. Select **"Yes"**.

Thermo X-series II:

Continuing on the instrument tab, select autotune, introduce the Tune A solution The Instrument stock tune solution (Table 9) is a 10 µg/L, Tune A is a 10 fold dilution. Run the autotune after a minimum 40 second uptake delay.

From the drop down menu select Run Performance Check with the sample probe in Tune A solution. After completion of the performance check, select print and the file will be save to the archive. Upon successfully passing the performance check the instrument is ready for calibration.

Typical values of tuning parameters

Parameter	Typical Conditions	Adjustment
RF Power (W)	1300	1200 to 1600
Sampling Depth (mm)	6	4 to 8
Carrier gas (L/min)	1.2	0.8 to 1.3
Makeup gas (L/min)	0	0 to 0.4
Peri-pump 1 (rps)	0.1	0.06 TO 0.15
S/C Temp (°C)	2	Normally used at 2 °C
Extraction	-150	-200 to -100
Extraction	-70	-150 to -10
Einzel 1.3 (V)	-100	-130 to -40
Einzel 2(V)	7	-20 to +70
Omega Bias (V)	-35	-40 to 0

Omega (+)(V)	5	0 to +30

Typical value of Sensitivity and RSD (Using the normal torch)

Mass	Counts / 10ppb Integ. Time = 0.1 sec	RSD
^{7}Li	>6400	<5%
^{89}Y	>16000	<5%
^{205}Tl	>9600	<5%

9.3 Initial Calibration (ICV / ICB)

Mixed calibration standard solutions are prepared by diluting the stock-standard solutions to levels within the linear range for the instrument in a solvent consisting of 5% HNO_3 (v/v) in reagent water. The calibration standard solutions must contain a suitable concentration of an appropriate internal standard for each analyte. Internal standards are added at the time of analysis using a second channel of the peristaltic pump and an appropriate mixing manifold. Generally, an internal standard must be no more than 50amu removed from the analyte. Alpha employs the following internal standards: ^{6}Li, ^{45}Sc, ^{74}Ge, ^{115}In and ^{209}Bi.

Prior to preparing the mixed standards, each stock solution must be analyzed separately to determine possible spectral interferences or the presence of impurities. Care must be taken when preparing the mixed standards that the elements are compatible and stable. Transfer the mixed standard solutions to freshly acid-cleaned FEP fluorocarbon bottles for storage. Fresh mixed standards must be prepared as needed with the realization that concentrations can change upon aging. Calibration standards must be initially verified using a quality control standard (ICV), and monitored weekly for stability.

Calibrate the instrument for the analytes of interest (recommended isotopes for the analytes in Table 1 are provided in Table 3), using the calibration blank (Section 10.4.1) and the set of 6 standards (see Table 4.). The analytical range brackets an RDL of 0.2 µg/L to 500 µg/L with the exceptions of Fe, K, Na, Ca and Mg which bracket the range of 10µg/L to 50,000µg/L. All solutions and standards are prepared in a 1% Nitric Acid matrix. The calibration is defined as the calibration blank and five standards. The only standards that may be discarded in the calibration are the first standard (the low standard) and the fifth standard (the high standard). The only instance when the standard may be discarded is if the linearity of the element in question does not meet the correlation coefficient acceptance criteria of 0.995 or greater. No mid-level standards are ever discarded. The LDR is defined by the LDR study, no sample is to exceed 90% of the top LDR standard or a dilution must be performed. All standards, QC samples and samples are to be integrated three times and then averaged. The calibration block is part of the analytical sequence and includes an ICV and an ICB immediately following the analysis of the calibration standards. The calibration block can also contain a pause so that the analyst can evaluate the calibration prior to sample analysis. The routine calibration sequence is as follows:

Blank #1
Cal blank
0.2 µg/L std (10 µg/L Fe, K, Na, Ca, Mg)
1.0 µg/L std (100 µg/L Fe, K, Na, Ca, Mg)
10.0 µg/L std (1000 µg/L Fe, K, Na, Ca, Mg)
120 µg/L std (12,000 µg/L Fe, K, Na, Ca, Mg)
250.0 µg/L std (25,000 µg/L Fe, K, Na, Ca, Mg) this standard is optional in the calibration, it extends the calibration range.

500.0 µg/L std (50,000 µg/L Fe, K, Na, Ca, Mg) this standard is optional in the calibration, it further extends the calibration range.

The quality control standard is the Initial Calibration Verification solution (ICV), which must be prepared in the same acid matrix as the calibration standards. This solution must be an independent standard near the midpoint of the linear range at a concentration other than that used for instrument calibration. An independent standard is defined as a standard composed of analytes from a source other than that used for the standards for instrument calibration.

Immediately after the calibration has been established, the calibration must be verified and documented for every analyte by the analysis of the Initial Calibration Verification solution (ICV) (Section 8.7). The calibration is verified if the solution is within the 10% of the true value (Table 5.) for each element. See Section 12 for corrective action if the ICV fails. The ICB/CCB (10.4.1) are analyzed immediately following the ICV/CCV. The ICB/CCB must be no greater than ± |RL| for any analyte. See Sections 12.4, 12.5 and 12.6 for Corrective Actions.

9.4 Interference Check Solution (ICSA and ICSAB)

The interference check solution (ICS) is prepared to contain known concentrations of interfering elements that will demonstrate the magnitude of interference and provide an adequate test of any corrections.

Chloride in the ICS provides a means to evaluate software corrections for chloride-related interferences such as $^{35}Cl^{16}O^+$ on $^{51}V^+$ and $^{40}Ar^{35}Cl^+$ on $^{75}As^+$.

Iron is used to demonstrate adequate resolution of the spectrometer for the determination of manganese.

Molybdenum serves to indicate oxide effects on cadmium isotopes.

The other components are present to evaluate the ability of the measurement system to correct for various molecular-ion isobaric interferences. The ICS is used to verify that the interference levels are corrected by the data system within quality control limits. The ICSA solution (Section 8.8) contains 20,000mg/L of Cl^- , 3,000 mg/L of Ca, 2,500 mg/L of Fe and Na, 2,000 mg/L of C, 1,000 mg/L of Al, K , Mg, P, S and 20 mg/L of Mo and Ti. The ICSAB (Section 8.9) solution contains ICSA plus the addition of 0.1 mg/L of As, Cd, Zn, Se 0.2 mg/L Cu, Mn V, Cr, Ni, Co, 0.05 mg/L Ag.

The non-target analytes for the ICSA should have a recovery less than 10ppb, and the spiked analytes for the ICSAB should be recovered within ±20% of the true value. Narrate non-conformance.

9.5 Sample Analysis and Continuing Calibration Verification (CCV)

Sample analysis takes place from the **"Samples"** block. When filling out the autosampler table in the tuning section (Section 9.2.6), fill in the block for "Samples". This will run the ICV, ICB, ICSA, ICSAB, samples and CCV and CCB. After the initial Instrument QC has been analyzed and passed, then 10 samples will be analyzed. After the tenth sample has been analyzed, a CCV and a CCB will be analyzed. Analysis of standards and samples must only take place when the instrument has come to equilibrium. All masses which could affect data quality must be monitored to determine potential effects from matrix components on the analyte peaks. The recommended isotopes to be monitored are listed in Table 3. When the analysis is ready to start, flush the system with the rinse blank solution (Section 10.4.3) until the signal levels return to the method's level of quantitation (usually about 30 seconds) before the analysis of each sample. Nebulize each sample until a steady-state signal is achieved (usually in about 30 seconds) prior to collecting the data. Analyze the Continuing Calibration Verification solution (CCV) (Section 8.7) and the continuing Calibration blank (Section 10.4.1) at a frequency of at least once per ten analytical samples, and at the end of the analytical run. Flow injection systems may be used as long as they meet the performance criteria of this method. Dilute and reanalyze samples that are more concentrated than the linear range (or species needed for a correction) or measure an alternate less-abundant isotope. The linearity at the alternate mass must be confirmed by appropriate calibration.

9.6 Scheduled Maintenance

The scheduled maintenance is automatically tracked by the run time log for the following parameters. A message will appear on the computer screen reminding the analyst that a piece of maintenance must be performed. An electronic log, along with a maintenance notebook is kept. Below is a list what needs to be performed:

1. Check rough pump oil
2. Replace rough pump oil
3. Replace mist filter
4. Clean the Einzel lenses (Agilent only)
5. Clean the extraction lenses
6. Clean the skimmer cone
7. Clean the sampling cone
8. Clean the nebulizer
9. Clean the spray chamber
10. Inspect pump tubing for the samples and the internal standards daily, replace as needed
11. The cones are soaked in Citrinox for 15-20 minutes when carryover becomes a problem, the use of a sonicator is optional.

9.7 Calculations

The quantitative values are reported in appropriate units directly from the instrument: micrograms per liter (µg/L) for aqueous samples and milligrams per kilograms (mg/Kg) for solid samples. If dilutions were performed, the appropriate corrections must be applied to the sample values.

9.7.1 It is required that results for solids be reported on a dry weight basis as follows:

A separate determination of percent solids is performed by the Wet Chemistry Department and the result is loaded in the **LIMS**. To retrieve the result in the LIMS, go to **"Status"** and type in the sample ID. Click the sample number that is part of that sample ID, and click the product that says **TS-S**. The percent solids for the sample is there. LIMS will automatically correct the sample for percent solids after the metals analysis has been **Final Metals Reviewed.** This is the calculation:

$$\text{Concentration (dry weight) (mg/Kg)} = \frac{C \times V}{W \times S}$$

Where:
C= Digest Concentration (mg/L)
V= Final volume in Liters after sample preparation
W= Weight in Kg of wet sample
$S = \frac{\%\text{Solids}}{100}$

Calculations must include appropriate interference corrections (see Section 4.1 for examples), internal-standard normalization, and the summation of signals at 206, 207, and 208 m/z for Lead (to compensate for any differences in the abundances of these isotopes between samples and standards).

9.7.2 Calculate Percent Recovery for the Matrix Spike

9.7.2 Calculate Percent Recovery for the Matrix Spike corrected for concentrations measured in the unfortified sample. Percent recovery is calculated using the following equation:

$$\% \text{ Recovery} = \frac{(Cm - C)}{s} \times 100$$

Where:

Cm = measured Mercury in the fortified sample
C = measured native mercury sample concentration
S = concentration equivalent of spike added to sample

9.7.3 Calculate the Relative Percent Difference (RPD) for each Duplicate of the initial quantitated concentration (IC) and duplicate quantitated concentration (Dc) using the following formula:

$$RPD = \frac{|(IC - Dc)|}{\{(IC + Dc) / 2\}} \times 100$$

10. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a calibration verification standard is used to confirm the measurements were performed in an in-control mode of operation.

10.1 Demonstration of Capability

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. Each time a method modification is made, the analyst is required to repeat the procedure.

When one or more of the parameters tested fail at least one of the acceptance criteria, the analyst must locate and correct the source of the problem and repeat the test for failed parameters of the method.

Repeated failure confirms a general problem with the measurement system or analytical technique of the analyst. If the failure repeats, locate and correct the source of the problem and repeat the test for all parameters listed in the method.

10.2 Instrument Detection Limits (IDLs)

Instrument detection limits (IDLs) are useful means to evaluate the instrument noise level and response changes over time for each analyte from a series of reagent blank analyses to obtain a calculated concentration. They are not to be confused with the lower limit of quantitation, nor should they be used in establishing this limit. It may be helpful to compare the calculated IDLs to the established lower limit of quantitation, however, it should be understood that the lower limit of quantitation needs to be verified.

Instrument Detection limits (in µg/L) can be estimated by calculating the average of the standard deviations of the three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day. Each measurement must be performed as though it were a separate analytical sample (i.e. each measurement must be followed by a rinse and/or any other procedure normally performed between the analysis of separate samples). IDLs should be determined at least every three months and kept in the instrument log book.

10.3 Internal Standards

The intensities of all internal standards must be monitored for every analysis. If the intensity of any internal standard applied to a sample falls below 70% of the intensity of that internal standard in the initial calibration standard, a significant matrix effect must be suspected.

Under these conditions, the established lower limit of quantitation has degraded and the correction ability of the internal standardization technique becomes questionable. The following procedure is followed -- First, make sure the instrument has not drifted by observing the internal standard intensities in the nearest calibration blank.

If the low internal standard intensities are also seen in the nearest calibration blank, terminate the analysis, correct the problem, recalibrate, verify the new calibration, and reanalyze the affected samples. If drift has not occurred, matrix effects need to be removed by dilution of the affected sample. The sample should be diluted fivefold (1+4) and reanalyzed with the addition of appropriate amounts of internal standards. If the first dilution does not eliminate the problem, this procedure must be repeated until the internal-standard intensities rise to the minimum 70% limit. Reported results must be corrected for all dilutions.

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10.4 Blank

Three types of blanks are required for the analysis. The calibration blank, which is also the ICB/CCB, is used in establishing the calibration curve. The ICB/CCB is used to monitor carryover, signal noise, and drift. The preparation blank is used to monitor for possible contamination resulting from the sample preparation procedure. The rinse blank is used to flush the system between all samples and standards. See Section 12.3 for Corrective Action.

10.4.1 The Calibration blank, Initial Calibration Blank and the Continuing Calibration Blank consists of the same concentration of the same acid used to prepare the final dilution of the calibrating solutions of the analytes. This is a 1% HNO_3 solution (v/v) in Type I de-ionized water along with the selected concentrations of internal standard element for each of the analytes. The Calibration Blank is analyzed before the standards are analyzed. The Initial Calibration Blank must follow the Initial Calibration Verification standard (ICV) and the Continuing Calibration Blank must follow the Continuing Calibration Verification standard (CCV). These must be analyzed at a frequency of every 10 or less samples and at the end of the analytical run. The ICB/CCB must be no greater than ± |RL| for any analyte. See Section 12.11 for Corrective Action.

10.4.2 The preparation (or reagent) blank must be carried through the complete preparation procedure and contain the same volumes of reagents as the sample solutions. Results for the preparation blank must be less than the RL for any analyte. See Section 12.8 for Corrective Action.

10.4.3 The rinse blank consists of HNO_3 (1% or 2%) (v/v) in reagent water. Prepare a sufficient quantity to flush the system between standards and samples.

10.5 Calibration Verification (ICV/CCV) and Laboratory Control Samples (LCS)

The ICV and CCV must have a recovery that is within ±10% of the true value. The ICV and the CCV are from the same solution, and must contain all of the elements that are calibrated. The ICV/CCV is an independent source other than those standards used for the calibration of the instrument. The ICV must be analyzed following the calibration. The CCV must be analyzed at a frequency of 10 samples or less and at the end of the analytical run. The Laboratory Control Sample (LCS) must be analyzed for each analyzed for each analyte using the same sample preparations, analytical methods and QA/QC procedures employed for the test samples. One LCS must be prepared and analyzed for each sample batch at a frequency of one LCS for each 20 samples or less. Aqueous LCS recoveries must be 80-120%, and soil LCS recoveries must be 70-130%. See Sections 12.9 and 12.10 for Corrective Actions.

10.6 Interference Check Standards

Verify the magnitude of elemental and molecular-ion isobaric interferences and the adequacy of any corrections at the beginning of an analytical run or once every 12 hours, whichever is more frequent. Do this by analyzing the interference check solutions A and AB (9.4). The analyst must be aware that precipitation from solution AB may occur with some with some elements, specifically silver. Refer to Section 4.0 for a discussion on interferences and potential solutions to those interferences if additional guidance is needed. ICSAB must have a recovery of 80-120%. See Section 12.7 for Corrective Action.

10.7 Matrix Spike

Analyze one matrix spike per twenty or less analytical samples. The recovery of the matrix spike must be between 75 – 125%. Calculate percent recovery using Section 9.7.2.

10.7.1 Post Digestion Spike Addition: If the matrix spike recoveries are unacceptable an analyte spike added to a portion of a prepared sample, or its dilution, must be run, recovery limits equal to 80% to 120% of the known spike value. The spike addition must produce a minimum level of 10 times and a maximum of 100 times the instrumental detection limit. If the spike is not recovered within the specified limits, a dilution test (10.3.4.2) should be performed. If both the MS/MSD and post spike fail then a matrix effect must be suspected.

10.7.2 Dilution Test: If the analyte concentration is sufficiently high (minimally, a factor of 10 above the lower limit of quantitation after dilution), an analysis of a 1:5 dilution must agree within ± 10% of the original determination. If not, a chemical or physical interference effect must be suspected.

10.9 Duplicates

Analyze one duplicate sample for every matrix in a batch at a frequency of one matrix duplicate for every 20 samples. Calculate RPD under section 9.7.3.
A control limit of 20% RPD must not be exceeded for analyte values greater than 100 times the instrument detection limit (Section 10.2). See Section 12.14 for Corrective Action.

10.10 Control Limits

The laboratory maintains performance records to document the quality of data that is generated. Method accuracy for samples is assessed and records maintained. After the analysis of 20 spiked samples, and 20 laboratory control samples, calculate the average percent recovery (R) and the standard deviation of the percent recovery (S).

Control limits for the method parameters are generated by the QC staff and distributed to the analysts. The control limits are calculated based on in-house performance data. The limits are compared to the control limits found in the reference method.

10.11 Analytical Sequence

Performance Check Solution / Tuning Solution

Calibration of instrument

Initial Calibration Verification Standard

Initial Calibration Blank

Interference Check Solution A

Interference Check Solution AB

Continuing Calibration Verification Standard

Continuing Calibration Blank

Samples (10)

Continuing Calibration Verification Standard

Continuing Calibration Blank

11. Method Performance

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL concentrations were obtained using reagent water in 5% HNO_3 (except for Antimony and Silver which use 3:1 HNO_3:HCl. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

Method performance data is on file in the laboratory QC department. Comparison of method performance data for the laboratory to the reference method criteria occurs when laboratory in-house acceptance limits are generated. In-house generated data must be within the specifications of the reference method or the analysis is not continued until corrective action is completed.

12. Corrective Actions

Holding time exceedances, improper preservation and observed sample headspace are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

12.1 The performance check standard is included in the tuning solution. Ce and Ba are included with the tuning solution and monitor the formation of oxides and the effect of doubly-charged ions respectively. If the solution fails >3% (Section 9.2.1) then instrument maintenance must be performed and the solution re-run.

12.2 For the Tune to pass, the mass calibration for the three tune elements (Section 9.2.1) must not differ by more than 0.1 amu from the true value and the resolution must be <0.9 amu full width at 10% peak height. Furthermore the RSD for the three tune elements must be <5% If any of these criteria fail then the mass calibration must be adjusted to the correct value. This is done by re-optimizing the instrument conditions and re-tuning.

12.3 The results of the calibration blank (Section 10.4.1) must be less than 3 times the current IDL for each element. If this is not the case, the reason for the out-of-control condition must be found and corrected, and affected samples must be reanalyzed. If the laboratory consistently has concentrations greater than 3 times the IDL, the IDL may be indicative of an estimated IDL and must be re-evaluated.

12.4 Calibration is performed after the tune passes. A five point calibration is performed (Section 9.3). If more than three points are to be used for the calibration, then the resultant curve must have a correlation coefficient (cc) of 0.995 or greater. If the cc is <0.995, then the instrument must be re-optimized and re-calibrated. The calibration must define the working linear range of the curve. The reporting RL must be the low standard, and the upper linear range must be defined by the high standard.

12.5 The ICV (Section 9.3) is performed immediately after an acceptable calibration has been produced. The acceptable range for this standard is 90-110%. If this standard fails then the analysis must be stopped and the instrument re-calibrated, and the ICV re-analyzed. Analysis cannot continue until this standard passes.

12.6 The ICB (Section 10.4.1) must be performed immediately after the ICV. The ICB must be < Reporting Limit. If the ICB fails then the analysis is terminated, sources of contamination are checked for, and the instrument is re-calibrated and the ICV and ICB are re-analyzed.

12.7 The Interference Check Solutions (Section 10.6), ICSA and ICSAB monitor how well the system is correcting for interference. The target elements in ICSA must be below the RL for those elements in question. Solution ICSAB must have a % recovery of 80-120% for the target elements. If the recovery of these solutions is outside of the control limits, the non-compliance must be narrated. There is no corrective action required because instrument corrections are based on natural isotope abundances that cannot be changed. If the IS is in compliance then the data is acceptable.

12.8 The Method (Preparation) Blank (Section 10.4.2) must be less than the RL for all of the elements that are being analyzed. If the element in question is non-detect, and the method blank is positive then the corrective action is a narration on the final report. If the samples associated with the method blank have “hits”, and they are 10x greater then the method blank, then the corrective action is a narration on the final report. If the method blank is not less than the RL, and the associated samples have results that are greater then the RL but less than 10x the method blank, then the samples must be re-digested and re-analyzed.

12.9 If the LCS (Section 10.5) fails, then all samples associated with that batch must be re-digested and re-analyzed. (Massachusetts recognizes that if the MS passes and the LCS fails then the data can be accepted. Narrate then non-compliance. This is only for MCP projects)

12.10 Failure of the CCV (Section 10.5), rerun once, if continued failure, terminate the analysis immediately, correct the problem, and re-calibrate and re-analyze all samples since the last compliant CCV.

12.11 Failure of the CCB (10.4.1) rerun once, if continued failure evaluate the data; if associated sample results are greater than 10x CCB level then the results are acceptable. Otherwise, re-calibrate and re-analyze all samples since last compliant CCB.

12.12 If the dilution test (Section 10.7) fails, then an interference may be suspected. There is no corrective action to be applied. Narrate the non-compliance on the final report if the sample concentration is >50x RL.

12.13 If the Post–Digestion Spike (Section 10.8) fails, then matrix interference may be suspected and a dilution should be performed to confirm. Narrate the non-compliance on the final report.

12.14 Failure of the duplicate sample (Section 10.9) must be investigated. If the sample is found to be non-homogeneous then the non-compliance must be narrated on the final report. If the sample is aqueous in nature or a homogenous soil, then the duplicates must be re-digested and re-analyzed and the non-compliance narrated on the final report.

12.15 If the Internal Standards (Section 10.3) fail the acceptance criteria, then dilute the samples until the IS passes. If the criteria are still not met, then terminate the analysis, re-calibrate, verify the new calibration, and reanalyze all of the affected samples. If IS continues to fail at dilutions, seek an alternate technology to analyze the affected samples.

13. Pollution Prevention

See Chemical Hygiene Plan for pollution prevention operations.

14. Waste Management

See Chemical Hygiene Plan for waste handling and disposal.

15. Attachments

Table 2: Detection Limits
Table 3: Interference Check Solution Concentrations
Table 4: Calibration Standards
Table 5: Recommended Isotopes for Selected Elements
Table 6: Precision and Accuracy Acceptance Criteria
Table 7: Metals LCS Concentrations
Table 8: Internal Standard
Table 9: Tune Solution
Table 10: ICV / CCV Solution
Table 11: Interference Check Solutions
Table 12: Interference Correction Equations

Table 2
Detection Limits

Element	Atomic Symbol	Mass (m/z)	Aqueous (µg/L)	Soil / Solid (ug/Kg)
Beryllium	Be	9	0.5	20
Sodium	Na	23	100	4000
Magnesium	Mg	24	100	4000
Aluminum	Al	27	10	400
Potassium	K	39	100	4000
Calcium	Ca	44	100	4000
Vanadium	V	51	0.50	20
Chromium	Cr	52	0.50	20
Manganese	Mn	55	0.50	20
Iron	Fe	57	50	2000
Cobalt	Co	59	0.50	20
Nickel	Ni	60	0.50	20
Copper	Cu	65	0.50	20
Zinc	Zn	66	5.0	100
Arsenic	As	75	0.50	20
Selenium	Se	82	0.50	20
Molybdenum	Mo	98	0.50	20
Silver	Ag	107	0.50	20
Cadmium	Cd	111	0.50	20
Antimony	Sb	121	0.50	20
Barium	Ba	137	0.50	20
Thallium	Tl	205	0.50	20
Lead	Pb	208	0.50	20
Internal Standards				
Lithium	Li	6		
Scandium	Sc	45		
Germanium	Ge	74		
Indium	In	115		
Bismuth	Bi	209		

ND = Not determined or listed in the reference method.
NL = Compound not listed in the reference method.
Calculated Method Detection Limits are on file in the QC Department.

Table 3
Interference Check Solution

Solution Component	Solution A Concentration (ug/L)	Solution AB Concentration (ug/L)
Al	100,000	100,000
Ca	300,000	300,000
Fe	250,000	250,000
Mg	100,000	100,000
Na	250,000	250,000
P	100,000	100,000
K	100,000	100,000
S	100,000	100,000
C	200,000	200,000
Cl	2,000,000	2,000,000
Mo	2,000	2,000
Ti	2,000	2,000
As	0.0	100
Cd	0.0	100
Cr	0.0	200
Co	0.0	200
Cu	0.0	200
Mn	0.0	200
Ni	0.0	200
Ag	0.0	50
Zn	0.0	100
Se	0.0	100
V	0.0	200

Table 4
Calibration Standards

Multi-element standard (Section 8.4) containing the following:

High Range Elements (HR): 1000 mg/L of the following: Fe, K, Ca, Na, Mg, Sr

Low Range Elements (LR): 10 mg/L of the following: Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn, Th, U

All Calibration Standards are purchased in 5% HNO3, Tr HF (v/v).

Standard #1 (0.2 µg/L LR, 20 ug/L HR): Dilute Standard #3: 1.0 mL to 50mL final volume 1% HNO_3 (v/v).

Standard #2 (1.0 µg/L LR, 100 ug/L HR): Dilute Standard #3: 5.0 mL to 50mL final volume 1% HNO_3 (v/v).

Standard #3 (10.0 µg/L LR, 1000 ug/L HR): Dilute 0.05 mL to 50mL final volume 1% HNO_3 (v/v).

Standard #4 (120.0 µg/L LR, 12000 ug/L HR): Dilute 0.6 mL to 50mL final volume 1% HNO_3 (v/v).
Standard #5 (250.0 µg/L LR, 25000 ug/L HR): Dilute 1.25 mL to 50mL final volume 1% HNO_3 (v/v).
Standard #6 (500.0 µg/L LR, 50000 ug/L HR): Dilute 2.5 mL to 50mL final volume 1% HNO_3 (v/v).

Table 5: Recommended Isotopes for Selected Elements

Mass	**Element of Interest**
27	Aluminum
121, **123**	Antimony
75	Arsenic
138, 137, 136, **135**, 134	Barium
9	Beryllium
209	Bismuth (IS)
114, 112, **111**, 110, 113, 116, 106	Cadmium
42, 43, **44**, 46, 48	Calcium (I)
35, 37, (77, 82)[a]	Chlorine (I)
52, 53, **50**, 54	Chromium
59	Cobalt
63, **65**	Copper
165	Holmium (IS)
115, 113	Indium (IS)
56, 54, **57**, 58	Iron (I)
139	Lanthanum (I)
208, 207, **206**, 204	Lead
6[b], 7	Lithium (IS)
24**, 25**, **26**	Magnesium (I)
55	Manganese
98, 96, 92, **97**, 94 (108)[a]	Molybdenum (I)
58, **60**, 62, **61**, 64	Nickel
39	Potassium (I)
103	Rhodium (IS)
45	Scandium (IS)
80,**78**,**82**,**76**,**77**,74	Selenium
107, **109**	Silver
23	Sodium (I)
159	Terbium (IS)
205, 203	Thallium
51 ,50	Vanadium
120, **118**	Tin (I)
89	Yttrium (IS)
64, **66, 68**, **67**, 70	Zinc

NOTE: Method 6020 is recommended for only those analytes listed in Table 1. Other elements are included in this Table because they are potential interferents (I) in the determination of recommended analytes, or because they are commonly used internal standards (IS). Isotopes are listed in descending order of natural abundance. The most useful isotopes are underlined and in boldface, although certain matrices may require the use of alternative isotopes.

[a] These masses are also useful for interference correction (Section 4.2)

[b] Internal standard must be enriched in the 6Li isotope. This minimizes interference from indigenous Li.

Table 6
Precision and Accuracy Acceptance Criteria *

	Aqueous % Recovery LCS		**Soil % Recovery LCS**		**Duplicate**	
Element	**Lower Control Limit**	**Upper Control Limit**	**Lower Control Limit**	**Upper Control Limit**	**Aqueous %RPD**	**Soil %RPD**
Aluminum	80	120	70	130	20	20
Antimony	80	120	70	130	20	20
Arsenic	80	120	70	130	20	20
Barium	80	120	70	130	20	20
Berylium	80	120	70	130	20	20
Cadmium	80	120	70	130	20	20
Calcium	80	120	70	130	20	20
Chromium	80	120	70	130	20	20
Cobalt	80	120	70	130	20	20
Copper	80	120	70	130	20	20
Iron	80	120	70	130	20	20
Lead	80	120	70	130	20	20
Magnesium	80	120	70	130	20	20
Manganese	80	120	70	130	20	20
Molybdenum	80	120	70	130	20	20
Nickel	80	120	70	130	20	20
Potassium	80	120	70	130	20	20
Selenium	80	120	70	130	20	20
Silver	80	120	70	130	20	20
Sodium	80	120	70	130	20	20
Thallium	80	120	70	130	20	20
Vanadium	80	120	70	130	20	20
ZInc	80	120	70	130	20	20

* These are default limits. The limits are re-evaluated and updated as necessary pending compilation of the minimum number of data points.

Table 7
Metals LCS Concentrations

Analyte	Liquid Concentration (mg/L)	Soil Concentration (mg/Kg)
Antimony	0.5	20
Arsenic	0.12	4.8
Barium	2.00	80
Beryllium	0.05	2.0
Cadmium	0.051	2.04
Chromium	0.20	8.0
Copper	0.25	10
Lead	0.51	20.4
Nickel	0.50	20
Selenium	0.12	4.8
Silver	0.05	2.0
Thallium	0.12	4.8
Zinc	0.50	20
Iron	1.00	40
Manganese	0.50	20
Calcium	10.0	400
Magnesium	10.0	400
Potassium	10.0	400
Sodium	10.0	400
Aluminum	2.00	80
Cobalt	0.50	20
Vanadium	0.50	20

Table 8
Internal Standard

Multiple Element Standard, purchased (Section 8.5), 100mg/L of ^{6}Li,^{45}Sc, ^{74}Ge, ^{103}Rh, ^{115}In, ^{159}Tb, ^{209}Bi

Working Internal Standard (IS) Solution (1 mg/L solution) Dilute 10.0 mL to 1L final volume 1% HNO_3 (v/v).

Table 9
Tune Solution

Tune Solution: 100 ug/L multi-element standard, purchased for ^{7}Li ^{9}Be, ^{58}Ce ^{59}Co, ^{115}In, ^{137}Ba and ^{208} Pb, ^{238}U in 1% HNO_3 (v/v) (Section 8.6).

Working Tune Solution: Dilute 1.0 mL of 100 ug/L multi-element standard for ^{7}Li ^{9}Be, ^{58}Ce ^{59}Co, ^{115}In, ^{137}Ba and ^{208} Pb, ^{238}U with 1% HNO_3 (v/v) to 100mL final volume. This will give a final concentration of these metals at 1.0µg/L.

Table 10
ICV / CCV Solution

Multiple Element Standard, purchased (Section 8.7):
1000mg/L of K, Na, Ca, Mg, Fe, Sr
10mg/L of Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, An, Th, U

Working ICV/CCV Solution: Dilute 0.25 mL with 1% HNO_3 (v/v) to 50mL final volume. This will give the following concentrations:

5000µg/L of K, Na, Ca, Mg, Fe, Sr
50µg/L of Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, An, Th, U

Table 11
Interference Check Solutions

ICSA, High-Purity Standards Cat. #ICP-MS-ICS-2 A (Section 8.8):
20000 mg/L of Cl^-
3000 mg/L Ca
2500 mg/L Fe, Na
2000 mg/L of C
1000 mg/L of Al, K, Mg, P, S
20 mg/L of Mo, Ti

Working ICSA Solution: Dilute 5 mL of High-Purity Standards Cat. #ICP-MS-ICS-2 A, with 1% HNO_3 (v/v) to 50mL final volume. This will give the following concentrations:
2000 mg/L of Cl^-
300 mg/L Ca
250 mg/L Fe, Na
200 mg/L of C
100 mg/L of Al, K, Mg, P, S
2 mg/L of Mo, Ti

ICSB, High-Purity Standards Cat. #ICP-MS-ICS-2 B (Section 8.9): 20 mg/l Cu, Mn, V, Cr, Ni, Co. 10 mg/L As, Cd, Zn, Se. 5 mg/L Ag

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Working ICSAB Solution (Section 8.10): Dilute 30 uL of ICSB High-Purity Standards Cat. #ICP-MS-ICS-2 B with 3.0 mL of the working ICSA solution. This will give the following concentrations:
20000 mg/L of Cl^-
3000 mg/L Ca
2500 mg/L Fe, Na
2000 mg/L of C
1000 mg/L of Al, K, Mg, P, S
20 mg/L of Mo, Ti
0.2 mg/L Cu, Mn V, Cr, Ni, Co, 0.1 mg/L of As, Cd, Zn, Se 0.05 mg/L Ag.

Table 12

Interference Correction Equations

Correction equations are in the form: corrected signal for mass X=(signal from mass X) ± (signal from mass Y)*(correction factor).

6= (6) - ((7)*0.082)

44= (44) - ((88)*0.015)

51= (51) - ((53)*3.0)) + ((52)*0.34)

66= (66) - ((69)*0.00141)

75= (75) – ((77)*2.9) + ((82)*2.23) – ((83)*2.23)

82= (82) – (83)

98= (98) – ((99)*0.146)

111= (111) – ((108)*1.073) + ((106)*0.712)

114= (114) – ((118)*0.027)

115= (115) – ((118)*0.016)

208= (208) + (206) + (207)

Chromium, Hexavalent

References: **3500 Cr-B**, Standard Methods, 21-st Edition (2005)

7196A, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997.

3060A, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, 1997.

1. Scope and Application

Matrices: This method is applicable for the determination of hexavalent chromium in natural or treated water or in a soil or solid matrix.

Definitions: See Alpha Analytical Quality Manual Appendix A

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one of the following laboratory personnel before performing the modification: Area Supervisor, Laboratory Services Manager, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Spectrophotometer and in the interpretation of Spectrophotometric data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case by case basis.

The hexavalent chromium concentration of U.S. drinking waters has been reported to vary between 3 and 40µg/L with a mean of 3.2µg/L. Chromium salts are used extensively in industrial processes and may enter a water supply through the discharge of wastes. Chromate compounds frequently are added to cooling water for corrosion control. Chromium may exist in water supplies in both the hexavalent and the trivalent state although the trivalent form rarely occurs in potable water.

2. Summary of Method

This procedure measures only hexavalent chromium (Cr^{6+}). The hexavalent chromium is determined colorimetrically by reaction with diphenylcarbazide in acid solution. A very sensitive red-violet color of unknown composition is produced, and its absorbance is measured photometrically at 540nm.

2.1 Method Modifications from Reference

The coloring reagent used for the standards in the calibration curve and for the samples is made by dissolving 1 gram of 1,5-diphenylcarbazine in 250mL of acetone, whereas the reference method 7196A dissolves 1 gram in 200mL of acetone.

Alpha uses a smaller sample volume for analysis; therefore reagent volumes are reduced accordingly.

2.5 cm (not 1cm) absorption cell is used for water samples to increase sensitivity.

3. Reporting Limits

The RDL reported is 0.01mg/L for 50mL of an aqueous sample. The RDL reported is 0.8mg/Kg for 2.5g of a soil/solid sample. The RDLs are not adjusted for % Moisture.

4. Interferences

4.1 Background Color

Turbidity and background sample color are removed by filtering the sample through a 0.45µm filter. In cases when filtration alone is not sufficient, background interference can be subtracted out by adding all reagents to the sample except diphenylcarbazide solution, measuring the background absorbance, and then subtracting this value from the colored sample absorbance value.

4.2 Other Metals

The reaction with diphenylcarbazide is nearly specific for chromium. Hexavalent molybdenum and mercury salts will react to form color with the reagent but the intensities are much lower than that for chromium at the specified pH. Concentrations as high as 200 mg/L of Mo or Hg can be tolerated. Vanadium interferes strongly but concentrations up to 10 times that of chromium will not cause trouble. Potential interference from permanganate is eliminated by prior reduction with azide. Iron in concentrations greater than 1mg/L may produce a yellow color but the ferric ion (Fe^{3+}) color is not strong and no difficulty is encountered normally if the absorbance is measured photometrically at the appropriate wavelength. Interfering amounts of molybdenum, vanadium, iron, and copper can be removed by extraction of the cupferrates of these metals into chloroform ($CHCl_3$). A procedure for this extraction is provided in the reference but do not use it unless necessary because residual cupferron and $CHCl_3$ in the aqueous solution complicate the later oxidation. Therefore, follow the extraction by additional treatment with acid fuming to decompose these compounds.

4.3 Reducing/oxidizing tendency of sample matrix

When analyzing a sample digest for total Cr(VI), it is appropriate to determine the reducing/oxidizing tendency of each sample matrix, if the matrix spike for that sample matrix has failed the quality control acceptance criteria for this method. Determination of the Reducing/oxidizing potential for failing matrix spike samples can be accomplished by characterization of each sample for additional parameters, such as pH (Method 9045) and Oxidation Reduction Potential (ORP) (ASTM 1498-93 –aqueous samples). Method 9045 (Section 7.2 of Method 9045) is referenced as the preparatory method for soil samples. The ORP and temperature probes are inserted directly into the soil slurry derived from the pH analysis. The displayed ORP value is allowed to equilibrate and the resulting measurement is recorded. Analysis of these parameters establishes the tendency of Cr(VI) to exist or not exist in the unspiked sample(s) and assists in the interpretation of QC data for matrix spike recoveries outside conventionally accepted criteria for total metals.

4.4 Soluble Cr(III) concentration

For waste materials or soils containing soluble Cr(III) concentrations greater than four times the laboratory Cr(VI) reporting limit, Cr(VI) results obtained using this method may be biased high due to method-induced oxidation. The addition of Mg^{2+} in a phosphate buffer to the alkaline extraction solution has been shown to suppress this oxidation. If an analytical method for Cr(VI) is used that can correct for possible method induced oxidation/reduction, then the Mg^{2+} addition is optional. The presence of soluble Cr(III) can be approximated by extracting the sample with deionized water.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Samples are collected in plastic or glass containers with teflon-lined caps. Sample containers must not contain any stainless steel. Separate container has to be provided for MCP HexCr (see MCP addendum)

6.2 Sample Preservation

Samples are unpreserved and refrigerated at 4 ± 2 °C.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Aqueous samples must be analyzed within 24 hours of collection.

Soil and solid samples must be digested within 30 days of collection. The extracts must be analyzed within 168 hours (7 days) after extraction.

7. Equipment and Supplies

7.1 Spectrophotometer: Genesys 10 Vis: for use at 540nm, with a light path of 1cm or longer.

7.2 100 ml digestion cups

7.3 pH Meter: Calibrated.

7.4 Volumetric flasks: 1000mL and 100mL.

7.5 Filtration apparatus.

7.6 0.45µm Membrane filters.

7.7 Hot block Model # SC151 with Stir Base Stirring device (part #SC160)

7.8 Balance.

7.9 Thermometers.

7.10 Volumetric pipets: various volumes.

7.11 50mL Centrifuge Tubes.

7.12 100mL Graduated cylinder

7.13 pH paper range 1-14.

8. Reagents and Standards

8.1 1000ppm Stock Hexavalent Chromium Solution (for calibration and LCS): Commercial purchase. Expire upon manufacturer's expiration date. Use different lots for calibration and LCS.

8.2 1ppm Working Standard Hexavalent Chromium Solution (for calibration): Dilute 1.00mL stock chromium solution (Section 8.1) to 1000mL with DI. Store at room temperature. Expires three months from the date of preparation.

8.3 10ppm Working Standard Hexavalent Chromium Solution (for LCS/ICV): Dilute 1.00mL stock chromium solution (Section 8.1) to 100mL with DI. Store at room temperature. Expires six months from the date of preparation

8.4 Nitric acid, HNO_3, concentrated. Do not use if has a yellow tinge. Expires upon manufacturer's expiration date.

8.5 Nitric Acid, 50%: Into a 500mL volumetric flask, dilute 250mL of Concentrated Nitric Acid with 250mL of DI water. Expires six months from the date of preparation.

8.6 Sulfuric acid, H_2SO_4, concentrated.

8.7 Sulfuric acid, H_2SO_4, 10%: Dilute 50mL concentrated H2SO4 to 500mL with DI water. Expires six months from the date of preparation.

8.8 Diphenylcarbazide solution: Dissolve 1.0g 1,5-diphenylcarbazide (1,5-diphenylcarbohydrazide) in 250mL acetone. Store in a plastic bottle cover with aluminum foil or away from light. Discard when solution becomes discolored.

8.9 Sodium carbonate: Na_2CO_3, anhydrous, analytical reagent grade. Store at 20 – 25°C in a tightly sealed container.

8.10Sodium hydroxide: NaOH, analytical reagent grade. Store at 20 – 25°C in a tightly sealed container.

8.11 Magnesium Chloride: $MgCl_2$ (anhydrous), analytical reagent grade. 392.18mg $MgCl_2$ is equivalent to 100mg Mg^{2+}. Store at 20 – 25°C in a tightly sealed container. As an alternate, use 0.8366g $MgCl_2 \cdot 6\ H_2O$.

8.12 Phosphate Buffer:

8.12.1 K_2HPO_4: Analytical reagent grade.

8.12.2 KH_2PO_4: Analytical reagent grade.

8.12.3 0.5M K_2HPO_4 / 0.5M KH_2PO_4 buffer: Dissolve 87.09g K_2HPO_4 and 68.04g KH_2PO_4 into 700mL of DI water. Transfer to a 1L volumetric flask and dilute to volume. (When prepared accordingly, the buffer solution has an approximate pH value of 7.) Store at 20 – 25°C in a tightly sealed container. Expire one year from prep.

8.13 Lead Chromate: $PbCrO_4$, analytical reagent grade. Store under dry conditions at 20 – 25°C in a tightly sealed container. Expires upon manufacturer's expiration date.

8.13.1 Soil matrix insoluble spiking solution: Add 10 – 20mg $PbCrO_4$ (Section 8.12) to a separate aliquot of sample. This spike is used to evaluate the dissolution during the digestion process.

8.14 Digestion solution: Dissolve 20.0 ± 0.05g NaOH and 30.0 ± 0.05g Na_2CO_3 in deionized water in a one-liter volumetric flask and dilute to the mark. Store the solution in a tightly capped polyethylene bottle at 20 – 25 °C and prepare fresh monthly. The pH of the digestion solution must be checked before using. The pH must be 11.5 or greater; if not, discard.

8.15 Potassium Dichromate, $K_2Cr_2O_7$, spiking solution (1000mg/L Cr (VI)): Commercial purchase. Expire upon manufacturer's expiration date.

8.15.1 100mg/L Cr (VI): Add 10.0mL of the 1000mg/L $K_2Cr_2O_7$ spiking solution (Section 8.14) to a 100mL volumetric flask and dilute to volume with deionized water. Mix well.

8.15.2 5ppm: To a 100mL volumetric flask, add 5mL of 100ppm spiking solution (Section 8.15.1), bring to volume with DI.

8.15.3 Soil sample soluble spike: Add 1 ml of 1000mg/L Cr (VI) spiking solution (Section 8.15) to 2.5g of sample.

8.15.4 Post spike soil sample: Add 1 ml of 100mg/L Cr(VI) solution (section 8.15.1) to 25 ml extracted sample.

8.15.5 Aqueous sample spike: Add 1ml of 5 ppm (section 8.15.2) to 50 ml of sample**.**

8.16 ICV and CCV Standards: Commercially prepared solution of known hexavalent chromium concentration. A Certificate of Analysis is kept on file. This solution is diluted with DI to a concentration 0.2 ppm on each day of use.

8.17 Acetone: Analytical reagent grade.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

One preparation blank is digested and analyzed per batch of 20 samples or less for method 3500. Method 7196: batch size is 10 samples or less. The concentration of the Blank must be less than the RDL, or one-tenth the regulatory limit or action level, whichever is greater, otherwise the entire batch must be redigested and reanalyzed.

The ICB consists of DI water that has been colored and analyzed as per Section 10.3.4. Results must be less than the RDL, otherwise another ICB is colored and analyzed. It failure continues, a new calibration curve is generated (Section 10.1).

9.2 Laboratory Control Sample (LCS)

One LCS is prepared and analyzed per batch of 20 samples or less for method 3500. Method 7196: batch size is 10 samples or less.

The LCS for aqueous samples consists of the ICV (Section 10.2). LCS recovery for liquids must be within 85 – 115%, otherwise the entire sample batch must be reanalyzed.

For solids samples, a soluble LCS and insoluble LCS must be digested per batch of 20 samples or less (Refer to Section 10.3.3.1) LCS recovery for solids must be within 80 – 120%, otherwise the sample batch must be redigested and reanalyzed.

Note: SRM HexCr standard made by ERA is used for soil LCS: use 0.3-0.5 g, based on certified value. Expires upon manufacturer's expiration date.

9.3 Initial Calibration Verification (ICV)

Refer to Section 10.2

9.4 Continuing Calibration Verification (CCV)

Refer to Section 10.4

9.5 Matrix Spike

9.5.1 Aqueous samples

One sample per delivery group per batch of 20 samples (method 3500) or 10 samples (method 7196) or less is required to be spiked.

Example: If a batch consists of 6 liquid samples (3 wastewater from Client A and 3 wastewater from Client B), then one wastewater from Client A and one wastewater from Client B each require spiking.

The spike is prepared by adding 1mL of 5ppm aqueous spiking solution (Section 8.14.2) to 50mL of sample. Spike recovery must be within 85 – 115. If spike recovery is outside of the range, adjust sample pH to 8.5 then add 1 ml of 5 ppm spiking solution and reanalyze. If spike recovery still outside of the range, then dilute sample and retest both diluted sample and spiked diluted sample. Report sample results at the dilution for which the spike recovered at 85 – 115%.

Sample dilutions can be made with DI, up to 200X or up to the client's specified detection limits.

If interferences remain after dilutions, and spike recovery is still less than 85% for aqueous samples, refer to Section 10.3.5.

9.5.2 Soil / solid matrix samples

Two spikes per batch of 10 samples or less are required; one with a soluble spike and one with an insoluble spike (Section 10.3.3.1). The acceptance range for spike recovery is 75 – 125%. If recoveries are not within the specified limits, then the matrix spike(s) and the associated samples must be re-homogenized/re-digested/re-analyzed. If upon reanalysis, it is found that the recoveries are acceptable, then the data is submitted with the new spike results. If it is found that the recoveries are still unacceptable upon redigestion, then it is assumed that the sample matrix is suspect and the pH and ORP are measured at once for the sample that was spiked.

If prior knowledge of an interfering sample matrix is known, then matrix spike duplicates (MSD) are set for the soluble and insoluble matrix spikes, along with the pH and ORP analyses for the samples to be spiked. Failure of the MS/MSD will verify that the sample matrix interferes with the digestion, and will not necessitate a re-digestion of the sample and matrix spikes.

9.6 Laboratory Duplicate

Analyze one sample in duplicate per batch of 20 samples (method 3500) or 10 samples (method 7196) or less. The %RPD must be $\leq$ 20% for aqueous samples and $\leq$ 20% for solid samples, if both the original sample and the duplicate results are greater than or equal to four times the reporting limit. A control limit of ± the laboratory reporting limit is used when either the original sample result or the duplicate sample result is less than four times the laboratory reporting limit.

9.7 Method-specific Quality Control Samples

Not applicable.

9.8 Method Sequence

- Sample preparation (digestion and/or pH adjustment and filtration)
- Coloring procedure
- Analysis on Spectrophotometer
- Verification
- Calculation

10. Procedure

10.1 Equipment Set-up

10.1.1 A calibration curve is generated at a minimum of once per year, as follows:

10.1.1.1 **For Liquid**: Pipet the following volumes of the 1ppm working standard (Section 8.2) into separate 50mL volumetric flasks: 0.25 ml, 0.5 ml, 1 ml, 2.5 ml, 5 ml, 10 ml and 25 ml. Bring each to volume with DI to give the following concentrations respectively: 0.005ppm, 0.01ppm, 0.02 ppm, 0.05 ppm, 0.10ppm, 0.20ppm and 0.50ppm. Include a 50mL DI blank and proceed with subsequent treatment of the standards in the same manner as samples (Section 10.3.2).

10.1.1.2 **For Soil**: Prepare seven 100 ml dijestion cups, weigh 0.8366g of $MgCl_2 \cdot 6\ H_2O$ into each cup, then pipet following volumes of the 10 ppm working standard (section 8.3) into separate digestion cups:0 ml, 0.1mL, 0.5mL, 1.0mL, 2.0mL, 5.0 ml and 10mL. To all digestion cups add 50 ml of digestion solution and 0.5 ml of phosphate buffer. Proceed to soil/solid digestion and extraction procedure(sections 10.3.3.2 to 10.3.3.7)

10.1.1.3 Develop color for standards and blank as in Section 10.3.4.

10.1.1.4 Construct a calibration curve by plotting the absorbance values against mg/L hexavalent chromium. An acceptable curve must have a calibration coefficient of $\geq$ 0.995. This calibration curve is valid for one year, unless failure of an ICV requires construction of a new calibration curve.

Note: see MCP-HexCr and NJ-HexCr addendum for frequency of calibrations for MCP and NJ sites.

10.2 Initial Calibration

A non-digested, colored ICV (Section 8.16) (from a different source than was used for the calibration standards) must be recovered between 85 – 115%. If these criteria are not met, then the ICV is re-analyzed. If failure repeats, then the ICV is re-made and re-analyzed. If failure continues, prepare a new calibration curve (Section 10.1). See Section 12 for corrective actions.

10.3 Equipment Operation and Sample Processing

10.3.1 Treatment of sample: If interfering amounts of molybdenum, vanadium, copper, or iron are present, then follow the removal procedures as stated in the reference method.

10.3.2 Aqueous Samples:

Samples containing sediment, floating or suspended matter, or turbidity are filtered through a 0.45µm membrane filter prior to pH adjustment. If background interferences persist, measure an absorbance reading before adding diphenylcarbazide reagent (Section 10.3.4) and correct the absorbance of the final colored solution by subtracting the absorbance measured previously.

Proceed to Section 10.3.4.

10.3.3 Solid / soil sample digestion and extraction procedure:

10.3.3.1 **Samples:** Thoroughly mix the sample and weigh 2.5g into a 100 ml digestion cup. Add 0.8366 g of $MgCl_2 \cdot 6H_20$.

Blank: Weigh 2.5g Ottawa Sand into a 100ml digestion cup, add 0.8366g of $MgCl_2 \cdot 6H_20$.

Insoluble LCS: Weigh 2.5g Ottawa Sand into a 100 ml digestion cup, add 0.3-0.5 g of SRM (ERA catalog # 921) and 0.8366g of $MgCl_2 \cdot 6H_20$.

Soluble LCS: Weigh 2.5g Ottawa Sand into a 100ml digestion cup, add 0.8366 g of $MgCl_2 \cdot 6H_20$ and 1.0mL 1000ppm $K_2Cr_2O_7$. (Section 8.15).

Matrix Spike, insoluble: Thoroughly mix the sample and weigh 2.5g into a 100 ml digestion cup. Add 0.8366 g of $MgCl_2 \cdot 6H_20$ and 0.01 – 0.02g $PbCrO_4$ (Section 8.13.1).

Matrix Spike, soluble: Thoroughly mix the sample and weigh 2.5g into a 100mL digestion cup. Add 0.8366 g of $MgCl_2 \cdot 6H_20$ and 1.0mL 1000ppm $K_2Cr_2O_7$. (Section 8.15).

To all samples and QC samples, add 50mL of digestion solution (8.14) and 0.5mL of phosphate buffer (Section 8.12.3).

10.3.3.2 Stir the sample on a stir plate (unheated) for at least 5 minutes.

10.3.3.3 Place samples on hot block with Stirring base; heat samples for 1 hour at 90 – 95 °C (after temperature reached 90°C)

10.3.3.4 While still stirring, allow to cool to room temperature. Transfer the contents of the digestion vessel to 50 ml centrifuge tube then centrifuge in 10minute.Pour centrifuged solution back to original cup. Save the solid centrifuged material from the matrix spikes for possible later analysis for assessing low Cr (VI) recoveries. Store the centrifuged solid at 4 ±2°C.

10.3.3.5 Under a fume hood, while constantly stirring, very slowly add 50% HNO_3 (Section 8.4) to the centrifuged liquid to carefully adjust the pH to 7.5 ± 0.5. If the pH drops below 7.0, discard the solution and re-digest.

10.3.3.5.1 If a precipitate forms, filter the sample again through a 0.45μm membrane filter into a clean 250mL beaker.

10.3.3.6 Remove the stir-bar and rinse, and transfer quantitatively to a 100mL volumetric flask or 100 ml graduated cylinder. Bring to volume with DI.

10.3.3.7 Proceed with coloring and analysis as described in Section 10.3.4.

10.3.4 Color development and measurement:

Place 45mL of sample or standard solution into a 50mL centrifuge tube. Adjust to pH 2 ± 0.5 with 0.6N H_2SO_4 (Section 8.6). Record pH on excel format. Add 1mL Diphenylcarbazide solution (Section 8.7) and adjust to 50mL with DI water. Mix and let stand 5 – 10 minutes for full color development.

Set the spectrophotometer to zero at 540 nm, utilizing the colored reagent blank in a 1cm absorption cell for soil samples and 2.5 cm absorption call for waters. Next, transfer a suitable portion of each colored standard solution or sample to a 1cm absorption cell for soils and 2.5 cm absorption cell for waters. Measure and record each absorbance at 540nm. Determine mg/L chromium present by reference to the calibration curve (Section 10.1.1.3).

10.3.4.1 Dilute samples volumetrically with DI water if they are more concentrated than the highest standard in the calibration curve.

10.3.5 Verification of Samples

10.3.5.1 For aqueous and soil samples, verification is required to ensure that neither a reducing condition nor a chemical interference is affecting color development. This is accomplished by analyzing a second 10mL aliquot of the pH adjusted filtrate of the soluble spike. 1mL of 100ppm $K_2Cr_2O_7$ solution (Section 8.15.1) is added to the filtrate and analyzed. To verify the absence of an interference, the spike recovery must be between 85% and 115%.

If the spike recovery is less than 85%, the presence of an interference or reducing condition is verified. Client Services must be notified and a narrative included on the final report that indicates “verification of this sample indicates the presence of a reducing condition or a chemical interference that could affect the results”.

10.3.5.2 If addition of the spike extends the concentration beyond the calibration curve, the analysis solution must be diluted with a blank solution and the calculated results adjusted accordingly.

10.3.5.3 If the result of verification indicates a suppressive interference, the sample must be diluted and reanalyzed.

10.3.5.4 If the interference persists after sample dilution then an alternative method must be considered. See the Inorganics Supervisor for further instruction.

Aqueous samples with acidic extracts that yield recoveries of less than 85% are re-tested to determine if the low spike recovery is due to the presence of residual reducing agent. This determination is performed by first making an aliquot of the extract alkaline (pH 8.0-8.5) using 1N NaOH. The pH is recorded in the laboratory notebook. This aliquot is respiked and analyzed. If a spike recovery of 85-115% is obtained on the alkaline aliquot of an acidic extract that initially was found to contain less than 5 mg/L Cr(VI), one can conclude that the analytical method has been verified.

10.3.5.5 If the spike recovery is still below 85%, then the presence of reducing agent is confirmed. Client Services must be notified and a narrative included on the final report that indicates "verification of this sample indicates the presence of a reducing condition or a chemical interference that could affect the results".

10.4 Continuing Calibration

The calibration curve must be verified after every 10 samples or less, with a recovery of 85 – 115% of a non-digested, colored ICV/CCV standard (Section 8.15). If these criteria are not met, then the CCV is re-analyzed. If failure repeats, then the CCV is re-made and re-analyzed. If failure continues, prepare a new calibration curve (Section 10.1). See Section 12 for corrective actions.

10.5 Preventive Maintenance

The Spectrophotometer is calibrated on a semi-annual basis by an instrument service company. Records are kept on file.

11. Data Evaluation, Calculations and Reporting

For aqueous samples:

$$\text{mg Cr}^{+6}/\text{L} = \left[\frac{\text{absorbance} - \text{y-intercept}}{\text{slope}}\right] \times \text{dilution}$$

For solid samples:

$$\text{mg Cr}^{+6}/\text{Kg} = \left[\frac{\text{absorbance} - \text{y-intercept}}{\text{slope}}\right] \times \left[\frac{\text{dilution x 0.1L (final volume)}}{\text{weight (Kg) of sample}}\right]$$

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Holding time exceedence, improper preservation and observed sample headspace are noted on the nonconformance report form.

Perform routine preventative maintenance following manufacturer's specification. Record all maintenance in the instrument logbook.

Review of standards, blanks and standard response for acceptable performance occurs for each batch of samples. Record any trends or unusual performance on a nonconformance action form.

If the CV or LCS recovery falls outside the designated acceptance range, the laboratory performance is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result in the unspiked samples is suspect and is only reported for regulatory compliance purposes with the appropriate nonconformance action form. Immediate corrective action includes reanalyzing all affected samples by using any retained sample before the expiration of the holding time.

Failure of the LCS for method 3060A requires that the entire sample batch be re-digested and re-analyzed.

If the method blank for method 3060A is greater than the reporting limit, then the following action must be taken. Samples that are non-detect may be reported, and the method blank result is narrated on the final report. If the sample concentration is greater than 10X the concentration of the method blank, then the sample may be reported, and the method blank is narrated on the final report. If the sample(s) concentration are above the reporting limit, but are not greater than 10X the concentration of the method blank, then those samples must be re-digested and re-analyzed. In this case, it is not necessary to submit a narrative unless there is a problem with the hold time, or there is not enough sample to re-digest. The Client Services Department must be made aware of the situation, and if the data is released then the method blank non-conformance is narrated.

The ICV for the analysis must have a recovery of 85-115%. If the ICV fails, it must be re-made and re-analyzed. If the failure persists, then a new calibration curve is constructed.

The ICB for the analysis must be below the detection limit for the analysis. If the ICB fails this requirement, then fresh blank must be colored and analyzed, if this does not solve the problem then a new calibration curve must be constructed.

If the CCV or the CCB fail, pour out a fresh aliquot of CCV and CCB and re-color and re-analyze. If the CCV or the CCB does not pass, then construct a new calibration curve and re-analyze the samples that followed the last acceptable CCV/CCB.

A duplicate result that is outside of the controls limits for this method must be narrated. The sample must be examined to determine the cause of the poor duplication. If it is determined that the poor duplication was due to analyst technique, then the sample and its duplicate are re-digested and re-analyzed. Otherwise, narrate the non-conformance on the final report.

If the matrix spike (aqueous samples) falls outside of the acceptable range of the method, then the analyst must go to the verification (section 10.3.5) part of this method. Poor spike recoveries must be narrated on the final report. Upon Client authorization, hexachromes with poor spike recoveries can be analyzed for total chromium by ICP-AES (Method 6010). The sample must be processed according to the Total Chromium procedure employed and the digestion procedure necessary. Clients will be invoiced for the Total Chromium analysis. Solids and soils digested under 3060A that have failing matrix spike recoveries must be re-digested and re-analyzed to determine if the failure is do to poor technique or the sample matrix. If upon reanalysis, it is found that the recoveries are acceptable, then the data is submitted with the new spike results. If it is found that the recoveries are still unacceptable upon redigestion, then it is assumed that the sample matrix is suspect and the pH and ORP are measured at once for the sample that was spiked. A “Change Order” is submitted to the Client Services Department, and the pH and ORP products are added to the applicable job. The pH and ORP results are evaluated against the Eh/pH Phase Diagram (Figure 1), and the result (reducing or oxidizing) is included in a sample narrative explaining the poor spike recovery.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1734,1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha’s Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1734,1739 IDC/DOC Generation

SOP/1728 Waste Management and Disposal SOP

16. Attachments

Figure 1: Eh/pH Phase Diagram

FIGURE 1
Eh/pH PHASE DIAGRAM

The dashed lines define Eh-pH boundaries commonly encountered in soils and sediments.

Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

References: **Method 8260C**, SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, 2006.

Method 5035A, Closed System Purge &Trap and Extraction for Volatile Organics in Soil and Waste Samples. SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update IV, Draft, July 2002.

Method 5030B, Purge & Trap for Aqueous Samples. SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, December, 1996.

Method 5030C, Purge & Trap for Aqueous Samples. SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update IV, May, 2003.

1. Scope and Application

Matrices: Method 8260 is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including various air sampling trapping media, ground and surface water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments.

Definitions: Refer to Alpha Analytical Quality Manual.

The following compounds may be determined by this method:

8260C LIST OF ANALYTES		
Dichlorodifluoromethane	Carbon tetrachloride	Isopropylbenzene
Chloromethane	1,2-Dichloroethane	1,4-Dichloro-2-butane
Vinyl chloride	Benzene	1,1,2,2-Tetrachloroethane
Chloroethane	Trichloroethene	Trans-1,4-dichloro-2-butene
Bromomethane	1,2-Dichloropropane	1,2,3-Trichloropropane
Trichlorofluoromethane	Bromodichloromethane	n-Propylbenzene
Ethyl ether	Dibromomethane	Bromobenzene
Acetone	4-Methyl-2-pentanone	2-Chlorotoluene
1,1-Dichloroethene	cis-1,3-Dichloropropene	1,3,5-Trimethylbenzene
Carbon disulfide	Toluene	4-Chlorotoluene
Methylene chloride	Trans-1,3-dichloropropene	Tert-butylbenzene
Acrylonitrile	Ethyl-methacrylate	1,2,4-Trimethylbenzene
Methyl-tert-butyl ether	1,1,2-Trichloroethane	Sec-butylbenzene
Trans-1,2-dichloroethene	2-Hexanone	p-Isopropyltoluene
1,1-Dichloroethane	1,3-Dichloropropane	1,3-Dichlorobenzene
Vinyl acetate	Tetrachloroethene	1,4-Dichlorobenzene
2-Butanone	Chlorodibromomethane	n-Butylbenzene
2,2-Dichloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene
Cis-1,2-dichloroethene	Chlorobenzene	1,2-Dibromo-3-chloropropane
Chloroform	1,1,1,2-Tetrachloroethane	1,2,4-Trichlorobenzene
Bromochloromethane	Ethyl benzene	Hexachlorobutadiene
Tetrahydrofuran	p/m Xylene	Naphthalene
1,1,1-Trichloroethane	o Xylene	1,2,3-Trichlorobenzene

8260C LIST OF ANALYTES (continued)		
1,1-Dichloropropene	Styrene	Bromoform
Acrolein	2-Chloroethylvinyl ether	Ethanol
Cyclohexanone	Ethyl acetate	1,3,5-Trichlorobenzene
Iodomethane	Methyl methacrylate	Tert-amyl methyl ether
Di-isopropyl ether	n-Butanol	1,4-Dioxane
Ethyl Tert-Butyl Ether	Pentachloroethane	

There are various techniques by which these components may be introduced into the GC/MS system. Purge-and-trap, by Methods 5030C (aqueous samples) and 5035A (solid and waste oil samples), is the most commonly used technique for volatile organic analytes. However, other techniques are also appropriate and necessary for some analytes. One technique is direct injection of an aqueous sample (concentration permitting).

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the gas chromatograph/mass spectrometers and in the interpretation of mass spectra and their use as a quantitative tool. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method or by direct injection. The analytes are introduced to a narrow-bore capillary column for analysis. The Gas Chromatograph (GC) is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced to the GC.

Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact (or electron impact-like) spectra of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard, comparing sample response to the calibration standards.

2.1 Method Modifications from Reference

None.

3. Reporting Limits

Table 1 lists our typical reporting limits.

4. Interferences

4.1 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be free from contamination under the conditions of the analysis. Running laboratory reagent blanks as described in Section 10.3 and 9.1 demonstrates the system is free of contamination. The use of non-Teflon plastic tubing, non-Teflon thread sealants, or flow controllers with rubber components in the purge and trap system must be avoided.

4.2 Sample contamination occurs by diffusion of volatile organics (particularly fluorocarbons and methylene chloride) through the septum seal into the sample during shipment and storage. A trip blank or a field reagent blank prepared from reagent water and carried through the sampling and handling protocol serves as a check on such contamination.

4.2.1 Storage blanks shall be analyzed if contamination is suspect. If contamination is confirmed by positive detections in the sample storage blanks, all data from samples contained in the relative refrigerator or freezer shall be evaluated for possible contamination. If the samples contain suspected contamination, the Client Services department shall be notified in order to contact the necessary clients regarding the contamination. Samples shall be reanalyzed if so desired by the client. If suspected contamination is not confirmed by storage blanks, no further action shall be pursued concerning said blanks. It is recommended that further action be taken to determine the possible cause of suspected contamination.

4.3 Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. Whenever a highly concentrated sample is being encountered, it should be followed by an analysis of reagent water (instrument blank) to check for potential contamination. If carry-over is suspected, then numerous instrument blanks may be required; additionally all affected samples are rerun for confirmation.. In case of severe contamination, preventive maintenance of the entire system may be required.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromoethane, tetrachloroethene, trichloroethene, and vinyl chloride. Pure standard materials and stock standard solutions of these compounds should be handled in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

5.1 Lab coats, safety glasses, and gloves must be worn when handling samples, standards, or solvents.

5.2 All stock solution standard preparation must be performed in the volatiles hood. Initial calibration, continuing calibration, laboratory control sample and client sample dilutions do not need to be performed in the hood.

5.3 All expired standards must be placed into the waste bucket in the lab, for future disposal. The container must be labeled properly with hazard warning labels indicating the container contents.

5.4 Bottles containing Methanol must be stored in the flammables cabinet.

6. Sample Collection, Preservation, Storage, Shipping and Handling

6.1 Sample Collection and Preservation

6.1.1 Aqueous Samples

Grab samples are collected in standard 40mL amber glass screw-cap vials with Teflon lined silicon septa (VOA vial). Two or more VOA vials should be filled per sample location. EPA Method 8260 requires that samples be acidified to eliminate the possibility of biological degradation. Unless otherwise directed for project-specific reasons, all VOA vials are delivered to the client with approximately 2 – 4 drops of 1:1 HCl added to the vial, which is sufficient to adjust the pH of the sample to < 2. Prepared trip blanks are provided to the client to accompany field samples for QC purposes.

Fill the sample vial to the point of overflowing so that no headspace is contained within. Samples must be introduced into the vials gently to reduce agitation, which might drive off volatile compounds or cause loss of the HCl preservative.

Seal the bottle so that no air bubbles are in the VOA vial. If preservative has been added, shake vigorously for one minute. Invert the bottle and tap to check for air bubbles. Recollect the samples if any air bubbles are present.

Maintain the hermetic seal on the VOA vial until time of analysis.

6.1.2 Soil Samples

The recommended sampling method for soil samples is EPA 5035A. Method 5035A provides for two distinct sampling procedures, depending on the required reporting limits and suspected or known concentration levels of target analytes. These methods are referred to as the High Level and Low Level methods. Both are listed below, but depending on the samples only one of the methods may be required. If concentration levels are unknown, it is recommended that samples be collected using both procedures. The Lab will analyze the high level sample first, followed by the low level sample if the results from the high level analysis show that the sample is clean or contains analytes at low levels. The typical reporting levels of the two methods are listed in Table 1.

6.1.2.1 High Level Soil Samples

Collect sample in a standard 40mL amber glass screw-cap vial with Teflon lined silicon septa (VOA vial). The vial is provided containing 15mL of Purge and Trap Grade methanol, and is labeled and weighed prior to addition of sample. Record the weight of the vial with methanol on the vial label. Prepared trip blanks are provided to the client to accompany field samples for QC purposes.

Approximately 15g of soil is added to the vial in the field, making sure that the sample is completely covered by the methanol.

Maintain the hermetic seal on the VOA vial until the time of analysis.

An additional sample of the soil must also be obtained (without methanol) to be used for the determination of soil moisture content to allow for the calculation of the dry weight results, and to calculate the methanol dilution effect. (See Sections 11.1.2.2.2 and 11.1.2.2.3)

6.1.2.2 Low Level Soil Samples

` Collect sample in a standard 40mL amber glass screw-cap vials with Teflon lined silicon septa (VOA vial). Two samples should be taken per sample location. Vials are provided containing a magnetic stirring bar and 5 mL of either 200g/L sodium bisulfate solution or water, prepared by a certified vendor. These vials are labeled and weighed prior to addition of sample. Record the weight of the vial with the stirring bar and preservative on the vial label.

Approximately 5g of soil is added to the vial in the field, making sure that the sample is completely covered by the sodium bisulfate solution or water.

Maintain the hermetic seal on the VOA until the time of analysis.

6.2 Sample Handling and Storage

Document client specific sample handling, preservation and collection criteria in the project file. The laboratory Log-in staff documents sample temperature at the time of receipt.

Record deviations from this SOP or client specific criteria on the chain of custody form.

Record holding time exceedence, improper preservation and observed sample headspace on the nonconformance report form.

6.2.1 Aqueous Samples

Ice or refrigerate all samples from the time of collection until analysis, maintaining the sample temperature between 1 and 4 °C. Sample receiving personnel note on the sample delivery group form when samples received at the laboratory are not within the temperature criteria. If more than one vial is received for a sample the vials are stored in separate refrigerators. Storing the vials apart provides a useful check if laboratory contamination of a sample is suspected. Samples must be analyzed within 14 days of collection. Unpreserved samples requiring aromatic analysis must be analyzed within 7 days of collection.

6.2.2 High Level Soil Samples

Ice or refrigerate all samples from the time of collection until analysis, maintaining the sample temperature between 2 and 6 °C. Sample receiving personnel note on the nonconformance report form when samples received at the laboratory are not within the temperature criteria.

6.2.3 Low Level Soil Samples

Ice or refrigerate samples preserved with water or sodium bisulfate from the time of collection until analysis, maintaining the sample temperature between 2 and 6 °C. Samples preserved with water are to be immediately frozen after sampling. Sample receiving personnel note on the nonconformance report form when samples received at the laboratory are not within the temperature criteria.

6.3 Sample Shipping

Samples requiring shipment to the laboratory are shipped in ice-packed coolers via an overnight delivery service in accordance with applicable Department of Transportation regulations.

7. Equipment and Supplies

7.1 Purge and Trap System (For Aqueous samples and High Level Soils): The purge-and-trap system consists of two separate pieces of equipment: a purging device (autosampler) (Varian Archon/8100, Tekmar Solatek, EST Centurion) coupled to the desorber (concentrator) (Tekmar Velocity or EST Encon).

7.1.1 Purge gas = Helium, analytical grade (99.999%).

7.1.2 The purging device is configured with 25 mL sample purge tubes, and the helium purge gas is introduced at the bottom of the water column as finely divided bubbles

7.1.3 The trap used in the desorber is typically a Supelco “K” trap. Different traps may be used if equivalent performance is demonstrated.

7.1.4 The desorber is capable of rapidly heating the trap to 260°C. The trap is not heated above manufacturer’s specifications

7.2. Purge and Trap System (For Low Level Soil Samples): The purge and trap system consists of two separate pieces of equipment: a purging device (autosampler) coupled to the desorber (concentrator) (Varian Archon/8100, Tekmar Solatek, EST Centurion with EST Encon, Tekmar Velocity, or equivalents).

7.2.1. Purge gas = Helium, analytical grade (99.999%).

7.2.2. The autosampler purging device is a closed system, designed to accept the 40mL VOA vials. The VOA vial, containing the soil sample, water (or sodium bisulfate), and stirring bar is placed into the autosampler tray. The instrument automatically adds reagent water, internal standards, and surrogates to the unopened VOA vial. The vial is heated to 40 °C, and the helium purge gas is introduced into the aqueous portion to purge the volatile components onto the trap.

7.2.3. The trap used in the desorber is typically a Supelco “K” trap. Different traps may be used if equivalent performance is demonstrated.

7.2.4. The desorber is capable of rapidly heating the trap to 260 °C. The trap is not heated above manufacturer specifications.

7.3 Gas Chromatography/Mass Spectrometer/Data System:

7.3.1 **Gas Chromatograph, Agilent 6890/7890 or equivalent:** An analytical system complete with a temperature-programmable gas chromatograph with appropriate interface for sample introduction device. The system includes all required accessories, including syringes, analytical columns, and gases. The capillary column is directly coupled to the source of the GC/MS system.

7.3.2 Typical Gas Chromatographic Columns:

7.3.2.1 Column 1: Restek 502.2, 40 meter, 0.18mm ID, or equivalent.
7.3.2.2 Column 2: Restek RTX-VMS, 30 meter, 0.25mm ID, or equivalent

7.3.3 Mass Spectrometer, Agilent 5973/5975/5978 or equivalent: Scanning from 35 to 300 amu every 2 seconds or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for 4-Bromofluorobenzene (BFB) which meets all of the criteria in Table 3, when 50ng of the GC/MS tuning standard (BFB) are injected through the GC. For 1,4-Dioxane SIM analysis, the mass spectrometer must also be able to acquire data in a dual acquisition mode (SIM and full scan).

7.3.4 Data System: Hewlett-Packard EnviroQuant software is used for data acquisition, and allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program.

Thruput Target 4.12 software or Enviroquant E.02.02 (or equivalent) is used for data processing, and allows searching of any GC/MS data file for ions of a specified mass, and plotting such ion abundances versus time or scan-number.

The most recent version of the EPA/NIST Mass Spectral Library is loaded onto the Target / Enviroquant data system.

7.4 Wiretrol or Microsyringes: 10µL - 1,000µL.

7.5 Syringes: 5mL, 10mL, or 25mL, glass with Luerlock tip.

7.6 Balances: Top-loading, capable of weighing 0.1g.

7.7 Vials: 2mL, 4mL.

7.8 Disposable Pipets.

7.9 Volumetric Flasks: Class A, appropriate sizes, with ground-glass stoppers.

7.10 Eppendorf Pipets

8. Reagents and Standards

Reagent grade organic chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all organic reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

Great care must be taken to maintain the integrity of all standard solutions. Standards in methanol are stored at –10ºC or less, in amber vials with PTFE-lined screw-caps.

8.1 Organic-free Reagent Water:

All references to water in this method refer to organic-free reagent water, which is tap water passed through activated carbon and air bubbled through.

8.2 Methanol:

Purge and Trap Grade or equivalent. Store in flammables cabinet.

8.3 Stock Solutions:

All stock standard solutions are purchased from commercial vendors as ampulated certified solutions. When an ampulated stock solution is opened, it is transferred to a labeled amber screw-cap vial with minimal headspace. The expiration date of the stock solution is either the vendor specified expiration date or 6 months from the date the ampule was opened, whichever is sooner. Typical stock standard concentrations are listed in Table 4.

8.4 Intermediate Standards:

Intermediate standards are prepared volumetrically by diluting the appropriate stock standard(s) with methanol. Initial Calibration solutions expire 2 months from the date of preparation, or sooner if daily continuing calibration checks do not achieve the method acceptance criteria. If the Intermediate Standards are used as a second source to verify a valid Initial Calibration solution, there is no expiration date.

8.4.1 Internal Standard Solutions:

The internal standards are Fluorobenzene, Chlorobenzene-d_5, and 1,4-Dichlorobenzene-d_4. The intermediate IS solution is prepared by diluting the stock solution(s) with methanol to a concentration of 100 µg/mL. The appropriate amount of IS solution is added to the water or soil sample or QC sample to achieve a final concentration of 100 ng/sample or standard. Internal standard is added at the same concentration to all standards, samples, and QC samples.

8.4.2 Surrogate Standard Solutions:

The surrogate standards are Dibromofluoromethane, 1,2-Dichloroethane-d_4, Toluene-d_8, and 4-Bromofluorobenzene. The intermediate surrogate solution is prepared by diluting the stock solution(s) with methanol to a concentration of 100 µg/mL. The appropriate amount of surrogate solution is added to the water or soil sample or QC sample to achieve a final concentration of 100 ng/sample.

8.4.3 Target Compound Solutions:

The target analytes routinely reported by this method are listed in the beginning of this SOP. The intermediate target compound solutions are prepared by diluting the stock solution(s) with methanol. This set of solutions, at concentrations of 200 µg/mL, is used for preparation of the calibration standards.

8.4.4 4-Bromofluorobenzene (BFB) Tune solution:

A solution containing BFB at a concentration of 50 µg/mL is prepared by volumetrically diluting the BFB stock solution. 1 µL of this solution is direct-injected or purged into the GC/MS system to verify system performance prior to any standard or sample analysis.

8.5 Calibration Standards:

There are two types of calibration standards used for this method – initial calibration standards and calibration verification standards.

8.5.1 Initial Calibration Standards:

Initial calibration standards can be prepared at the levels listed in Table 4 (other/different levels are allowed). The Initial Calibration needs to have a minimum of 5 standards, 6 if a quadratic curve fit is used. Prepare these solutions in organic-free reagent water. The standards correspond to the range of concentrations found in typical samples and do not exceed the working range of the GC/MS system. Initial calibration should be mixed from fresh stock standards and dilution standards when generating an initial calibration curve.

8.5.2 Initial Calibration Verification Standard (ICV):

The initial calibration verification standard is at the same concentration as the level 3 initial calibration standard. This standard is made from a second source than the Initial Calibration Standards.

8.5.3 Continuing Calibration Verification Standard:

The continuing calibration verification standard, or calibration check standard, should be analyzed near the action level of the project. Since most projects are focused on achieving low reporting limits, the continuing calibration verification standard is at the same concentrations as the level 3 initial calibration standard. This standard is run at the beginning of each analytical sequence, following the BFB tune standard, to verify system performance.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

Blank samples must be matrix specific, i.e. methanol samples need to have methanol in the blank; sodium bisulfate samples need to have a sodium bisulfate blank analyzed; TCLP samples need a TCLP blank.

Analyze a matrix-specific blank each day prior to sample analysis to demonstrate that interferences from the analytical system are under control. The blank must contain the internal standards and surrogates.

Analyze the reagent water blank from the same source of water used for preparing the standards, QC samples and making sample dilutions. The method blank must not contain any target analytes at or above the compound reporting limits.

9.2 Laboratory Control Sample (LCS)/ Laboratory Control Sample Duplicate (LCSD)

A LCS/LCSD pair is analyzed at the beginning of each analytical sequence. Since the LCS contains the same compounds at the same concentrations as the continuing calibration check standard, the same analysis is used to satisfy both QC elements. The LCS/LCSD acceptance criteria are based on in-house control limits, unless specified by project/regulation.

9.3 Initial Calibration Verification (ICV)

Refer to Section 10.2.5.

9.4 Continuing Calibration Verification (CCV)

Refer to Section 10.4.4.

9.5 Matrix Spike/ Matrix Spike Duplicate

Upon Client Request, a matrix spike/matrix spike duplicate pair may be analyzed with each batch of 20 or less samples. The MS/MSD are sample aliquots spiked with the target compounds at the same concentration as the continuing calibration standard. The MS/MSD acceptance criteria are based on in-house control limits. If the MS/MSD does not meet the criteria, but the LCSD does, the failure may be attributed to sample matrix. Report the MS/MSD, including a narrative sheet for inclusion with the client report.

9.6 Laboratory Duplicate

Not applicable.

9.7 Method-specific Quality Control Samples

9.7.1 Internal Standards

Area counts of the internal standard peaks in all samples and QC samples must be between 50-200% of the areas of the internal standards in the QC check standard.

If any individual percent recovery falls outside the range, that parameter has failed the acceptance criteria. For calibration standards, CCVs, LCS/LCSD or blanks the internal standard must be within the range for data to be reported to the clients. For samples, matrix spikes and duplicates: if the data is not within the range, the sample is rerun to confirm that the failure is due to sample matrix. A nonconformance report form is completed to ensure client notification and reporting if matrix effect is confirmed.

9.7.2 Surrogates

Surrogates are added to each field sample and QC sample. The laboratory must evaluate surrogate recovery data from individual samples versus the surrogate control limits developed by the laboratory. The surrogate acceptance criteria are listed in Table 2. Since the 1,4-Dioxane SIM analysis is acquired in dual mode, the surrogates from the full scan are used to evaluate the entire sample (SIM and full scan).

9.8 Method Sequence

In a 12-hour period, the typical analytical sequence is as follows:

- BFB
- QC Check Standard/Laboratory Control Sample/LCSD
- Method Blank
- Samples
- MS/MSD (upon Client request, may be run anytime after the Method Blank)

10. Procedure

10.1 Equipment Set-up

Typical instrument operating conditions are listed below. Alternate conditions are allowed, as long as method performance criteria can be met.

10.1.1 GC Conditions:

Temperature 1: 35°C
Hold Time 1: 4 minutes
Ramp 1: 6°C/minute
Temperature 2: 150°C
Hold Time 2: 0 minutes
Ramp 2: 8°C/minute
Temperature 3: 220°C
Final Time: 1 minute

Carrier gas: Helium, 99.999%
Carrier mode: Constant flow
Carrier flow: 1 mL/minute

10.1.2 MS Conditions:

Mass scan range: 35 – 260 amu
Scan time: 0.5 minutes/scan
Source temperature: 230°C

10.1.3 Velocity Concentrator Purge and Trap Conditions:

Purge time: 11 minutes
Dry purge: 2 minutes

Desorb preheat: 250°C
Desorb temp: 255°C
Desorb time: 2 minutes

Bake temp: 290°C
Bake time: 10 minutes

10.1.4 Encon Concentrator Purge and Trap Conditions:

Purge time: 11 minutes
Dry purge: 1 minute

Desorb preheat: 245°C
Desorb temp: 255°C
Desorb time: 1 minute

Bake temp: 270°C
Bake time: 10 minutes

10.2 Initial Calibration

10.2.1 The initial calibration is performed at a minimum of five (5) concentration levels listed in Table 4, the low level of the either at or below the reporting limit. The calibration is performed using instrument conditions listed in Section 10.1.

BFB must be analyzed prior to analysis of the initial calibration standards, and must pass the criteria listed in Table 3. The mass spectrum of BFB should be acquired in the following manner:

(1) Three scans (the peak apex scan, the scan immediately preceding the apex and the scan immediately following the apex) are acquired and averaged.
(2) Background subtraction is performed using a single scan of no more than 20 scans prior to the elution of BFB.

This is done automatically with the ThruPut Target / Enviroquant software.

10.2.1.1 **Low Level/High Level Soil Curve on Archon or Centurion:** To prepare a calibration standard, add the appropriate volume of standard solution(s) to a 50mL volumetric flask using a microsyringe. Remove the needle quickly and mix by inverting the flask 3 times. Pour several mLs of the aqueous standard into the waste vessel, then gently fill a 5mL syringe with standard and transfer to a 40mL VOA vial containing a magnetic stir bar. Load the vial onto Archon Autosampler.

10.2.1.2 **Aqueous/High Level Soil Curve on Solatek or Centurion:** To prepare a calibration standard, add the appropriate volume of standard solution(s) to a 100mL volumetric flask using a microsyringe. Remove the needle quickly and mix by inverting the flask 3 times. Pour several mLs of the aqueous standard into the waste vessel, then gently fill a 40mL VOA vial to the top. Load the vial onto the Autosampler.

10.2.2 Establish the GC operating conditions by loading the appropriate GC method. Typical instrument conditions are listed in Section 10.1. The same operating conditions are used for calibration and sample analyses. Create the analytical sequence using the HP Enviroquant data acquisition software.

Relative Response Factors: The internal standard calibration technique is used. In each calibration standard, calculate the relative response factor for each analyte and the relative standard deviation (RSD) of the response factors using the Target / Enviroquant data processing software. The response factors are calculated using the areas of the characteristic (quantitation) ion for each target analyte and internal standard. The calculations are performed automatically using the Target / Enviroquant software, using the formulae listed in Alpha's Quality Manual.

10.2.3 **Initial Calibration Criteria:** The following sections outline the method acceptance criteria for an initial calibration curve. All criteria must be met for the calibration to be deemed acceptable, and for sample analysis to proceed.

10.2.3.1 **Relative Standard Deviation Criteria:** If the RSD for each target analyte is less than or equal to 20%, then the response for this compound is considered linear over the calibration range and the mean calibration factor can be used to quantitate sample results. If the 20% RSD criterion is not met for an analyte linear regression may be used if **r** ≥ 0.990, weighted linear with a weighting factor of 1/SD2 and r > 0.990, or quadratic fit if $\mathbf{r}^2 \geq 0.995$. A minimum of six points is required and the low point of the calibration must be re-quantitated and recover within 70-130% to be deemed acceptable. The calibration must be repeated for any compounds that fail. If more than 10% of the compounds exceed the 20% RSD limit and do not achieve the minimum correlation coefficient for alternative curve fits, sample analysis cannot proceed.

10.2.3.2 Minimum Response Factors: Table 1 lists the suggested minimum response factors for the most common analytes. Each calibration level must be evaluated against the specified criteria. Analytes that fall below the criteria, but are greater than or equal to 0.05, are narrated for inclusion on the final report. There are certain very poor purgers (1,4-Dioxane, Acrolein, ketones and alcohols) that should meet a 0.001 response factor. If an analyte falls below 0.05 (or 0.001 for 1,4-Dioxane, Acrolein, ketones and alcohols), then corrective action must be taken to resolve the problem before analysis can proceed.

10.2.4 Evaluation of Retention Times: The relative retention times used for identification of target analytes are +/- 0.06 RRT (Relative Retention Time) units, based on the most recent standard run. It has been determined that these limits work well, being wide enough to eliminate false-negative results while being tight enough to eliminate false positive results. Due to the selectivity of the mass spectrometer, compound identification is more definitive than when using a less selective detector.

10.2.5 Initial Calibration Verification: After each calibration and before the analysis of samples, an ICV must be analyzed at or near the midpoint of the curve. The ICV must be prepared using a different source than the Initial Calibration and must contain all target analytes. The percent recoveries must be between 70% and 130% for target analytes except for “difficult” analytes (Table 7), which must exhibit percent recoveries between 40% and 160%. Corrective action is required if greater than 10% of all analytes are outside the prescribed criteria.

10.3 Equipment Operation and Sample Processing

The same GC, MS, and Purge and Trap conditions used for the initial calibration must be employed for sample analysis. After verification of system performance by analysis of BFB, the continuing calibration standard and method blank, samples are analyzed and processed as described below.

10.3.1 Analysis of Samples

Retrieve sample VOA vials from the sample bank refrigerator just prior to loading onto the purge and trap system. High level soil samples must be shaken for 1 – 2 minutes to extract the volatile components into the methanol. Let sample settle prior to taking methanol aliquot. Low level soil sample should be shaken briefly to ensure that the stir bar is loose, and will spin on the Archon or Centurion unit.

10.3.1.1 Low level soil samples: (Archon or Centurion)
Take the low level VOA vial and place directly into the rack of the Archon sampling unit. Surrogate and internal standards are added automatically by the Archon prior to sample purging.

10.3.1.2 Aqueous samples: (Solatek or Centurion)

Load the VOA vial directly on the sampling rack. Dilutions may be prepared volumetrically and poured into VOA vials ensuring there is no headspace left in the vial. The auto-sampler will then sample 10mL from the VOA vial.

10.3.1.3 High level soil samples: (Archon/Solatek/Centurion)

Shake for 2 minutes, ensuring the methanol has completely penetrated the soil in the vial.

10.3.1.3.1 Through liquid path
Load a maximum of 430µL or appropriate dilution of the methanol into a half-full VOA vial. Fill the VOA vial up to the top with water and cap with no headspace. Allow the auto-sampler to sample 10mL out of the VOA vial which would be equivalent to injecting 100µL of the methanol extract. Prepare dilutions accordingly.

10.3.1.3.2 Through soil path
Into a VOA vial with a stir bar added, load 4.9mL of water plus a maximum of 100 µL of methanol or appropriate dilution of methanol extract from a 5mL luerlock syringe. Cap the vial and load onto the auto-sampler.

10.3.2 Qualitative Analysis:

10.3.2.1 The qualitative identification of each compound is based on retention time and on comparison of the sample mass spectrum with the reference mass spectrum. The reference mass spectrum must be generated by the laboratory on the same GC/MS system. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.3.2.1.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. The Target / Enviroquant data system is configured to make this check.

10.3.2.1.2 The relative retention time (RRT) of the sample component is within ±0.06 RRT units of the RRT of the standard component.

10.3.2.1.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.)

10.3.2.1.4 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs (i.e., m and p-xylene).

10.3.2.1.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.

10.3.2.1.6 Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e., only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

10.3.2.2 For samples containing non-target analytes, a library search will be performed at client request. Compound identification will be classified as “tentative”, and the concentration will be reported as an estimate as no quantitative standards are run for these compounds.

1) Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
2) The relative intensities of the major ions should agree within ±20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%.)
3) Molecular ions present in the reference spectrum should be present in the sample spectrum.
4) Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.
5) Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks.

10.3.3 Quantitative Analysis:

10.3.3.1 Quantitation of a target compound detected in a sample is performed automatically by the Target / Enviroquant data processing software, using the formulae found in Alpha’s Quality Manual. Either the average response factor or calibration curve will be used for sample quantitation, depending on how the particular analyte was processed in the initial calibration curve.

If non-target compounds are to be reported, the quantitation is performed automatically by the Target / Enviroquant software using the total area of the compound and the nearest internal standard, and assuming a relative response factor of 1.0.

10.4 Continuing Calibration

Calibration verification consists of three steps that are performed at the beginning of each 12-hour analytical shift.

10.4.1 Prior to the analysis of samples or calibration standards, inject or purge 1 µL (50 ng) of the 4-Bromofluorobenzene standard (Section 8.4.4) into the GC/MS system. The resultant mass spectra for the BFB must meet the criteria given in Table 3 before sample analysis begins.

10.4.2 The initial calibration curve for each compound of interest must be verified once every 12 hours prior to sample analysis. This is accomplished by analyzing the continuing calibration check standard (Section 8.5.3).

10.4.3 A method blank must be analyzed prior to any samples, typically immediately following the continuing calibration check standard, to ensure that the analytical system is free of contaminants. The method blank must not contain any target analytes at or above the required compound reporting limits.

10.4.4 The percent difference or drift for each target analyte must be less than or equal to 20% (30% for 1,4-Dioxane SIM). If greater than 20% of target analytes exceed the %D criteria corrective action must be taken prior to the analysis of samples. If less than or equal to 20% of compounds exceed the criteria, corrective action is not required.

10.4.5 The continuing calibration standard must also be evaluated for the suggested minimum response factor criteria, as specified in section 10.2.3.2

10.4.6 Internal Standard Retention Time:

The retention times of the internal standards in the calibration verification standard are evaluated after data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

10.4.7 Internal Standard Response:

If the area for any of the internal standards in the calibration verification standard changes by a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning is required.

10.5 Preventive Maintenance

Routine preventive maintenance should be performed on the analytical system. This includes replacement of GC septa and periodic rinsing or replacement of purge and trap tubes and sparge needles. The trap should be replaced every six months, or sooner if performance criteria cannot be met. Periodic cleaning (typically twice per year) of the mass spectrometer ion source is required. More frequent source cleaning may be needed, especially if dirty samples are analyzed.

If system performance deteriorates, additional maintenance may be required. This includes replacement of injector ports and seals, clipping several inches off of the front end of the GC column, or in extreme cases the replacement of the GC column. Flushing or replacement of purge and trap lines may be necessary if they become contaminated or develop active sites.

Perform routine preventative maintenance as described throughout this SOP. Record all maintenance in the instrument logbook.

11. Data Evaluation, Calculations and Reporting

11.1.1 LIMS Data Corrections

Please note that the Laboratory Information Management System (LIMS) automatically adjusts soil sample results to account for the % Total Solids of the sample (as determined per Alpha SOP/07-38) and the methanol preservation dilution effect.

11.1.2 Data Calculations

11.1.2.1 Results of Aqueous Sample Analysis:

$$\text{concentration (ug/L)} = \frac{(Conc.)(Vp)(DF)}{(Vs)}$$

where:

Conc. = On-column concentration obtained from the quantitation report.
Vp = Volume purged, 10 mL is standard
Vs = Volume of sample purged
DF = Dilution factor, for manually prepared dilutions, not instrumental "dilutions".

11.1.2.2 Results of Sediment/Soil, Sludge, and Waste Analysis:

All solids including soils, sediments, and sludges must be reported on a dry-weight basis.

11.1.2.2.1 Low-Level Samples:

$$\text{concentration (ug/Kg)} = \frac{(Conc.)(Vp)(DF)}{(W)(\%S)}$$

11.1.2.2.2 High-Level Samples:

$$\text{concentration (ug/Kg)} = \frac{(Conc.)(Vp)(5000)(DF)}{(W)(Ve)(\%S)}$$

where:

Conc. = On-column concentration obtained from the quantitation report.
DF = Dilution factor, for manually prepared dilutions, not instrumental "dilutions".
Ve = Extract volume, mL
Vp = Volume purged, 5 mL is standard
W = Aliquot of sample (wet), g
%S = Sample % solid
5000 = Constant representing the final volume of the methanol extraction.

11.1.2.2.3 High-Level Samples Corrected for Total Water/Solvent Mixture (V_t):

Samples that are extracted prior to analysis in a water miscible solvent such as methanol are diluted by the total volume of the water/solvent mixture. The total mixture volume can only be calculated based on the sample moisture present as determined by the % moisture calculation.

$$\text{\% moisture} = \frac{\text{g of sample} - \text{g of dry sample}}{\text{g of sample}} \times 100$$

$$V_t = \frac{[\text{mL of solvent} + (\text{\%moisture} \times \text{g of sample})]}{100} \times 1000\text{mL/mL}$$

The calculated V_t value is now added to the volume of methanol in the sample (typically 5000µL), and the corrected concentration is calculated using the equation below:

$$\text{Corrected concentration (mg/Kg)} = \frac{(\text{Conc.})\ (V_t + \text{methanol vol.})\ (Vp)\ (DF)}{(W)\ (Ve)\ (\%S)}$$

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

All batch and sample specific QC criteria outlined in section 10 are evaluated by the analyst prior to approval of the data. When any QC criteria fail, the cause for the failure must be identified and corrected. This may include instrument recalibration followed by sample reanalysis, sample cleanup, or sample re-extraction. If it is determined that the failure is due to sample matrix effects, a project narrative report is written by the analyst for inclusion in the data report. If there is insufficient sample volume to perform the re-analysis for confirmation, this is also noted in the narrative and included in the client report.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/08-05. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/08-12 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/08-05 MDL/LOD/LOQ Generation

SOP/08-12 IDC/DOC Generation

SOP/14-01 Waste Management and Disposal SOP

16. Attachments

TABLE 1: 8260 REPORTING LIMITS

TABLE 2: 8260 QC ACCEPTANCE CRITERIA

TABLE 3: BFB TUNING CRITERIA

TABLE 4: STANDARD SOLUTIONS

TABLE 5: 8260C Volatile Internal Standards with Corresponding Target Compounds and Surrogates Assigned for Quantitation

TABLE 6: 8260C Quantitation Ions

Table 1
Standard Reported Detection Limits
US EPA METHOD 8260C and 5035A/8260C

Analyte	**Recommended Minimum Response Factor**	**RDL (µg/L)**	**RDL(µg/KG)(1)**	**RDL (µg/KG) (2)**
Acetone (3,4,5)	0.100	5.0	10	250
Acrolein (5)		5.0	25	1250
Acrylonitrile (3,4)		5.0	5	200
Benzene (3,4,5)	0.500	0.5	1	50
Bromobenzene (3,4)		2.5	5	250
Bromochloromethane (3,4,5)		2.5	5	250
Bromodichloromethane (3,4,5)	0.200	0.5	1	50
Bromoform (3,4,5)	0.100	2.0	4	200
Bromomethane (3,4,5)	0.100	1.0	2	100
2-Butanone (3,4,5)	0.100	5.0	10	500
n-Butyl benzene (3,4)		0.5	1	50
sec-Butyl benzene (3,4)		0.5	1	50
tert-Butyl benzene (3,4)		2.5	5	250
Carbon disulfide (3,4,5)	0.100	5.0	10	500
Carbon tetrachloride (3,4,5)	0.100	0.5	1	50
Chlorobenzene (3,4,5)		0.5	1	50
Chloroethane (3,4,5)	0.100	1.0	2	100
2-Chloroethylvinyl ether (3)		10.0	20	1000
Chloroform (3,4,5)	0.200	0.75	1.5	75
Chloromethane (3,4,5)	0.100	2.5	5	250
o-Chlorotoluene (3,4)		2.5	5	250
Cyclohexane (5)	0.100	10	20	1000
Cyclohexanone		10	20	1000
p-Chlorotoluene (3,4)		2.5	5	250
Dibromochloromethane (3,4,5)	0.100	0.5	1	50
1,2-Dibromo-3-chloropropane (3,4,5)	0.050	2.5	5	250
1,2-Dibromoethane (3,4,5)	0.100	2.0	5	250
Dibromomethane (3,4)		5.0	10	500
1,2-Dichlorobenzene (3,4,5)	0.400	2.5	5	250
1,3-Dichlorobenzene (3,4,5)	0.600	2.5	5	250
1,4-Dichlorobenzene (3,4,5)	0.500	2.5	5	250
1,4-Dichlorobutane (3,4)		5.0	10	500
trans-1,4-Dichloro-2-butene (3,4)		2.5	5	250
Dichlorodifluoromethane (3,4,5)		5.0	10	500
1,1-Dichloroethane (3,4,5)	0.200	0.75	1.5	75
1,2-Dichloroethane (3,4,5)	0.100	0.5	1	50
1,1-Dichloroethene (3,4,5)	0.100	0. 5	1	50
cis-1,2-Dichloroethene (3,4,5)	0.100	0.5	1	50
trans-1,2-Dichloroethene (3,4,5)	0.100	0.75	1.5	75

Table 1 (continued)
Standard Reported Detection Limits
US EPA METHOD 8260C and 5035A/8260C

Analyte	Recommended Minimum Response Factor	RDL (µg/L)	RDL(µg/KG)$^{(1)}$	RDL (µg/KG) $^{(2)}$
1,2-Dichloropropane $^{(3,4,5)}$	0.100	1.75	3.5	175
1,3-Dichloropropane $^{(3,4)}$		2.5	5	250
2,2-Dichloropropane $^{(3,4)}$		2.5	5	250
1,1-Dichloropropene $^{(3,4)}$		2.5	2.5	250
cis-1,3-Dichloropropene $^{(3,4,5)}$	0.200	0.5	1	50
p-Diethylbenzene $^{(4)}$		2.0	4	200
Diisopropyl Ether $^{(6)}$		2.0	4	200
1,4-Dioxane $^{(5)}$ (non-SIM)		250	100	5000
trans-1,3-Dichloropropene $^{(3,4,5)}$	0.200	0.5	1	50
Ethanol $^{(7)}$		N/A	1000	50000
Ethyl acetate		10.0	20	1000
Ethylbenzene $^{(3,4,5)}$	0.100	0.5	1	50
Ethyl ether $^{(3,4)}$		2.5	5	250
4-Ethyltoluene $^{(4)}$		2.0	4	200
Ethyl methacrylate $^{(3,4)}$		5.0	10	500
Ethyl-Tert-Butyl-Ether $^{(6)}$		2.0	4	200
Freon-113 $^{(5)}$		10.0	20	1000
Hexachlorobutadiene $^{(3,4)}$		0.5	5	250
2-Hexanone $^{(3,4,5)}$	0.100	5.0	10	500
Iodomethane		5.0		
Isopropylbenzene $^{(3,4,5)}$	0.100	0.5	1	50
p-Isopropyltoluene $^{(3,4)}$		0.5	1	50
Methyl Acetate $^{(5)}$	0.100	20	20	1000
Methylene chloride $^{(3,4,5)}$	0.100	3.0	10	500
Methyl Cyclohexane $^{(5)}$	0.100	20	4	200
Methyl Methacrylate		1.0		
4-Methyl-2-pentanone $^{(3,4,5)}$	0.100	5.0	10	500
Methyl-tert-butyl-ether $^{(3,4,5)}$	0.100	1.0	2	100
Naphthalene $^{(3,4)}$		2.5	5	250
n-Butanol $^{(5)}$		100	200	10000
n-Propylbenzene $^{(3,4)}$		0.5	1	50
Styrene $^{(3,4,5)}$	0.300	1.0	2	100
Tert-Butyl Alcohol $^{(5)}$		30	100	5000
Tertiary-Amyl Methyl Ether $^{(6)}$		2.0	4	200
1,1,1,2-Tetrachloroethane $^{(3,4)}$		0.5	1	50
1,2,4,5-Tetramethylbenzene $^{(4)}$		2.0	4	200
1,1,2,2-Tetrachloroethane $^{(3,4,5)}$	0.300	0.5	1	50
Tetrachloroethene $^{(3,4,5)}$	0.200	0.5	1	50

Analyte	**Recommended Minimum Response Factor**	**RDL (µg/L)**	**RDL(µg/KG)[1]**	**RDL (µg/KG)[2]**
Tetrahydrofuran (3)		10.0	20	1000
Toluene (3,4,5)	0.400	0.75	1	75
1,2,3-Trichlorobenzene (3,4,5)		2.5	5	250
1,2,4-Trichlorobenzene (3,4,5)	0.200	2.5	5	250
1,3,5-Trichlorobenzene (6)		2.0	5	250
1,1,1-Trichloroethane (3,4,5)	0.100	0.5	1	50
1,1,2-Trichloroethane (3,4,5)	0.100	0.75	1.5	75
Trichloroethene (3,4,5)	0.200	0.5	1	50
Trichlorofluoromethane (3,4,5)	0.100	2.5	5	250
1,2,3-Trichloropropane (3,4)		5.0	10	500
1,2,4-Trimethylbenzene (3,4)		2.5	5	250
1,3,5-Trimethylbenzene (3,4)		2.5	5	250
Vinyl acetate (3,4)		5.0	10	500
Vinyl chloride (3,4,5)	0.100	1.0	2	100
m/p-Xylenes (3,4,5)	0.100	1.0	2	100
o-Xylene (3,4,5)	0.300	1.0	2	100
1,4-Dioxane (5) SIM		3.0		

(1) Detection Limits are for Low-level Aqueous preserved samples.
(2) Detection Limits are for High-level Methanol preserved samples.
(3) Analyte reported by standard 8260 reporting list.
(4) Analyte reported by New York TCL reporting list.
(5) Analyte reported by New Jersey TCL reporting list.
(6) Analyte reported for New Hampshire in addition to standard 8260 reporting list.
(7) Analyte only reported for New York TCL report upon client request.

Note: Reporting Limits are based on standard 8260 reporting list, RL's may vary for New York and New Jersey reporting lists.

Table 2

QUALITY CONTROL ACCEPTANCE CRITERIA

Surrogate Spike Percent Recovery	**Aqueous Limits**		**Soil Limits**	
	Lower Control Limit	**Upper Control Limit**	**Lower Control Limit**	**Upper Control Limit**
1,2-Dichloroethane-d_4	70%	130%	70%	130%
4-Bromofluorobenzene	70%	130%	70%	130%
Toluene-d_8	70%	130%	70%	130%
Dibromofluoromethane	70%	130%	70%	130%

Table 3

BFB (4-BROMOFLUOROBENZENE) MASS INTENSITY CRITERIA

m/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

Table 4

Stock Standard Concentrations and Suggested Calibration Concentration Levels

Target Compound	**Stock (µg/mL)**	**Level 1 (µg/L)**	**Level 2 (µg/L)**	**Level 3 (µg/L)**	**Level 4 (µg/L)**	**Level 5 (µg/L)**	**Level 6 (µg/L)**	**Level 7 (µg/L)**	**Level 8 (µg/L)**
Acetone	2000	0.5	2	10	20	30	50	100	200
Acrolein	2000	0.5	2	10	20	30	50	100	200
Acrylonitrile	2000	0.5	2	10	20	30	50	100	200
Benzene	2000	0.5	2	10	20	30	50	100	200
Bromobenzene	2000	0.5	2	10	20	30	50	100	200
Bromochloromethane	2000	0.5	2	10	20	30	50	100	200
Bromodichloromethane	2000	0.5	2	10	20	30	50	100	200
Bromoform	2000	0.5	2	10	20	30	50	100	200
Bromomethane	2000	0.5	2	10	20	30	50	100	200
2-Butanone	2000	0.5	2	10	20	30	50	100	200
n-Butyl benzene	2000	0.5	2	10	20	30	50	100	200
sec-Butyl benzene	2000	0.5	2	10	20	30	50	100	200
tert-Butyl benzene	2000	0.5	2	10	20	30	50	100	200
Carbon disulfide	2000	0.5	2	10	20	30	50	100	200
Carbon tetrachloride	2000	0.5	2	10	20	30	50	100	200
Chlorobenzene	2000	0.5	2	10	20	30	50	100	200
Chloroethane	2000	0.5	2	10	20	30	50	100	200
2-Chloroethylvinyl Ether	2000	0.5	2	10	20	30	50	100	200
Chloroform	2000	0.5	2	10	20	30	50	100	200
Chloromethane	2000	0.5	2	10	20	30	50	100	200
o-Chlorotoluene	2000	0.5	2	10	20	30	50	100	200
p-Chlorotoluene	2000	0.5	2	10	20	30	50	100	200
Cyclohexane	2000	0.5	2	10	20	30	50	100	200
Cyclohexanone	2000	0.5	2	10	20	30	50	100	200
Dibromochloromethane	2000	0.5	2	10	20	30	50	100	200
1,2-Dibromo-3-chloropropane	2000	0.5	2	10	20	30	50	100	200
1,2-Dibromoethane	2000	0.5	2	10	20	30	50	100	200
Dibromomethane	2000	0.5	2	10	20	30	50	100	200
1,2-Dichlorobenzene	2000	0.5	2	10	20	30	50	100	200
1,3-Dichlorobenzene	2000	0.5	2	10	20	30	50	100	200
1,4-Dichlorobenzene	2000	0.5	2	10	20	30	50	100	200
1,4-Dichlorobutane	2000	0.5	2	10	20	30	50	100	200
trans-1,4-Dichloro-2-butene	2000	0.5	2	10	20	30	50	100	200
Dichlorodifluoromethane	2000	0.5	2	10	20	30	50	100	200
1,1-Dichloroethane	2000	0.5	2	10	20	30	50	100	200
1,2-Dichloroethane	2000	0.5	2	10	20	30	50	100	200
1,1-Dichloroethene	2000	0.5	2	10	20	30	50	100	200
cis-1,2-Dichloroethene	2000	0.5	2	10	20	30	50	100	200
trans-1,2-Dichloroethene	2000	0.5	2	10	20	30	50	100	200
1,2-Dichloropropane	2000	0.5	2	10	20	30	50	100	200
1,3-Dichloropropane	2000	0.5	2	10	20	30	50	100	200
2,2-Dichloropropane	2000	0.5	2	10	20	30	50	100	200
1,1-Dichloropropene	2000	0.5	2	10	20	30	50	100	200

Table 4 (continued)

Stock Standard Concentrations and Suggested Calibration Concentration Levels

Target Compound	Stock (µg/mL)	Level 1 (µg/L)	Level 2 (µg/L)	Level 3 (µg/L)	Level 4 (µg/L)	Level 5 (µg/L)	Level 6 (µg/L)	Level 7 (µg/L)	Level 8 (µg/L)
cis-1,3-Dichloropropene	2000	0.5	2	10	20	30	50	100	200
trans-1,3-Dichloropropene	2000	0.5	2	10	20	30	50	100	200
p-Diethylbenzene	2000	0.5	2	10	20	30	50	100	200
Diisopropyl Ether	2000	0.5	2	10	20	30	50	100	200
1,4-Dioxane (non-SIM)	10000	100	400	1000	2000	3000	4000	5000	6000
Ethanol	10000	100	200	300	500	1000	2500	5000	N/A
Ethyl Acetate	2000	0.5	2	10	20	30	50	100	200
Ethylbenzene	2000	0.5	2	10	20	30	50	100	200
Ethyl ether	2000	0.5	2	10	20	30	50	100	200
Ethyl methacrylate	2000	0.5	2	10	20	30	50	100	200
Ethyl Tert-Butyl Ether	2000	0.5	2	10	20	30	50	100	200
4-Ethyltoluene	2000	0.5	2	10	20	30	50	100	200
Freon-113	2000	0.5	2	10	20	30	50	100	200
Halothane	2000	0.5	2	10	20	30	50	100	200
Hexachlorobutadiene	2000	0.5	2	10	20	30	50	100	200
2-Hexanone	2000	0.5	2	10	20	30	50	100	200
Iodomethane	2000	0.5	2	10	20	30	50	100	200
Isopropylbenzene	2000	0.5	2	10	20	30	50	100	200
p-Isopropyltoluene	2000	0.5	2	10	20	30	50	100	200
Methyl Acetate	2000	0.5	2	10	20	30	50	100	200
Methylene Chloride	2000	0.5	2	10	20	30	50	100	200
Methyl Cyclohexane	2000	0.5	2	10	20	30	50	100	200
Methyl Methacrylate	2000	0.5	2	10	20	30	50	100	200
4-Methyl-2-pentanone	2000	0.5	2	10	20	30	50	100	200
Methyl-tert-butyl-ether	2000	0.5	2	10	20	30	50	100	200
Naphthalene	2000	0.5	2	10	20	30	50	100	200
n-Butanol	5000	2.5	10	50	100	150	250	500	N/A
n-Propylbenzene	2000	0.5	2	10	20	30	50	100	200
Pentachloroethane	1000	0.5	2	10	20	30	50	100	200
Styrene	4000	1	4	20	40	60	100	200	400
Tert-Butyl alcohol	10000	2.5	10	50	100	150	250	500	1000
Tertiary-Amyl Methyl Ether	2000	0.5	2	10	20	30	50	100	200
1,1,1,2-Tetrachloroethane	2000	0.5	2	10	20	30	50	100	200
1,1,2,2-Tetrachloroethane	2000	0.5	2	10	20	30	50	100	200
Tetrachloroethene	2000	0.5	2	10	20	30	50	100	200
Tetrahydrofuran	2000	0.5	2	10	20	30	50	100	200
1,2,4,5-Tetramethylbenzene	2000	0.5	2	10	20	30	50	100	200
Toluene	2000	0.5	2	10	20	30	50	100	200
1,2,3-Trichlorobenzene	2000	0.5	2	10	20	30	50	100	200
1,2,4-Trichlorobenzene	2000	0.5	2	10	20	30	50	100	200

Table 4 (continued)

Stock Standard Concentrations and Suggested Calibration Concentration Levels

Target Compound	Stock (µg/mL)	Level 1 (µg/L)	Level 2 (µg/L)	Level 3 (µg/L)	Level 4 (µg/L)	Level 5 (µg/L)	Level 6 (µg/L)	Level 7 (µg/L)	Level 8 (µg/L)
1,3,5-Trichlorobenzene	2000	0.5	2	10	20	30	50	100	200
1,1,1-Trichloroethane	2000	0.5	2	10	20	30	50	100	200
1,1,2-Trichloroethane	2000	0.5	2	10	20	30	50	100	200
Trichloroethene	2000	0.5	2	10	20	30	50	100	200
Trichlorofluoromethane	2000	0.5	2	10	20	30	50	100	200
1,2,3-Trichloropropane	2000	0.5	2	10	20	30	50	100	200
1,2,4-Trimethylbenzene	2000	0.5	2	10	20	30	50	100	200
1,3,5-Trimethylbenzene	2000	0.5	2	10	20	30	50	100	200
Vinyl acetate	2000	0.5	2	10	20	30	50	100	200
Vinyl chloride	2000	0.5	2	10	20	30	50	100	200
m/p-Xylenes	4000	1	4	20	40	60	100	200	400
o-Xylene	4000	1	4	20	40	60	100	200	400
1,4-Dioxane (SIM)	100	0.5	2	10	20	30	50	100	200

Target Compounds	Stock (µg/mL)	Level 1 (µg/L)	Level 2 (µg/L)	Level 3 (µg/L)	Level 4 (µg/L)	Level 5 (µg/L)	Level 6 (µg/L)	Level 7 (µg/L)	Level 8 (µg/L)
Internal Standards									
Fluorobenzene	2500	10	10	10	10	10	10	10	10
Chlorobenzene-d5	2500	10	10	10	10	10	10	10	10
1,4-Dichlorobenzene-d4	2500	10	10	10	10	10	10	10	10
Surrogates									
Dibromofluoromethane	2500	10	10	10	10	10	10	10	10
1,2-Dichloroethane-d4	2500	10	10	10	10	10	10	10	10
Toluene-d8	2500	10	10	10	10	10	10	10	10
4-Bromofluorobenzene	2500	10	10	10	10	10	10	10	10

- For Low Level Soil analysis, the calibration levels are the same in µg/Kg units.
- For High Level Soil analysis, the calibration levels are at 50x the levels listed due to sample preparation requirements.

TABLE 5

8260C Volatile Internal Standards with Corresponding Target Compounds and Surrogates Assigned for Quantitation

Fluorobenzene

Dichlorodifluoromethane
Chloromethane
Vinyl Chloride
Bromomethane
Chloroethane
Trichlorofluoromethane
Ethyl Ether
Freon 113
Acrolein
Acetone
Ethanol
1,1,-dichloroethene
Tert-Butyl Alcohol
Methyl Acetate
Carbon Disulfide
Methylene Chloride
Acrylonitrile
Methyl Tert Butyl Ether
Halothane
Trans-1,2-dichloroethene
Diisopropyl Ether
Vinyl Acetate
1,1-dichloroethane
Ethyl-Tert-Butyl-Ether
2-butanone
2,2-dichloropropane
Cis-1,2-dichloroethene
Chloroform
Bromochloromethane
Tetrahydrofuran
Dibromofluoromethane (surr)
1,1,1-trichloroethane
Cyclohexane
1,1-dichloropropene
Carbon Tetrachloride
Tertiary-Amyl Methyl Ether
1,2-dichloroethane-d4 (surr)
1,2-dichloroethane
Benzene
Trichloroethene
Methyl Cyclohexane
1,2-dichloropropane
Bromodichloromethane
1,4-Dioxane
Dibromomethane
2-Chloroethylvinyl Ether
4-methyl-2-pentanone
Cis-1,3-dichloropropene
Iodomethane
Methyl methacrylate
n-Butanol
Ethyl acetate

Chlorobenzene-d5

Toluene-d8 (surr)
Toluene
Ethyl Methacrylate
Trans-1,3-dichloropropene
1,1,2-trichloroethane
2-hexanone
1,3-dichloropropane
Tetrachloroethene
Chlorodibromomethane
1,2-dibromoethane
Chlorobenzene
1,1,1,2-tetrachloroethane
Ethylbenzene
p/m xylene
o xylene
Styrene

1,4-Dichlorobenzene-d4

Isopropylbenzene
Bromoform
1,4-dichloro-2-butane
1,1,2,2,-tetrachloroethane
4-bromofluorobenzene (surr)
1,2,3-trichloropropane
trans-1,4-dichloro-2-butene
n-propylbenzene
Bromobenzene
4-ethyltoluene
1,3,5-trimethybenzene
2-chlorotoluene
4-chorotoluene
tert-butylbenzene
1,2,4-trimethylbenzene
sec-butylbenzene
p-isopropyltoluene
1,3-dichlorobenzene
1,4-dichlorobenzene
n-butylbenzene
p-diethylbenzene
1,2-dichlorobenzene
1,2,4,5-tetramethylbenzene
1,2-dibromo-3-chloropropane
1,3,5-trichlorobenzene
1,2,4-trichlorobenzene
Hexachlorobutadiene
Naphthalene
1,2,3-trichlorobenzene
Cyclohexanone
1,3,5-Trichlorobenzene
Pentachloroethane

TABLE 6
8260C Quantitation Ions

Analyte	Quantitation Ion	Analyte	Quantitation Ion
Dichlorodifluoromethane	85	Ethyl Methacrylate	69
Chloromethane	50	Trans-1,3-dichloropropene	75
Vinyl Chloride	62	1,1,2-trichloroethane	83
Bromomethane	94	2-hexanone	43
Chloroethane	64	1,3-dichloropropane	76
Trichlorofluoromethane	101	Tetrachloroethene	166
Ethyl Ether	74	Chlorodibromomethane	129
Freon 113	101	1,2-dibromoethane	107
Acrolein	56	Chlorobenzene	112
Acetone	43	1,1,1,2-tetrachloroethane	131
1,1,-dichloroethene	96	Ethylbenzene	91
Tert-Butyl Alcohol	59	p/m xylene	106
Methyl Acetate	43	o xylene	106
Carbon Disulfide	84	Styrene	104
Methylene Chloride	76	Isopropylbenzene	105
Acrylonitrile	53	Bromoform	173
Methyl Tert Butyl Ether	73	1,4-dichloro-2-butane	55
Halothane	117	1,1,2,2,-tetrachloroethane	83
Trans-1,2-dichloroethene	96	1,2,3-trichloropropane	75
Diisopropyl Ether	45	Trans-1,4-dichloro-2-butene	53
Vinyl Acetate	43	n-propylbenzene	91
1,1-dichloroethane	63	Bromobenzene	156
Ethyl-Tert-Butyl-Ether	59	4-ethyltoluene	105
2-butanone	43	1,3,5-trimethybenzene	105
2,2-dichloropropane	77	2-chlorotoluene	91
Cis-1,2-dichloroethene	96	4-chorotoluene	91
Chloroform	83	tert-butylbenzene	119
Bromochloromethane	128	1,2,4-trimethylbenzene	105
Tetrahydrofuran	42	sec-butylbenzene	105
1,1,1-trichloroethane	97	p-isopropyltoluene	119
Cyclohexane	56	1,3-dichlorobenzene	146
1,1-dichloropropene	75	1,4-dichlorobenzene	146
Carbon Tetrachloride	117	n-butylbenzene	91
Tertiary-Amyl Methyl Ether	73	p-diethylbenzene	119
1,2-dichloroethane	62	1,2-dichlorobenzene	146
Benzene	78	1,2,4,5-tetramethylbenzene	119
Trichloroethene	95	1,2-dibromo-3-chloropropane	75
Methyl Cyclohexane	83	1,3,5-trichlorobenzene	180
1,2-dichloropropane	63	1,2,4-trichlorobenzene	180
Bromodichloromethane	83	Hexachlorobutadiene	225
1,4-dioxane	88	Naphthalene	128
Dibromomethane	93	1,2,3-trichlorobenzene	180
2-Chloroethylvinyl Ether	63	Ethanol	45
4-methyl-2-pentanone	58	Cyclohexanone	55
Cis-1,3-dichloropropene	75	Ethyl acetate	43

TABLE 6
8260C Quantitation Ions (continued)

Analyte	Quantiation Ion	Analyte	Quantiation Ion
Toluene	92	Iodomethane	142
Methyl methacrylate	69	n-Butanol	56
Pentachloroethane	167		

Table 7

List of 8260 Difficult Analytes:

- 1,1,2,2-Tetrachloroethane
- 1,2-Dibromo-3-chloropropane (DBCP)
- 1,4-Dioxane
- 2-Butanone
- 2-chloroethylvinyl ether
- 2-Hexanone
- 2,2-dichloropropane
- 4-Methyl-2-pentanone
- Acetone
- Bromoform
- Bromomethane
- Carbon disulfide
- Chloroethane
- Chloromethane
- cis-1,3-Dichloropropene
- Dichlorodifluoromethane (Freon 12)
- Ethanol
- Iodomethane
- Isobutyl Alcohol
- naphthalene
- n-butanol
- Styrene
- Tert-Butyl Alcohol
- Trichlorofluoromethane (Freon 11)

Mercury in Liquid Waste

(Automated Cold-Vapor Technique)

Reference Method No.: **EPA 7470A**

Reference: SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update II, September 1994.

1. Scope and Application

Matrices: Method 7470 is a cold-vapor atomic absorption procedure approved for determining the concentration of mercury in mobility-procedure extracts, aqueous wastes, and ground waters. (Method 7470 can also be used for analyzing certain solid and sludge-type wastes; however, Method 7471 is usually the method of choice for these waste types.) All samples must be subjected to an appropriate dissolution step prior to analysis.

Definitions: See Alpha Laboratories Quality Manual Appendix A.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Mercury Analyzer and in the interpretation of Mercury data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

Prior to analysis, the liquid samples must be prepared according to the procedure discussed in this method.

Method 7470, a cold-vapor atomic absorption technique, is based on the absorption of radiation at 253.7-nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.1 Method Modifications from Reference

2.1.1 A smaller sample sized is prepared, and therefore proportionately less reagent volumes are used.

2.1.2 The original method does not address the automated instrument procedure.

3. Reporting Limits

The typical reporting limit for Mercury is 0.0002mg/L. This satisfies Massachusetts, GW1 and GW 2 criteria. Connecticut mobility criteria for SPLP is 0.0004mg/L, Rhode Island is 0.002mg/L, and the Drinking Water reporting limit is 0.0002mg/L.

4. Interferences

Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from reagent water.

Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.

Seawaters, brines, and industrial effluents high in chlorides require additional permanganate (as much as 25 mL) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253.7 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 mL). Both inorganic and organic mercury spikes have been quantitatively recovered from seawater by using this technique.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

Mercury compounds are highly toxic if swallowed, inhaled, or absorbed through the skin. Analysis is conducted under a laboratory exhaust hood. The analyst must wear chemical resistant gloves when handling concentrated mercury standards.

The acidification of samples containing reactive materials may result in the release of toxic gases, such as cyanides or sulfides. Therefore, the acidification of samples is to be conducted under a laboratory exhaust hood.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Samples are collected in either glass or plastic containers.

6.2 Sample Preservation

Samples are preserved with HNO_3 to a pH of <2.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Samples are stored under refrigeration at 4 ± 2°C and analyzed as soon as possible after collection. The samples have a 28-day holding time from the time of collection.

7. Equipment and Supplies

7.1 Perkin Elmer FIMS 100 Atomic absorption spectrophotometer: Use instrument settings recommended by the manufacturer. The PE FIMS is designed specifically for the measurement of mercury using the cold-vapor technique.

7.1.1 The FIMS has a PC that serves as a data station, collects and compiles the data, and the PC also contains the required software and hardware to operate the FIMS.

7.1.2 The FIMS employs a Quartz tube; it has an i.d. of 4mm, and an optical path length of 260mm. It has removable quartz windows on both ends of the tube. The cell is pre-aligned, so there is no need to align the cell for maximum throughput of energy.

7.1.3 The FIMS uses peristaltic pumps to transport the various reagents and sample through the system. The speed of the pumps is under software control: 20 – 120rpm or off.

7.1.3.1 Each pump accepts up to four magazines, which hold the pump tubing in place. There are different size magazines for different pump tubing sizes. Refer to the FIMS manual for replacement sizes. The pump tubing is available in different diameters depending on the reagent used. The different sizes have different colored collars.

7.1.4 The FIMS employs a 5-port Flow Injection Valve. The valve has two positions: fill and inject. The valve uses a sample loop to switch between fill and inject. The sample loops are made from PTFE. Alpha utilizes a 500µL loop. Sizes can range from 50 – 1000µL.

7.1.5 Sample and reagent are mixed in the manifold. The manifold has two purposes: to either initiate the reaction or to dilute one of the two mixing streams. The manifold blocks have three channels that are interconnected. The inlets of the channels have a ¼ -inch 28UNF internal screw thread. The blocks are made from inert, translucent plastic.

7.1.6 The gas/liquid separator is used in the mercury cold-vapor technique to separate the gas and liquid in the mixture as it leaves the manifold. It is connected to the manifold block by way of connector pegs.

7.1.7 An inert carrier gas is required for mercury determinations with FIMS. The FIMS is hard plumbed to accept Argon. The Argon is plumbed into the rear of the spectrometer, at the GAS IN connection. The gas outlet, flow regulator and flow gauge are on the front panel of the FIMS. Usable flows are between 40mL/minute and 250mL/minute at a recommended gas inlet pressure between 320kPa and 400kPa. The gas flow is off when the control knob is turned fully clockwise.

7.1.8 The radiation source is a low-pressure mercury lamp that is specific for the FIMS. This may be purchased from Perkin Elmer. The detector is a photocell with maximum sensitivity at 254nm.

7.1.9 Waste is pumped directly into a waste bottle. When the waste is full, it is emptied into the Metals/Wet Chem waste drum in the transfer room.

7.2 Graduated cylinder: Rinse once with 50% HNO_3 and then rinse with reagent water prior to use.

7.3 Volumetric Flasks, Class A, various volumes: Rinse once with 50% HNO_3 and then rinse with reagent water prior to use.

7.4 Heating Block: Environmental Express HotBlock, 48 position capacity, able to maintain 95°C +/-3.

7.5 50 mL Digestion Tubes: Polypropylene, graduated.

7.6 50 mL Digestion Tube Rack: 48 position, racklock

7.7 Pump tubing: Environmental Express, three stop (yellow/blue, red/red, and black/white).

7.8 PTFE membranes: Whatman TE37 disks.

7.9 Dilution vials: 20mL capacity, used to prepare analytical dilutions.

7.10 Low Dust Laboratory Wipes

7.11 Compressed Air

7.12 Whatman 41 filter paper or equivalent

8. Reagents and Standards

8.1 Reagent Water: Reagent water is DI water shown to be interference free. All references to water in this method will refer to reagent water unless otherwise specified.

8.2 Sulfuric acid (H_2SO_4), concentrated: Reagent grade. Store at room temperature in an appropriately designated acid cabinet.

8.3 Hydrochloric acid, concentrated: Trace Metal grade. Store at room temperature in an appropriately designated acid cabinet.

8.4 Carrier, Hydrochloric Acid, 3%: This is the ***carrier*** for the PE FIMS Instrument. In a 1L volumetric flask, add 30mL concentrated trace grade HCl (Section 8.3). Bring to volume with reagent water. Store at room temperature, prepare daily as needed.

8.5 Reductant, Stannous Chloride in 3% HCl: This is the ***reductant*** for the PE FIMS Instrument. In a 1L volumetric flask, add 30mL concentrated trace grade HCl and 11g $SnCl_2 \cdot 2H_20$. Mix to dissolve the solid and bring to volume with reagent water. Store at room temperature, prepare daily as needed.

8.6 Nitric acid (HNO_3), concentrated: Trace metal grade of low mercury content. If a high reagent blank is obtained, it may be necessary to distill the nitric acid. Store at room temperature in an appropriately designated acid cabinet.

8.7 Sodium chloride-hydroxylamine hydrochloride solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine hydrochloride in reagent water and dilute to 100mL. Store at room temperature. Expires one month from date of preparation.

8.8 Potassium permanganate, mercury-free, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 mL of reagent water. Store at room temperature. Expires one month from date of preparation.

8.9 Potassium persulfate, 5% solution (w/v): Dissolve 5 g of potassium persulfate in 100 mL of reagent water. Store at room temperature. Expires one month from date of preparation.

8.10 Mercury Stock Standard, 1000ppm: Purchased from a commercial source with a certificate of analysis. Purchase three different sources. Store at room temperature. Expires upon manufacturer's specification.

8.11 Mercury Stock Calibration Standard, 10ppm: To a 100mL volumetric flask, add 5mL of concentrated HNO_3, 2.5mL of concentrated H_2SO_4 and 1000ppm Mercury Stock Standard (Section 8.10, use one source). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.12 Mercury Working Calibration Standard / Matrix Spike Solution, 0.1ppm: To a 100mL volumetric flask, add 5mL of concentrated $HNO_{3,}$ 2.5mL of concentrated H_2SO_4 and 1mL of 10ppm Mercury Stock Standard (Section 8.11). Bring to volume with reagent water. Store at room temperature. Make fresh daily.

8.13 Mercury Calibration Standards: All calibration standards are prepared daily.

8.13.1 **0 ppm Calibration Standard:** Add 10 mL of reagent water to a polypropylene digestion vessel. This aliquot may be used for the CCB. Another separate aliquot is prepared in the same manner for use as the ICB and diluent for sample dilutions.

8.13.2 **0.0002ppm Calibration Standard:** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 0.05 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.13.3 **0.001ppm Calibration Standard:** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 0.25 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.13.4 **0.002ppm Calibration Standard** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 0.5 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.13.5 **0.005ppm Calibration Standard/Continuing Calibration Verification Standard:** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 1.25 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.13.6 **0.010ppm Calibration Standard / Post Analytical Spike Solution:** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 2.5 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.13.7 **0.020ppm Calibration Standard / Post Analytical Spike Solution:** Add 10 mL of reagent water to a polypropylene digestion vessel. Pipet 5.0 mL of 0.1ppm Mercury Working Stock (Section 8.12) to the digestion vessel. Bring to a final volume of 25 mL.

8.14 Mercury Stock LCS Standard, 10ppm: To a 100mL volumetric flask add 25mL of reagent water and 5mL of concentrated HNO_3 (Section 8.6). Add 1mL of 1000ppm Mercury Stock Standard (Section 8.10). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.15 Mercury Working LCS Standard, 0.1ppm: To a 100mL volumetric flask add 25mL of reagent water and 5mL concentrated HNO_3 (Section 8.6). Add 1mL of 10ppm Stock LCS Standard (Section 8.14). Bring to volume with reagent water. Store at room temperature. Expires one week from date of preparation.

8.16 Mercury LCS Standard, 0.001ppm: Prepare daily with each batch of samples. To a 50mL digestion vessel add 10mL of reagent water Add 0.25 mL of 0.1ppm Working LCS Standard (Section 8.15). Bring to a final volume of 25mL and carry through entire digestion process as in Section 10.1.1.

8.17 Mercury Stock ICV Standard, 10ppm: To a 100mL volumetric flask add 25mL of reagent water and 5mL of concentrated HNO_3 (Section 8.6). Add 1mL of 1000ppm Mercury Stock Standard (Section 8.10-use alternate source than that used for both the calibration standards and the LCS Stock Standard). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.18 Mercury Working ICV Standard, 0.3ppm: To a 100mL volumetric flask add 25mL of reagent water and 5mL of concentrated HNO_3 (Section 8.6). Add 3mL of 10ppm Stock ICV Standard (Section 8.5). Bring to volume with reagent water. Store at room temperature. Expires one week from date of preparation.

8.19 Mercury ICV Standard, 0.003ppm: Prepare daily with each batch of samples. To a 25mL digestion vessel add 10mL of reagent water. Add 0.25mL of 0.3ppm Working ICV Standard (Section 8.18). Bring to a 25mL final volume with reagent water and carry through entire digestion process as in Section 10.1.1..

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

The ICB, CCB, and Preparatory Blank: A 25mL aliquot of 0ppm calibration standard brought through the preparation procedure as outlined in Section 10.1.1 . Blank results must be <RL. See Section 12.1 for corrective action.

9.2 Laboratory Control Samples (LCS)

The LCS Standard consists of a 0.001ppm Mercury LCS Standard (Section 8.16). This standard is brought through the preparation procedure as outlined in Section 10.1.1. The LCS Standard must be recovered within ± 20% of the true value. See Section 12.3 for corrective action.

9.3 Initial Calibration verification (ICV)

The ICV Standard consists of a 25mL aliquot of 0.003ppm Mercury ICV Standard (Section 8.19). The ICV must be recovered within 10% of the true value. See Section 12.2 for corrective action.

9.4 Continuing Calibration Verification (CCV)

The CCV Standard consists of a 0.010ppm calibration standard (Section 8.13.3). The CCV must be recovered within 20% of the true value. See Section 12.2 for corrective action.

9.5 Matrix Spike

A matrix spike is analyzed once per batch of samples. A batch consists of 20 samples for monitoring wells, surface waters, influents and effluents. Prepare the matrix spike at 0.005ppm by adding 1.25mL of 0.1ppm Mercury Stock Standard (Section 8.3) to 25mL of the selected QC sample. The final concentration of the matrix spike is 0.005mg/L.

The matrix spike sample is brought through the preparation procedure as outlined in Section 10.1. A matrix spike is analyzed once per batch of samples. A batch consists of 20 samples for monitoring wells and surface waters. The recovery of the matrix spike must be between 75 – 125% (using the calculation in Section 11.2).

If the recovery of the matrix spike is out of range, a post-analytical spike is analyzed. Prepare the post analytical spike by adding 5mL of 0.010ppm Calibration Standard / Post Analytical Spike Solution (Section 8.1.6) and 5mL of the sample digestate to a 50mL centrifuge tube for a final concentration of 0.005mg/L. Analyze the post spike as outlined in Section 10.3.5.

Calculate the post spike concentration as follows:

Post Analytical Spike Sample Concentration (mg/L) =

[Sample Concentration (mg/L) x (0.5)] + 0.005mg/L

The percent recovery of the post-analytical spike must be between 75 – 125%. See Section 12.4 for corrective action.

9.6 Laboratory Duplicate

A sample is analyzed in duplicate once per batch of samples. A batch consists of 20 samples for monitoring wells and surface waters. The RPD between the sample and its duplicate must be 20% or less (using the calculation in Section 11.3), See Section 12.5 for corrective action.

9.7 Method-specific Quality Control Samples

Not applicable.

9.8 Method Sequence

- Calibration Blank
- 0.0002 ppm Calibration Standard
- 0.0005 ppm Calibration Standard
- 0.001 ppm Calibration Standard
- 0.002 ppm Calibration Standard
- 0.010 ppm Calibration Standard
- 0.020 ppm Calibration Standard
- ICV
- ICB
- Ten analytical samples
- CCV
- CCB
- Ten analytical samples
- CCV
- CCB
- Etc.

10. Procedure

10.1 Equipment Set-up

10.1.1 Preparation and Digestion

Samples, Standards and All Batch QC

Transfer 25mL of well-homogenized sample (or an aliquot of the sample diluted to 25mL with reagent water) or standards (Sections 8.13.1 through 8.13.7, 8.16 and 8.19) to a 50mL centrifuge tube.

Add 1.25mL of concentrated H_2SO_4 (Section 8.2), 0.625mL of concentrated HNO_3 (Section 8.6), Add 3.75mL of Potassium Permanganate Solution, shake and add additional portions of potassium permanganate solution (if necessary) to all samples and QC, until the purple color persists for at least 15 min. (Section 8.8). Add 2mL of Potassium Persulfate Solution (Section 8.9), and heat samples for 2 hours in a 95°C +/-3 heating block. Cool, and add 1.5mL of Sodium Chloride-Hydroxylamine hydrochloride solution (Section 8.7).
Filter the sample if needed to remove any sediment or particulate.

Analyze samples using the PE FIMS 100 as outlined in Section 10.4. The digested calibration standards (Sections 8.13.1 through 8.13.7) are used in Section 9.2 to generate a calibration curve on the PE FIMS Instrument.

10.2 Initial Calibration

Construct a calibration curve by plotting the absorbances of prepared standards (Section 10.1.1) versus micrograms of mercury. Determine the peak height of the unknown from the absorbance maxima on the spectrometer, and read the mercury value from the standard curve. (See Section 11.)

The curve correlation coefficient (cc) must be greater than or equal to 0.995 in order for the curve to be linear. If the correlation coefficient is less than 0.995, find and correct the problem. When the problem has been corrected, re-analyze either the previous standards or new standards. When the curve has generated an acceptable cc then the analysis can continue with the ICV/ICB.

10.3 Equipment Operation and Sample Processing

Sample and standard analysis using the Perkin Elmer FIMS 100:

10.3.1 Instrument Setup

10.3.1.1 Turn the instrument on by flipping the power switch on the face of the instrument. The autosampler will initialize itself.

10.3.1.2 Choose AA Winlab Analyst from the START menu. The autosampler will initialize again.

NOTE: The instrument must be turned on before the application is started. Otherwise, an error message will result.

10.3.1.3 Click the button next to “open a custom workspace”.

10.3.1.4 Select “startup.fms” from the list and click OPEN. This will open the “FIAS Control” and “Automated Analysis” windows.

10.3.1.5 Click on the “Analyze” tab in the Automated Analysis window, then click on the “Select Location” button. Click OK and the probe will go to the autosampler rinse.

10.3.1.6 Fill the carrier and reductant bottles.

10.3.1.6.1 The Carrier is 3% HCl (Section 8.4).

10.3.1.6.2 The Reductant is 1.1% $SnCl_2$ in 3% HCl (Section 8.5).

10.3.1.7 Allow the instrument to warm up while clearing samples. Samples that are cloudy or with particulate present after clearing must be filtered through Whatman 41 filter paper (Section 7.12) before analysis.

10.3.1.8 Optimize (sections 10.3.1.8 through 10.3.1.15) sample uptake if there has been a major change made : (i.e.: line ID type, length of tubing, etc.) Place carrier uptake line (blue/yellow tubing, Section 7.7) and reductant uptake line (red/red tubing. Section 7.7) into graduated cylinders containing reagent water.

10.3.1.9 Load carrier and reductant lines into pump magazines above the roller so that the long ends come out on the right side. The carrier line goes into the inner magazine, and the reductant line goes into the outer magazine.

10.3.1.10 Load the two waste lines into the pump magazines below the roller.

10.3.1.10.1 The blue/yellow line goes into the inner two-channel magazine so that the long end comes out on the left side.

10.3.1.10.2 The black line goes into the outer magazine so that the long end comes out on the right side

10.3.1.11 Lock both the top and bottom magazines into place.

10.3.1.12 Unscrew the fitting from the sample absorption cell leading to the liquid vapor separator and place it into an empty dilution-vial (Section 7.9).

10.3.1.13 Click the “Pump1” button in the “FIAS Control” window to start the roller.

10.3.1.14 Adjust the tension on the lower pump magazine using the thumbscrews until a steady (but not too fast) stream of bubbles comes out of the liquid vapor separator and through the black tubing.

10.3.1.15 Adjust the tension on the upper pump magazines to obtain the following flow rates:

10.3.1.15.1 Carrier = 9 – 11 mL/minute

10.3.1.15.2 Reductant = 5 – 7 mL/minute

10.3.1.16 When the flow rates are set, click on the “Pump1” button to stop the roller.

10.3.1.17 Place carrier uptake line in the carrier bottle and reductant line in the reductant bottle.

10.3.1.18 Click the “Pump1” button to restart the roller. Allow to run for a couple of minutes to flush the reagent water from the lines. Click on the “Fill/Inject” button several times to flush the sample loop.

10.3.1.19 With the “Fill/Inject” button in the “Fill” position, (button not depressed), click the “Pump1” button to stop the roller.

10.3.1.20 Remove the cap from the liquid/vapor separator and wipe dry with a KimWipe (Section 7.10). If necessary, blow compressed air (Section 7.11) through the vapor transfer line to dry it out.

10.3.1.21 Place a PTFE membrane (Section 7.8), <u>rough side up</u>, in the liquid/vapor separator; replace the cap and reattach the vapor transfer line to the sample absorption cell.

10.3.1.22 Click on the “Pump1” button to start the roller.

10.3.1.23 Adjust the gas flow by turning the black knob below the air flow meter to obtain a reading of just over 50.

10.3.1.24 Click on the “Pump1” button to stop the roller.

10.3.2 Creating a Sample Information File and Loading the Sample Tray

10.3.2.1 Click the “SampInfo” button on the toolbar.

10.3.2.2 In the description line, type “prep date MM/DD/YY”.

10.3.2.3 In the analyst line, type the analyst’s initials.

10.3.2.4 Drag the scroll bar so that the autosampler location 12 is showing.

10.3.2.5 Double-click the “Sample Units” cell in line 12.

10.3.2.6 Select “µg/L” from the list and enter the range of locations (12 up to 44) and click OK.

10.3.2.7 Starting with position 12, type in the sample ID

10.3.2.8 When finished, choose “Save As” from the “File” menu, then choose the “Sample Information” file.

10.3.2.9 Save the file as MMDDYYA

10.3.2.10 Load the samples into the tray as follows:

Position 1	Calibration Blank

Position 2	0.2ppb Standard
Position 3	1.0ppb Standard
Position 4	2.0ppb Standard
Position 5	5.0ppb Standard
Position 6	10.0ppb Standard
Position 7	20.0 ppb Standard
Position 8	ICV
Position 9	ICB
Position 10	PBW listed in the sample information file.
Position 11	LCSW listed in the sample information file.

Positions 12 – 42 Samples as listed in the sample information file.

10.3.2.11 Click the “Load Tray” button.

10.3.2.12 Replace the empty tray with the tray containing the standards and samples.

10.3.2.13 Click the “Load Tray” button.

10.3.2.14 Click the “Select Location” button and click OK to lower the probe into the autosampler rinse.

10.3.3 Instrument Calibration

10.3.3.1 Click the “Workspace” button in the toolbar.

10.3.3.2 Select a workspace template and click OK.

10.3.3.3 Click on the Setup tab in the automated analysis window.

10.3.3.4 Click the “Browse” button under “Sample Information File”

10.3.3.4.1 Select the sample information file that you want to open and click OK.

10.3.3.5 Click the “Browse” button under “Results Data Set Name”.

10.3.3.5.1 Type in the data set name in the format MMDDYYA and click OK.

10.3.3.6 Click the “X” under the “Use Entire Sample Info File” so that it disappears.

10.3.3.7 Under the “Use Autosampler Locations Listed Below”, enter the order of samples to be run. NOTE: Do not include standards and QC checks.

10.3.3.8 Click the “Analyze All” tab.

10.3.3.8.1 The instrument will run the calibration curve and continue with the samples.

10.3.4 Initial Calibration Verification

10.3.4.1 When the calibration is complete (6 – 7 minutes) evaluate the r^2 correlation coefficient, it must be between 0.995 and 1.000.

10.3.4.1.1 The instrument will run the ICV and ICB. If the recoveries of these are within the proper ranges (Sections 9.3 and 9.1), the instrument will continue with analysis of samples as outlined in Section 10.3.5.

10.3.4.1.2 If the recoveries of the ICV and/or ICB are not within the proper ranges (Sections 9.3 and 9.1), the problem must be found and corrected, and the instrument recalibrated per Section 10.3.3.

10.3.5 Sample Analysis

10.3.5.1 The instrument will now run ten analytical samples, a CCV and CCB, ten analytical samples, CCV, CCB, etc. The CCBs and CCVs must be recovered within the proper ranges (Sections 9.1 and 9.4) for analysis to continue.

10.3.5.2 If the recoveries of the CCB and/or CCV are not within the proper ranges (Sections 9.1 and 9.4), the instrument must be recalibrated per Section 10.3.3. The samples that were analyzed after the last valid CCV/CCB must be re-analyzed.

10.3.5.3 If the sample result is beyond 90% of the concentration of the highest point on the calibration curve used to define the linear range, dilute the sample extract with a portion of one of the prepared blanks (ICB, CCB or PWB) to produce an analytical result that is within range.

10.3.6 Instrument Shut Down

10.3.6.1 When analysis is complete, click the “Workspace” button in the toolbar.

10.3.6.2 Place reagent uptake lines in a beaker of reagent water.

10.3.6.3 Click on the “Analyze” tab.

10.3.6.4 Click on the “Pump1” button to start the roller

10.3.6.4.1 Allow to run for several minutes to flush reagents out of the lines.

10.3.6.4.2 Click on the “Fill/Inject” button several times to rinse the sample loop.

10.3.6.5 Click the “Move Probe Up/Down” button to raise the probe out of the autosampler rinse.

10.3.6.6 Pull the reagent uptake lines out of the reagent water beaker to allow the pump to draw air through the lines.

10.3.6.7 Click “Fill/Inject” button several times to pull air through the sample loop.

10.3.6.8 With the “Fill/Inject’ button in the “Fill” position, click “Pump1” button to stop roller.

10.3.6.9 Unlock the top and bottom pump magazines and remove tubing from the magazines.

10.3.6.10 Return the reagent uptake lines to the reagent water beaker.

10.3.6.11 Click the “Move Probe Up/Down” button to lower the probe into the rinse beaker.

10.3.6.12 Select “EXIT” from the File menu to exit the WinLab application.

10.3.6.12.1 A “Shutting Down System” message will display.

10.3.6.13 When the desktop appears, turn off the power switch on the instrument.

10.3.6.14 Dump the samples and instrument waste in the Metals/WetChem waste drum located in the transfer room.

10.4 Continuing Calibration

Continuing calibration verification samples are analyzed after every 10 samples in the sample run, as outlined in Section 10.3.5.

10.5 Preventative Maintenance

Preventative maintenance is conducted per the manufacturer's instructions. All preventative maintenance is recorded in the Instrument Maintenance Logbook.

11. Data Evaluation, Calculations and Reporting

11.1 Calculate Mercury concentration

Calculate Mercury concentration from the daily calibration curve. The curve is generated utilizing a straight-line equation defined as:

$$A = k_1 + k_2C$$

Where:

A = Average peak height of the sample/standard integrations
C = Sample/Standard Concentration, µg/L
k_1 = y-intercept
k2 = slope

The instrument will plot peak height against concentration (µg/L). The result is generated in µg/L . This value is divided by 1000 to convert the units to mg/L. If the sample is diluted (DF), the result is multiplied by the DF to generate the final result.

Result, mg/L = (concentration, µg/L) x (1mg/1000µg) x (DF)

11.2 Matrix Spike Calculation

Calculate percent recovery for the Matrix Spike corrected for concentrations measured in the unfortified sample. Percent recovery is calculated using the following equation:

$$\% \text{ Recovery} = \frac{(Cm - C)}{s} \times 100$$

Where:

Cm = measured Mercury in the fortified sample
C = measured native mercury sample concentration
S = concentration equivalent of spike added to sample

11.3 Relative Percent Difference (RPD) Calculation

Calculate the Relative Percent Difference (RPD) for each Duplicate of the initial quantitated concentration (IC) and duplicate quantitated concentration (Dc) using the following formula:

$$RPD = \frac{|(IC - Dc)|}{\{(IC + Dc) / 2\}} \times 100$$

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Method Blank Failure: When a prep blank mercury level constitutes 10% or more of analyte level determined for any sample in the batch, or is greater than 2.2x the MDL value (whichever is greater), the associated samples in the batch must be redigested (Section 10.1).

For method blanks that have concentrations greater than the RL, the data is rejected and the associated samples sent back for redigestion unless the associated sample concentrations are greater than 10x the blank concentration. In this case the blank is narrated and the results are reported without qualification.

12.2 ICV / CCV Failure: If the ICV %Recovery is outside of acceptance criteria, the ICV is reinjected. If the %Recovery is outside the acceptance criteria, the analysis is terminated until the problem is found and corrected. If the CCV %Recovery is outside of acceptance criteria, the CCV is reinjected. If the % Recovery is still outside the acceptance criteria, all samples analyzed since the last acceptable CCV must be reanalyzed following correction of the problem.

12.3 LCS Failure: If the LCS is not recovered within acceptance criteria, the LCS is reinjected. If the % Recovery is still outside the acceptance criteria, either recalibrate and rerun or the associated batch and another LCS must be redigested (Section 10.1).

12.4 Matrix Spike / Post Digestion Spike Failure: If the recovery of the matrix spike is outside of the acceptance criteria, a post digestion spike is performed (Section 9.54). If the post digestion spike is outside of 75 – 125%, a narrative must be included with the data. (Section 10.1).

12.5 Duplicate Failure: If the RPD between the sample and its duplicate is greater than 20%, visually evaluate the sample matrix. If the matrix appears problematic, the sample digestate may be diluted and reanalyzed, or a narrative included with the data to explain the matrix problem.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/08-05. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/08-12 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/08-05 MDL/LOD/LOQ Generation

SOP/08-12 IDC/DOC Generation

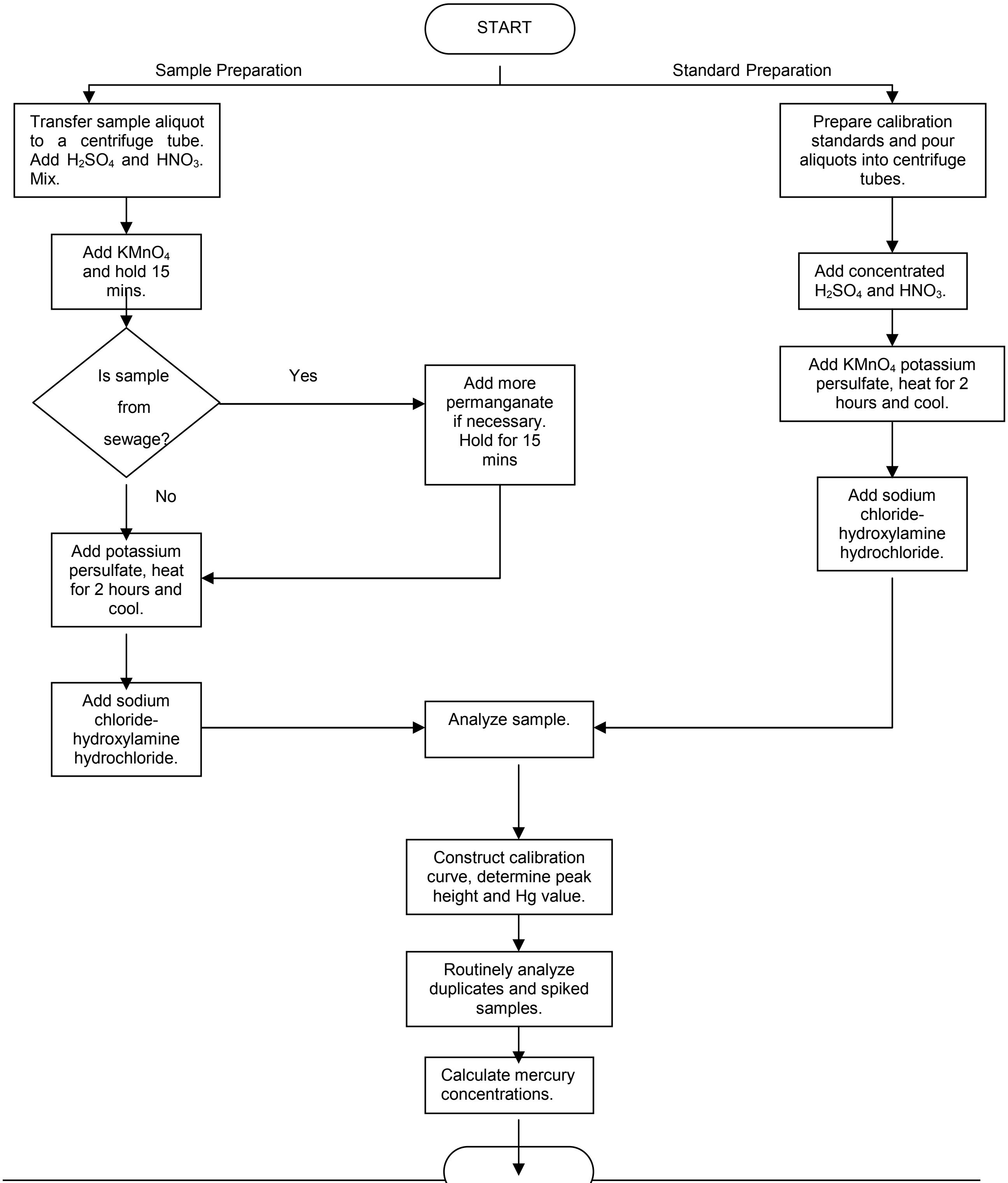
SOP/14-01 Waste Management and Disposal SOP

16. Attachments

Figure 1: Method 7470A Flow Chart

Figure 1

Method 7470A Flow Chart



END

Mercury in Solid or Semisolid Waste
(Manual Cold-Vapor Technique)

Reference Method No.: **EPA 7471B**

Reference: SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, Update III, Feburary 2007.

1. Scope and Application

Matrices: Method 7471 is approved for measuring total mercury (organic and inorganic) in soils, sediments, bottom deposits, and sludge-type materials. All samples must be subjected to an appropriate dissolution step prior to analysis. If this dissolution procedure is not sufficient to dissolve a specific matrix type or sample, then this method is not applicable for that matrix.

Definitions: Refer to Alpha Analytical Quality Manual.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the Mercury Analyzer and in the interpretation of Mercury data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability, analyzing a proficiency test sample and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the QA Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

Prior to analysis, the solid or semi-solid samples must be prepared according to the procedures discussed in this method.

Method 7471, a cold-vapor atomic absorption method, is based on the absorption of radiation at the 253.7-nm wavelength by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.1 Method Modifications from Reference

Alpha analyzes only one 0.6g aliquot of sample. The original method does not address the automated instrument procedure. A reduced volume of sample is digested in disposable digestion tubes on a hot block digestor.

3. Reporting Limits

The reporting limit for this method is 0.08mg/Kg.

4. Interferences

Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/Kg of sulfide, as sodium sulfide, do not interfere with the recovery of added inorganic mercury in reagent water.

Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/Kg had no effect on recovery of mercury from spiked samples.

Samples high in chlorides require additional permanganate (as much as 25 mL) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 mL).

Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

Because mercury vapor is toxic, precaution must be taken to avoid its inhalation.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Samples may be collected in plastic or glass containers.

6.2 Sample Preservation

None.

6.3 Sample Shipping

No special shipping requirements.

6.4 Sample Handling

Samples are stored under refrigeration at 4°C and analyzed as soon as possible after collection. The samples have a 28-day holding time from the time of collection.

7. Equipment and Supplies

7.1 Perkin Elmer FIMS 100 Atomic absorption spectrophotometer: Use instrument settings recommended by the manufacturer. The PE FIMS is designed specifically for the measurement of mercury using the cold-vapor technique.

7.1.1 The FIMS has a PC that serves as a data station, collects and compiles the data, and the PC also contains the required software and hardware to operate the FIMS.

7.1.2 The FIMS employs a quartz tube; it has an i.d. of 4mm, and an optical path length of 260mm. It has removable quartz windows on both ends of the tube. The cell is pre-aligned, so there is no need to align the cell for maximum throughput of energy.

7.1.3 The FIMS uses peristaltic pumps to transport the various reagents and sample through the system. The speed of the pumps is under software control: 20 – 120rpm or off.

7.1.3.1 Each pump accepts up to four magazines, which hold the pump tubing in place. There are different size magazines for different pump tubing sizes. Refer to the FIMS manual for replacement sizes. The pump tubing is available in different diameters depending on the reagent used. The different sizes have different colored collars. These can be ordered from Perkin Elmer.

7.1.4 The FIMS employs a 5-port Flow Injection Valve. The valve has two positions: fill and inject. The valve uses a sample loop to switch between fill and inject. The sample loops are made from PTFE. Alpha utilizes a 500µL loop. Sizes can range from 50 – 1000µL.

7.1.5 Sample and reagent are mixed in the manifold. The manifold has two purposes: to either initiate the reaction or to dilute one of the two mixing streams. The manifold blocks have three channels that are interconnected. The inlets of the channels have a ¼ -inch 28UNF internal screw thread. The blocks are made from inert, translucent plastic.

7.1.6 The gas/liquid separator is used in the mercury cold-vapor technique to separate the gas and liquid in the mixture as it leaves the manifold. It is connected to the manifold block by way of connector pegs.

7.1.7 An inert carrier gas is required for mercury determinations with FIMS. The FIMS is hard plumbed to accept Argon. The Argon is plumbed into the rear of the spectrometer, at the GAS IN connection. The gas outlet, flow regulator and flow gauge are on the front panel of the FIMS. Usable flows are between 40mL/minute and 250mL/minute at a recommended gas inlet pressure between 320kPa and 400kPa. The gas flow is off when the control knob is turned fully clockwise.

7.1.8 The radiation source is a low-pressure mercury lamp that is specific for the FIMS. This may be purchased from Perkin Elmer. The detector is a photocell with maximum sensitivity at 254nm.

7.1.9 Waste is pumped directly into a waste bottle. When the waste is full, it is emptied into the Metals/Wet Chem waste drum in the transfer room.

7.2 Hot Block Digestor: Environmental Express, 54 position, capable of maintaining a temperature of 95°C +/-3°C.

7.3 Graduated cylinder. Rinse once with 50% Nitric Acid, then rinse with reagent water prior to use.

7.4 Volumetric Flasks, Class A, various volumes. Rinse once with 50% Nitric Acid, then rinse with reagent water prior to use.

7.5 Polypropylene Digestion Vessels: 50 mL volume, with plastic screw caps

7.6 Pump Tubing: Environmental Express, three stop (yellow/blue, red/red and black/white).

7.7 PTFE membranes: Pall TF1000 disks

7.8 Dilution vials: 20mL capacity, used when making analytical dilutions.

7.9 Laboratory Wipes

7.10 Compressed Air

7.11 Whatman 41 or equivalent filter paper

8. Reagents and Standards

8.1 Reagent Water: Reagent water is DI water shown to be interference free. All references to water in this method refer to reagent water unless otherwise specified.

8.2 Aqua regia: Prepare immediately before use by carefully adding three volumes of concentrated HCl to one volume of concentrated HNO_3.

8.3 Concentrated Nitric Acid, (HNO_3): Trace grade. Store at room temperature in the appropriately marked acid cabinet.

8.4 Concentrated Hydrochloric Acid, (HCl): Trace grade. Store at room temperature in the appropriately marked acid cabinet.

8.5 Reductant, Stannous Chloride in 3% HCl: This is the ***reductant*** for the PE FIMS Instrument. In a 1L volumetric flask, add 30mL concentrated trace grade HCl and 11g $SnCl_2 \cdot 2H_20$. Mix to dissolve the solid and bring to volume with reagent water. Store at room temperature, prepare daily as needed.

8.6 Carrier, Hydrochloric Acid, 3%: This is the ***carrier*** for the PE FIMS Instrument. In a 1L volumetric flask, add 30mL concentrated trace grade HCl (Section 8.4). Bring to volume with reagent water. Store at room temperature, prepare daily as needed.

8.7 Potassium permanganate, mercury-free, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 mL of reagent water. Store at room temperature. Expires one month from date of preparation.

8.8 Sodium chloride-hydroxylamine hydrochloride solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine hydrochloride in reagent water and dilute to 100 mL. Store at room temperature. Expires one month from date of preparation.

8.9 Mercury stock solution, 1000ppm: This solution is purchased commercially prepared with a certificate of analysis. Three solutions are purchased, each from a different source. Store at room temperature. Expires according to manufacturer's specifications.

8.9.1 10ppm Mercury Stock Standard: To a 100mL volumetric flask, add 5mL of concentrated HNO_3 and 1.0mL of 1000ppm Mercury Stock Solution (Section 8.9). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.9.1.1 0.1ppm Mercury Working Stock / Matrix Spike Solution: To a 500mL volumetric flask, add 5mL of concentrated HNO_3 and 5 mL of 10ppm Mercury Stock Standard (Section 8.9.1). Bring to volume with reagent water. Store at room temperature. Expires one week from date of preparation.

8.9.2 10ppm Mercury ICV Stock Standard: To a 100mL volumetric flask, add 5mL of concentrated HNO_3 and 1.0mL of Mercury Stock Solution (Section 8.9, from an alternate source than that used in Section 8.9.1). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.9.2.1 0.3ppm Mercury ICV Working Stock: To a 100mL volumetric flask, add 5mL of concentrated HNO_3 and 3.0mL of 10ppm Hg ICV Stock Standard (Section 8.9.2). Bring to volume with reagent water. Store at room temperature. Expires one week from date of preparation.

8.9.3 10ppm Mercury LCS Stock Standard: To a 100mL volumetric flask, add 5mL of concentrated HNO_3 and 1.0mL of 1000ppm Mercury Stock Solution (Section 8.9, from an alternate source than that used in Sections 8.9.1 and 8.9.2). Bring to volume with reagent water. Store at room temperature. Expires one month from date of preparation.

8.9.3.1 0.1ppm Mercury LCS Working Stock: To a 100mL volumetric flask, add 5mL of concentrated HNO_3 and 1.0mL of 10ppm Mercury LCS Stock Standard (Section 8.9.3). Bring to volume with reagent water. Store at room temperature. Expires one week from date of preparation.

8.10 SRM: Purchased from a commercial source.

9. Quality Control and Data Assessment

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

The Method Blank consists of the 0ppm standard as prepared in Section 10.1.2.1.1. Analyze one Method Blank per analytical batch of twenty samples or less. The Method Blank must be less than the Reporting Limit (RL). See Section 12.1 for corrective action.

9.1.1 PBS

A preparation blank is analyzed once per batch of twenty samples or less. It is prepared in the same manner as the 0ppm standard (Section 10.1.2.1.1). The PBS must be recovered within ± 0.2 µg/L.

9.1.2 ICB

The ICB is analyzed after the ICV, and is prepared in the same manner as the 0ppm standard (Section 10.1.2.1.1). The ICB must be recovered within ± 0.2 µg/L.

9.1.3 CCB

The CCB is analyzed after the CCV. It is prepared in the same manner as the 0ppm standard (Section 10.1.2.1.1). The CCB must be recovered within ± 0.2 µg/L.

9.2 Laboratory Control Sample (LCS)

The LCS is analyzed once per each analytical batch of twenty samples or less. It is prepared in the same manner as in Section 10.1.2.3. The LCS must be recovered within 80 – 120% of the true value. See Section 12.3 for corrective action.

9.3 Initial Calibration Verification (ICV)

The ICV is analyzed after the calibration curve. It is prepared in the manner specified in Section 10.1.2.2. The ICV must be recovered within ± 10% of the true value. See Section 12.2 for corrective action.

9.4 Continuing Calibration Verification (CCV)

The CCV is analyzed after every ten analytical samples. It is prepared in the same manner as the 5.0ppb calibration standard (Section 10.1.2.1.5). The CCV must be recovered within 20% of the true value. See Section 12.2 for corrective action.

9.5 Matrix Spike

Analyze one matrix spike per twenty or less analytical samples. The recovery of the matrix spike must be between 80 – 120%. Calculate percent recovery using Section 11.2.

If the recovery of the matrix spike is out of range, a post-analytical spike is analyzed. Prepare the post analytical spike by adding 5mL of 0.010ppm Calibration Standard (Section 10.1.2.1.6) and 5mL of the sample digestate to a 50mL centrifuge tube for a final concentration of 0.005mg/L. Analyze the post spike as outlined in Section 10.3.

Calculate the post spike concentration as follows:

Post Analytical Spike Sample Concentration (mg/L) =

[Sample Concentration (mg/L) x (0.5)] + 0.005mg/L

The percent recovery of the post-analytical spike must be between 75 – 125%.

See Section 12.4 for corrective action.

9.6 Laboratory Duplicate

Analyze one sample in duplicate per twenty or less analytical samples. The RPD between the sample and its duplicate must be $\leq$ 20% (as calculated in Section 11.3). See Section 12.5 for corrective action.

9.7 Method-specific Quality Control Samples

None.

9.8 Method Sequence

- Sample preparation
- Sample digestion
- Standards preparation:
  - Calibration standards
  - ICV standard
  - LCS standard

- Standards digestion
- Analysis of calibration standards
- Generation of calibration curve
- Analysis of samples and standards:
  - ICV
  - ICB
  - analytical samples
  - CCV
  - CCB
  - analytical samples
  - CCV
  - CCB
  - etc.

10. Procedure

10.1 Equipment Set-Up

10.1.1 Sample preparation: Weigh a 0.3-g portion of untreated and homogenized sample and place in the bottom of a polypropylene digestion vessel. Record the weight in the laboratory notebook. NOTE: When preparing the batch, include one sample duplicate aliquot to be prepared in the same manner.

Add 2.5 mL of reagent water and 2.5 mL of aqua regia (Section 8.2). Heat 2 min on a hot block at 95°C +/-3°C. Cool; then add 15 mL reagent water, and 7.5 mL potassium permanganate solution (Section 8.7) to the digestion vessel. Wait 15 minutes to be sure the potassium permanganate solution (Section 8.7) to the digestion vessel. Wait 15 minutes to be sure the potassium permanganate is not exhausted (purple color disappears), if it does add additional potassium permanganate to all samples and QC until stable. Mix thoroughly and place in the hot block for 30 min at 95°C +/-3°C. Cool and add 3 mL of sodium chloride-hydroxylamine hydrochloride (Section 8.8) to reduce the excess permanganate.

CAUTION: Perform this addition under a hood, as Cl_2 could be evolved.

Bring up to a final volume of 50 mL with reagent water. Continue as described under Section 10.3.1.

10.1.2 Standard preparation: Standard preparation is performed each time samples are digested.

10.1.2.1 Calibration Standards

10.1.2.1.1 **0 ppb:** Add 10mL of reagent water to a polypropylene digestion vessel. This aliquot may be used for the CCB. Another separate aliquot is prepared for use as the ICB and the diluent for any samples with concentration greater than 90% the highest calibration standard used to determine the linear range.

10.1.2.1.2 **0.5ppb:** Add 10 mL of reagent water to a polypropylene digestion vessel. Using a volumetric pipet, add 0.25 mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vesel.

10.1.2.1.3 **1.0ppb:** Add 10 mL of reagent water to a polypropylene digestion vessel.. Using a volumetric pipet, add 0.5 mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vessel.

10.1.2.1.4 **2.0ppb:** Add 10 mL of reagent water to a polypropylene digestion vessel.. Using a volumetric pipet, add 1.0mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vessel.

10.1.2.1.5 **5.0ppb/CCV:** Add 10 mL of reagent water to a polypropylene digestion vessel.. Using a volumetric pipet, add 2.5 mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vessel.

10.1.2.1.6 **10ppb:** Add 10 mL of reagent water to a polypropylene digestion vessel.Using a volumetric pipet, add 5.0 mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vessel.

10.1.2.1.7 **20ppb:** Add 10 mL of reagent water to a polypropylene digestion vessel.Using a volumetric pipet, add 10.0 mL of 0.1ppm Mercury Working Stock (Section 8.9.1.1) to the digestion vessel.

10.1.2.2 **ICV Standard, 3.0ppb:** This standard is used for calibration verification.

Add 10.0 mL of reagent water to a digestion vessel. Using a volumetric pipet, add 0.5 mL of 0.3ppm Mercury Working Stock (Section 8.9.2.1) to the digestion vessel. Digest the ICV Standard as in Section 10.1.3.

10.1.2.3 **LCS Standard, 1.0ppb:** This standard is prepared and analyzed with each analytical batch.

Add 5.0mL of reagent water to a digestion vessel. Add 0.15g of SRM (Section 8.10). Digest the LCS Standard as in Section 10.1.3.

10.1.2.4 **Matrix Spike, 0.001mg/L:** Weigh two aliquots of the sample designated to be the batch matrix spike.

Add 10.0 mL of the reagent water to the digestion vessel containing the weighed sample aliquot. Add a 0.5 mL aliquot of 0.1ppm Mercury LCS Working Stock (Section 8.9.3.1). Digest the MS as in Section 10.1.3.

10.1.3 **Standard Digestion:**

To each standard (Sections 10.1.2.1 through 10.1.2.3), add 2.5 mL of reagent water and 2.5 mL of aqua regia (Section 8.2) and heat 2 min on the hot block at 95°C +/- 3°C. Allow the standard to cool; add 15 mL reagent water and 7.5 mL of $KMnO_4$ solution (Section 8.7) to each bottle and return to the hot block for 30 min. Cool and add 3 mL of sodium chloride-hydroxylamine hydrochloride solution (Section 8.8) to reduce the excess permanganate. Bring up to final volume of 50 mL with reagent water, continue as described in Section 10.3.3.

Note: Alternate volumes of standards may be made base on need as long as they are made with the same proportions as describe above.

10.2 Initial Calibration

Construct a calibration curve by plotting the absorbances of prepared standards (Section 10.1.2) versus micrograms of mercury. (See Section 11.1.) Determine the peak height of the unknown from the absorbance maxima on the spectrometer, and read the mercury value from the standard curve.

The curve correlation coefficient (cc) must be greater than or equal to 0.995 in order for the curve to be linear. If the correlation coefficient is less than 0.995, find and correct the problem.

When the problem has been corrected, re-analyze either the previous standards or new standards. When the curve has generated an acceptable cc, then the analysis can continue with the ICV/ICB.

Analyze an Initial Calibration Verification Standard (ICV) (Section 9.3), an Initial Calibration Blank sample (ICB) (Section 9.1.2) at the start of the analytical run. The results for the ICV must be within 10% of the true value. If results are outside this range, refer to Section 12.2 for corrective action.

10.3 Equipment Operation and Sample Processing

10.3.1 Instrument Setup

10.3.1.1 Turn the instrument on by flipping the power switch on the face of the instrument. The autosampler will initialize itself.

10.3.1.2 Choose AA Winlab Analyst from the START menu. The autosampler will initialize again.

NOTE: The instrument must be turned on before the application is started. Otherwise, an error message will result.

10.3.1.3 Click the button next to “open a custom workspace”.

10.3.1.4 Select “startup.fms” from the list and click OPEN. This will open the “FIAS Control” and “Automated Analysis” windows.

10.3.1.5 Click on the “Analyze” tab in the Automated Analysis window, then click on the “Select Location” button. Click OK and the probe will go to the autosampler rinse.

10.3.1.6 Fill the carrier and reductant bottles.

10.3.1.6.1 The Carrier is 3% HCl (Section 8.6).

10.3.1.6.2 The Reductant is 1.1% $SnCl_2$ in 3% HCl (Section 8.5).

10.3.1.7 Allow the instrument to warm up while clearing samples. Samples that are cloudy or with particulate present after clearing must be filtered through Whatman 41 filter paper (Section 7.11) before analysis.

10.3.1.8 Place carrier uptake line (blue/yellow tubing, Section 7.6) and reductant uptake line (red/red tubing, Section 7.6) into graduated cylinders containing reagent water.

10.3.1.9 Load carrier and reductant lines into pump magazines above the roller so that the long ends come out on the right side. The carrier line goes into the inner magazine, and the reductant line goes into the outer magazine.

10.3.1.10 Load the two waste lines into the pump magazines below the roller.

10.3.1.10.1 The blue/yellow line goes into the inner two-channel magazine so that the long end comes out on the left side.

10.3.1.10.2 The black line goes into the outer magazine so that the long end comes out on the right side

10.3.1.11 Lock both the top and bottom magazines into place.

10.3.1.12 Unscrew the fitting from the sample absorption cell leading to the liquid vapor separator and place it into an empty dilution-vial (Section 7.8).

10.3.1.13 Click the “Pump1” button in the “FIAS Control” window to start the roller.

10.3.1.14 Adjust the tension on the lower pump magazine using the thumbscrews until a steady (but not too fast) stream of bubbles comes out of the liquid vapor separator and through the black tubing.

10.3.1.15 Adjust the tension on the upper pump magazines to obtain the following flow rates:

10.3.1.15.1 Carrier = 9 – 11 mL/minute

10.3.1.15.2 Reductant = 5 – 7 mL/minute

10.3.1.16 When the flow rates are set, click on the “Pump1” button to stop the roller.

10.3.1.17 Place carrier uptake line in the carrier bottle and reductant line in the reductant bottle.

10.3.1.18 Click the “Pump1” button to restart the roller. Allow to run for a couple of minutes to flush the reagent water from the lines. Click on the “Fill/Inject” button several times to flush the sample loop.

10.3.1.19 With the “Fill/Inject” button in the “Fill” position, (button not depressed), click the “Pump1” button to stop the roller.

10.3.1.20 Remove the cap from the liquid/vapor separator and wipe dry with a Lab Wipe (Section 7.9). Compressed air (Section 7.10) through the vapor transfer line to dry it out.

10.3.1.21 Place a PTFE membrane (Section 7.7), rough side up, in the liquid/vapor separator; replace the cap and reattach the vapor transfer line to the sample absorption cell.

10.3.1.22 Click on the “Pump1” button to start the roller.

10.3.1.23 Adjust the gas flow by turning the black knob below the air flow meter to obtain a reading of just over 50.

10.3.1.24 Click on the “Pump1” button to stop the roller.

10.3.2 Creating a Sample Information File and Loading the Sample Tray

10.3.2.1 Select “Method 0.5 – 10ppb B”. Click the “SampInfo” button on the toolbar.

10.3.2.2 In the description line, type “prep date MM/DD/YY”.

10.3.2.3 In the analyst line, type the analyst’s initials.

10.3.2.4 Drag the scroll bar so that the autosampler location 12 is showing.

10.3.2.5 Double-click the “Sample Units” cell in line 11.

10.3.2.6 Select “µg/L” from the list and enter the range of locations (12 up to 91) and click OK.

10.3.2.7 Starting with position 11, type in the sample ID

10.3.2.8 When finished, choose “Save As” from the “File” menu, then choose the “Sample Information” file.

10.3.2.9 Save the file as MMDDYYA

10.3.2.10 Load the samples into the tray as follows:

Calibration Blank
0.5ppb Standard
1.0ppb Standard
2.0ppb Standard
5.0ppb Standard
10.0ppb Standard
20.0ppb Standard
ICV
ICB
CCV
CCB
PBS listed in the sample information file.
LCSS listed in the sample information file.
Samples as listed in the sample information file.

10.3.2.11 Click the “Load Tray” button.

10.3.2.12 Replace the empty tray with the tray containing the standards and samples.

10.3.2.13 Click the “Load Tray” button.

10.3.2.14 Click the “Select Location” button and click OK to lower the probe into the autosampler rinse.

10.3.3 Instrument Calibration

10.3.3.1 Click the “Workspace” button in the toolbar.

10.3.3.2 Select the file name and click OK. Select “Method 0.5 – 20 ppb B”.

10.3.3.3 Click on the Setup tab in the automated analysis window.

10.3.3.4 Click the “Browse” button under “Sample Information File”

10.3.3.4.1 Select the sample information file that you want to open and click OK.

10.3.3.5 Click the “Browse” button under “Results Data Set Name”.

10.3.3.5.1 Type in the data set name in the format MMDDYYA and click OK.

10.3.3.6 Click the “X” under the “Use Entire Sample Info File” so that it disappears.

10.3.3.7 Under the “Use Autosampler Locations Listed Below”, enter the order of samples to be run. NOTE: Do not include standards and QC checks.

10.3.3.8 Click the “Analyze” tab.

10.3.3.9 Click the “Calibrate’ button

10.3.3.9.1 The instrument will run the calibration curve.

10.3.3.9.2 Watch the calibration blank run; if the readings vary widely, stop the run by clicking the “Calibrate” button.

10.3.4 Initial Calibration Verification

10.3.4.1 When the calibration is complete (6 – 7 minutes) and has a r^2 of 0.995 or better, click the “Analyze Samples” button.

10.3.4.1.1 The instrument will run the ICV and ICB. If the recoveries of these are within the proper ranges (Sections 9.3 and 9.1.2), the instrument will continue with analysis of samples as outlined in Section 10.3.5.

10.3.5 Sample Analysis

10.3.5.1 The instrument will now run ten analytical samples, a CCV and CCB, ten analytical samples, CCV, CCB, etc. The CCBs and CCVs must be recovered within the proper ranges (Sections 9.4 and 9.1.3) for analysis to continue.

10.3.5.2 If the sample result is beyond 90% of the concentration of the highest point on the calibration curve used to establish the linear range, dilute the sample extract with a portion of one of the prepared blanks (ICB, CCB or PBS) to produce an analytical result that is within the range.

10.3.6 Instrument Shut Down

10.3.6.1 When analysis is complete, click the “Workspace” button in the toolbar.

10.3.6.2 Place reagent uptake lines in a beaker of reagent water.

10.3.6.3 Click on the “Analyze” tab.

10.3.6.4 Click on the “Pump1” button to start the roller

10.3.6.4.1 Allow to run for several minutes to flush reagents out of the lines.

10.3.6.4.2 Click on the “Fill/Inject” button several times to rinse the sample loop.

10.3.6.5 Click the “Move Probe Up/Down” button to raise the probe out of the autosampler rinse.

10.3.6.6 Pull the reagent uptake lines out of the reagent water beaker to allow the pump to draw air through the lines.

10.3.6.7 Click “Fill/Inject” button several times to pull air through the sample loop.

10.3.6.8 With the “Fill/Inject’ button in the “Fill” position, click “Pump1” button to stop roller.

10.3.6.9 Unlock the top and bottom pump magazines and remove tubing from the magazines.

10.3.6.10 Return the reagent uptake lines to the reagent water beaker.

10.3.6.11 Click the “Move Probe Up/Down” button to lower the probe into the rinse beaker.

10.3.6.12 Select “EXIT” from the File menu to exit the WinLab application.

10.3.6.12.1 A “Shutting Down System” message will display.

10.3.6.13 When the desktop appears, turn off the power switch on the instrument.

10.3.6.13.1 Dump the samples and instrument waste in the Metals/WetChem waste drum located in the transfer room.

10.4 Continuing Calibration

After every 10 samples, analyze a Continuing Calibration Verification Standard (CCV), and a Continuing Calibration Blank sample (CCB). Determine the concentrations from the calibration curve. The results for the CCV must be within 20% of the true value.

10.5 Preventive Maintenance

Preventative maintenance is conducted per the manufacturer's instructions. All preventative maintenance is recorded in the Instrument Maintenance Logbook.

11. Data Evaluation, Calculations and Reporting

11.1 Calculate Mercury Concentration From the Daily Calibration Curve

The curve is generated utilizing a straight-line equation defined as:

$$A = k_1 + k_2C$$

Where:

A = Average peak height of the sample/standard integrations
C = Sample/Standard Concentration, µg/L
k_1 = y-intercept
k2 = slope

The instrument will plot peak height against concentration (µg/L). The result is generated in µg/L. This value is divided by 1000 to convert the units to mg/L. The mg/L units are converted to mg/Kg by multiplying by L/Kg. A dilution factor (DF) is applied if necessary. The Result is then divided by the % Total Solids prior to release to the client.

$$\text{Result, mg/Kg} = (\text{concentration, µg/L}) \times (1\text{mg}/1000\text{µg}) \times (\text{DF}) \times (\text{L/Kg})$$

Where:

$$\text{L/Kg} = \frac{\text{Final volume of digestate, in L}}{\text{Weight of original sample, in Kg}}$$

11.2 Calculate Percent Recovery for the Matrix Spike corrected for concentrations measured in the unfortified sample.

Percent recovery is calculated using the following equation:

$$\%\ \text{Recovery} = \frac{(Cm - C)}{s} \times 100$$

Where:

Cm = measured Mercury in the fortified sample
C = measured native mercury sample concentration
S = concentration equivalent of spike added to sample

11.3 Calculate the Relative Percent Difference (RPD) for each Duplicate of the initial quantitated concentration (IC) and duplicate quantitated concentration (Dc) using the following formula:

$$RPD = \frac{|(IC - Dc)|}{\{(IC + Dc) / 2\}} \quad x \quad 100$$

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Method Blank Failure

When a prep blank mercury concentration is $\geq$10% of the mercury concentration determined for any associated sample, or is greater than 2.2x the MDL value (whichever is greater), the entire batch associated with the prep blank must be redigested.

12.2 ICV / CCV Failure

If the ICV %Recovery is outside of acceptance criteria, analysis is terminated until the problem is found and corrected. If the CCV %Recovery is outside of acceptance criteria, all samples analyzed since the last acceptable CCV must be reanalyzed following correction of the problem.

12.3 LCS Failure

If the LCS is not recovered within acceptance criteria, the associated batch and another LCS must be redigested (Section 10.1).

12.4 Matrix Spike/Post Digestion Spike Failure

If the recovery of the matrix spike is outside of the acceptance criteria of 80 – 120%, a post digestion spike is performed (Section 9.5). If the post digestion spike is beyond 75 – 125%, the sample and its spike are redigested (Section 10.1).

12.5 Duplicate Failure

If the RPD between the sample and its duplicate is greater than 20%, visually evaluate the sample matrix. If the sample matrix appears clean, the sample and its duplicate are removed from the batch and redigested (Section 10.1). If the matrix appears problematic, the sample digestate may be diluted and reanalyzed, or a narrative included with the data to explain the matrix problem.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/08-05. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/08-12 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha's Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/08-05 MDL/LOD/LOQ Generation

SOP/08-12 IDC/DOC Generation

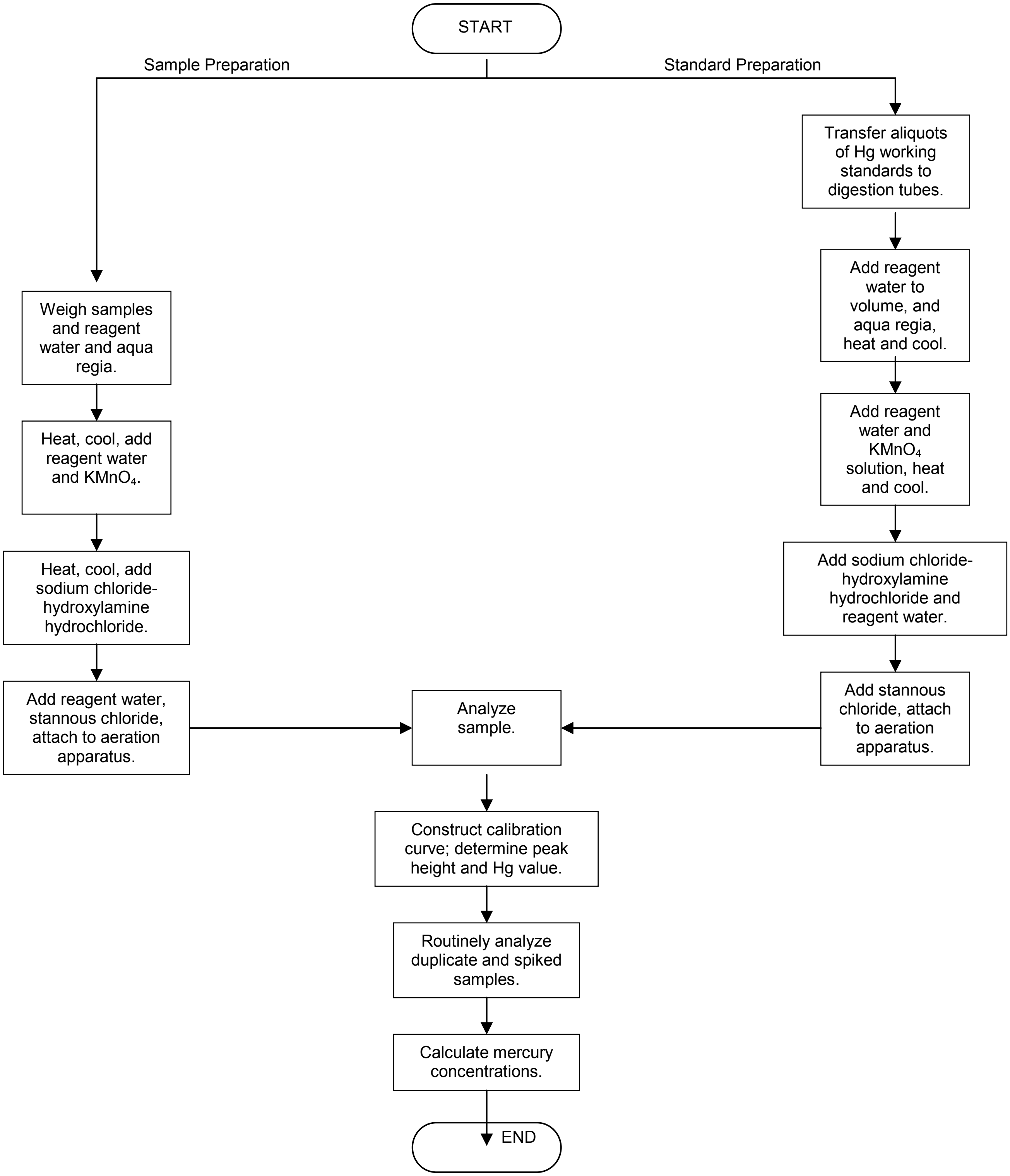
SOP/14-01 Waste Management and Disposal SOP

16. Attachments

FIGURE 1: Flow Chart for Method 7471B

Figure 1

Method 7471B Flow Chart



Total Organic Carbon and Soot in Soil, Sediment

References: USEPA, Region II, Lloyd Kahn, "Determination of Total Organic Carbon in Sediment", July 27, 1988.

Perkin Elmer, "PE 2400 Series II CHNS/O Analyzer User's Manual," The Perkin-Elmer Corporation, April 1998.

USEPA, "Method 9060A Total Organic Carbon," in Test Methods for Evaluating Solid Waste, SW846, Revision 1 November 2004.

"Quantification of the Dilute Sedimentary Soot Phase: Implications for PAH Speciation and Bioavailability" published in Environmental Science and Technology, Vol. 31, No. 1, 1997 by Gustafsson, Haghseta, Chan, McFarlane and Gschwend.

"Reinterpreting Literature Sorption Data Considering Both Absorption into Organic Carbon and Adsorption onto Black Carbon" published in Environmental Science and Technology, Vol. 37, No. 1, 2003 by Accardi-Dey and Gschwend

1. Scope and Application

Matrices: This method is applicable for solid samples (soils, sediments, sludges).

Definitions: Refer to Alpha Analytical Quality Manual.

The organic carbon in a sample consists of a variety of organic compounds in various oxidation states. Some of these compounds may be oxidized by biological or chemical processes and can be measured by the Biochemical Oxygen Demand or Chemical Oxygen Demand tests. To measure the amount of organically bound carbon, the organic carbon molecules are broken down into single carbon units, and converted into a form that can be measured quantitatively.

The PE 2400 Series II CHNS/O Analyzer can simultaneously determine carbon (C), hydrogen (H), nitrogen (N), sulfur (S), and oxygen (O) in organic material. In the CHN mode, the PE 2400 Series II CHNS/O Analyzer uses a combustion method to convert the sample elements to simple gases (CO_2, H_2O, and N_2). The resulting gases are homogenized and controlled to exact conditions of pressure, temperature, and volume. The homogenized gases are allowed to de-pressurize through a column where they are separated in a stepwise steady-state manner and detected as a function of their thermal conductivity and reported as a percentage for solid samples. Treated with hydrochloric acid prior to analysis, the Total Organic Carbon (TOC) content is determined by the amount of CO_2 in the sample. If the sample is analyzed without pretreatment, the Total Carbon (TC) content is determined. Total Inorganic Carbon can be determined by subtraction of the TOC from the TC values.

This method is applicable to the measurement of TOC and Soot in solid samples $\geq$ 100mg/Kg or $\geq$ 0.01%, dry weight. According to the instrument manufacturer, a sample of up to 70% carbon can be analyzed without dilution.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the TOC Analyzer and in the interpretation of the data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability and completing the record of training.

After initial demonstration, ongoing demonstration is based on acceptable laboratory performance of at least a quarterly laboratory control sample or acceptable performance from an annual proficiency test sample. A major modification to this procedure requires demonstration of performance. The identification of major method modification requiring performance demonstration is directed by the Quality Assurance Officer and/or Laboratory Director on a case-by-case basis.

2. Summary of Method

An aliquot of solid sample is dried, homogenized, weighed into a tin capsule, pre-treated with hydrochloric acid and heated to 75°C to convert the inorganic carbon (*i.e.,* carbonate and bicarbonate in the form of CO_2) prior to analysis.

Organic carbon is measured using combustion and a carbon analyzer. The sample, of approximately 5-10 (masses less than 5 mg must be avoided since balance is not calibrated below 5 mg)mg corrected sample weight (a larger aliquot may be used for heterogeneous, or low- carbon samples to improve reproducibility), is oxidized in a pure oxygen environment, introduced into a furnace by a 60-slot Autosampler, then combusted. A greater mass may be weighed if the sample observations indicate low carbon content. As much as 20-25mg may be utilized. The carrier gas (O_2) is combined with the carbon content of the combusted sample to form CO_2. Elements, such as halogens and sulfur, are removed by scrubbing reagents in the combustion zone. A thermal conductivity detector then measures the CO_2. The amount of CO_2 derived from a sample is directly proportional to the concentration of organic carbon material in the sample.

For Soot, the sample will be transferred to an aluminum tin. The tins will be placed in an oven or muffle furnace for 24 hours at 375^{o}C. After sample is in the muffle furnace for 24hrs sample is reduced to a powder with a mortar and pestle, weighed into a tin capsule, then treated with acid then re-dried and analyzed on the TOC Analyzer.

Method Modifications from Reference

Samples are analyzed using 2 replicates unless otherwise specified by the Client. Hydrochloric acid is substituted for phosphoric acid. The use of this acid has been validated and documented by the laboratory.

3. Reporting Limits

The Practical Quantitation Limit (PQL) or Reporting Limit (RL) is 0.05% (or 500mg/Kg) for solid samples.

4. Interferences

4.1 To determine the TOC/Soot content, the inorganic fractions (carbonate and bicarbonate) must be removed prior to analysis by lowering the pH of the sample to $\leq$ 2. When removing the inorganic carbon, care must be taken in sample pretreatment to minimize the potential of loss of volatile organic carbon present in the sample.

4.2 Maintaining the samples at 4±2°C, and analyzing within the specified holding time minimizes bacterial decomposition and volatilization of the organic material.

4.3 Elements, such as halogens and sulfur, are removed by scrubbing reagents in the combustion zone. Large and/or complex organic molecules such as tannins, lignins, or humic acids may be oxidized slowly. If these compounds are suspected to be present, it is advisable to check the efficiency of the oxidation procedure with a selected representative sample, and adjust the analysis (sample size) as needed.

4.4 Oils from skin, or contact with any organic material, such as plastic containers and rubber tubing, can contaminate samples. Handle the weighing tins with tweezers.

4.5 Sample heterogeneity can be a major source of imprecision in TOC/Soot results. Recommend to clients to perform a client-specific duplicate, to evaluate precision and representativeness of the TOC/Soot results to the site.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material data handling sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

The use of laboratory equipment and chemicals exposes the analyst to several potential hazards. Good laboratory techniques and safety practices shall be followed at all times. All relevant Material Safety Data Sheets (MSDSs) are kept on file.

Approved PPE, which includes Safety Glasses, Gloves and Lab Coats, must be worn at ***all*** times when handling samples, reagents, chemicals, or when in the vicinity of others handling these items, so that dermal contact is avoided. All standards, reagents and solvents shall be handled using the proper PPE. All flammable solvents must be kept in the flammable storage cabinet, and returned to the cabinet immediately after use. When transporting chemicals, use a secure transporting device and/or secondary outer container. Chemical storage is properly segregated and adequately ventilated to reduce the possibility of hazardous reactions. Chemical storage in work areas shall be kept to a minimum. Storage on bench tops or other work surfaces, except temporary, is not permitted.

All standards and reagents shall be prepared in a hood while using the proper PPE.

Analytical instrumentation poses the unique possibility of exposure to high voltages. Other than the *routine* instrument maintenance, as listed in the front of every Instrument Maintenance Logbook, at no time shall an instrument operator attempt to maintenance an instrument alone, or without the proper training, supervision or instruction. Caution must always be used in the presence of moving parts (autosamplers) and hot surfaces (injection ports).

All additional company safety practices shall be followed at all times as written in the *Chemical Hygiene Plan*.

All TOC standard solutions must be handled with caution. See pages 5-3 through 5-5 of the PE 2400 Series II CHNS/O Analyzer User's Manual for additional and specific Warnings and Precautions.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

A minimum of 5 grams of sample must be collected in a glass jar.

6.2 Sample Preservation

Soil samples must be refrigerated and maintained at 4°±2°C until drying and analysis.

Sediment samples are either processed within 28 days(where citing 9060 hold time reference) (or 14 days for Lloyd Kahn) or can be frozen (for programs with an EPA approved holding time extension for frozen storage) at -15C to -20C until processing.

6.3 Sample Shipping

The *Sample Receipt & Login SOP* (1559) describes how samples are normally shipped or obtained by the laboratory, precautions to be used in opening sample shipments, and sample storage conditions.

6.4 Sample Handling

Soil samples must be refrigerated and maintained at 4°±2°C until drying and analysis.

Sediment samples are either processed within 28 days (or 14 days for Lloyd Kahn) or can be frozen at -15C to -20C until processing (for programs with an EPA approved holding time extension for frozen storage)

All solid samples (NOT requiring the *Lloyd Kahn* Calibration method) must be analyzed within 28 days from the date of collection unless extended hold times are provided in client specific QAPP. **Note:** If samples require the *Lloyd Kahn* Calibration method, the hold time is 14 days unless otherwise indicated by client.

The *Sample Receipt & Login SOP* (1559) describes the responsibilities of sample custody including all proper documentation, verification, and tracking procedures, following Chain of Custody (COC) protocols and sample receipt procedures using the *Sample Receipt Checklist*, which includes the check for proper sample preservation and cooler temperature verification.

Internal COC procedures for sample tracking include the use of sample tracking logbooks. These procedures are also described in the *Sample Receipt & Login SOP* (1559).

7. Equipment and Supplies

7.1 Instrument: Perkin Elmer 2400 Series II CHNS/O Analyzer with computer and PE software

7.2 Detector: Thermal Conductivity

7.3 Mortar and pestle

7.4 Oven: 75 +/- 2 °C

7.5 Muffle Furnace: Capable of maintaining temperature of 375°C

7.6 Dessicator

7.7 Volumetric Flasks: Class-A, various volumes

7.8 Microbalance: Perkin-Elmer, Model AD-6. See the Manufacturer User's Manual, Section 1.2, pages 3-4, for Microbalance and weighing instructions. The Microbalance calibration is verified every day using 5.0mg - 200mg weights, in the range of daily use, and be accurate within +/1%. If the balance needs to be re-calibrated, see the Manufacturer User's Manual SOP, Section 1.1, page 3, for details.

7.9 Tweezers: Anti-Magnetic

7.10 Tin Boats: 5 X 8 mm.

7.11 Polypropylene beakers: 50 mL, for weighing wet samples.

7.12 Glass Beads: Filter Aid 400, High-density; from Perkin Elmer or 3M. Used as the CCB/Method Blank media. Beads must be muffled at 375°C prior to use to remove any trace carbon.

7.13 Gas-tight syringes: Various measuring sizes, including 10µL for direct sample spiking

7.14 Transfer pipets and/or Eppendorf pipettor for delivering HCl: Polypropylene.

7.15 Printer : OKIDATA Microline 320 Turbo-9 Pin or equivalent

Note: All maintenance records including routine upkeep and outside service visits are maintained in the instrument maintenance logbooks. See the Manufacturers User's Manual for detailed troubleshooting instructions and routine maintenance, as needed.

8. Reagents and Standards

Use reagent grade chemicals for all reagents. All reagents and standards are stored at room temperature and expire 6 months from preparation, unless otherwise indicated below.

8.1 Deionized (DI) water: All references to DI water refer to ASTM Type II reagent grade water which has been boiled, cooled and capped to eliminate CO_2. Water must be replaced weekly.

8.2 10% Hydrochloric Acid solution: Add 300mL of concentrated HCl (34-37%) to 700mL of DI water. Mix thoroughly and cool to room temperature before use. Store in a glass bottle and keep at room temperature. This solution is stable for 6 months.

8.3 Potassium Hydrogen Phthalate (KHP), CCV or K-Factor for TOC:

CCV- 10,000mg/L equivalent to 10,000mg/Kg Carbon, or 1.0 % TOC:

Dry potassium hydrogen phthalate (KHP) (primary standard grade) at 110°C for 1 hour. Cool to room temperature in a dessicator. Dissolve 2.128g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. This standard is good for 6 months, stored at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed.

Calibration Standards-
Dry KHP (primary standard grade) at 110°C for 1 hour. Cool to room temperature in a dessicator.

- 0.1% (1000mg/Kg) – Add 10 mL of the 1.0% calibration solution (see below) to a 100 mL volumetric flask. Dilute to 100 mL using ASTM DI water.

- 0.5% (5000 mg/Kg) - Dissolve 1.064g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. This standard is good for 6 months, stored at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed.

- 1.0% (10000mg/Kg) - Dissolve 2.128g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. This standard is good for 6 months, stored at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed.

- 2.0% (20000mg/Kg) - Dissolve 4.256g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. This standard is good for 6 months, stored at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed.

- 4.0% (40000mg/Kg) - Dissolve 8.512g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. This standard is good for 6 months, stored at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed.

8.4 Potassium Hydrogen Phthalate (KHP) Spiking Solution/MS/ICV: 10,000mg/L equivalent to 10,000mg/Kg Carbon, or 1.0 % TOC. From a separate source than the solution in Section 8.3, Sigma Aldrich or equivalent.

Dry KHP (primary standard grade) at 110°C for 1 hour. Cool to room temperature in a dessicator. Dissolve 2.128g of KHP (primary standard grade) in ASTM DI water, and dilute to 100mL in a volumetric flask. *Use a separate source or different lot of KHP from that used to prepare the calibration standards.*

This stock may be stored up to six months at room temperature. Discard solution if discoloration or any signs of bacterial growth are observed. Use at 1.0 % TOC concentration for solid samples, and at 10,000mg/L for aqueous samples.

8.5 Solid Standard Reference Materials: Standard Reference Material (SRM) NIST 1944, a separate source from the calibration standard that is certified at the concentration of 4.4% TOC for solid samples. SRM 1650b for Soot, this material has no certified value, however has a reference value of 78% soot carbon. ("Quantification of the Dilute Sedimentary Soot Phase: Implications for PAH Speciation and Bioavailability" published in Environmental Science and Technology, Vol. 31, No. 1, 1997 by Gustafsson, Haghseta, Chan, McFarlane and Gschwend.)

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 Blank(s)

9.1.1 Method Blank: A method blank must be analyzed once per every 20 samples or per TOC/Soot batch, whichever is more frequent. The Blank consists of 30-50mg of Filter Aid acidified with HCl and dried. (Section 7.11).

TOC must not be detectable in the method blank at a concentration greater than the reporting limit for the given matrix (Section 3).

Corrective Action: Analysis of the method blank and all associated samples must be performed until the blank is in control. Samples cannot be analyzed until an acceptable method blank analysis is obtained. Exceptions may be made with approval of the Department Manager, if the samples associated with the out of control method blank are non-detect for TOC/Soot, or if sample TOC/Soot concentrations are greater than 10X the blank levels. In such cases, the sample results are accepted without corrective action for the high method blank and the client is notified in a project narrative associated with the sample results.

9.1.2 Continuing Calibration Blank: A CCB must be analyzed immediately after every CCV. The CCB is 30-50mg of Filter Aid acidified with HCl and dried. (Section 7.10).

The CCB concentration must not be greater than the reporting limit for the given matrix (Section 3).

Corrective Action: Repeat analysis once to see if an analytical error occurred. If the CCB still exceeds the control limits, re-calibrate and/or re-analyze a fresh blank. All samples associated with the out of control CCB must be re-analyzed (since the last acceptable CCB). Exceptions may be made with approval of the Department Manager if the samples associated with the out of control method blank are non-detect for TOC/Soot or if sample TOC/Soot concentrations are greater than 10X the blank levels. In such cases, the sample results are accepted without corrective action for the high CCB and the client is notified in a project narrative associated with the sample results.

9.1.3 Instrument Blank: An Instrument Blank must be analyzed during Calibration.run2. The Instrument Blank consists of 30-50mg of Filter Aid acidified with HCl and dried at 75°C. (Section 7.10).

9.2 Laboratory Control Sample (LCS)

Laboratory control sample (LCS) must be from a second source or lot number to verify the accuracy of the standard curve. The LCS is analyzed along with the samples. A LCS must be analyzed once per every 20 samples or per TOC batch, whichever is more frequent. For *solid* samples, the LCS is the NIST SRM at 4.4% TOC. The LCS is treated identically as samples with HCl and dried at 75°C.

LCS consists of approximately 5.0mg of SRM 1944 with a true value of 4.4% TOC (Section 8.6). This SRM is NOT evaluated for Soot since no certified concentration for Soot is published.

The acceptable recovery QC range is 75%-125% for the LCS.

Corrective Action: Repeat analysis once to see if an analytical error has occurred. If the LCS recovery is still out of control, re-calibrate and re-analyze the LCS and all associated samples. Samples cannot be analyzed until an acceptable LCS is obtained. Exceptions may be made with approval of the Department Manager if the samples associated with the out of control LCS are also associated with a matrix spike that is in control. This is an acceptable measure of accuracy of the analytical procedures. An explanation of this out of control LCS recovery must be included in the project narrative to the client and the sample data reported with the acceptable MS results as batch QC.

9.3 Initial Calibration Verification (ICV)

Second source analyzed at the beginning of the run. Sample matrix of ICV is a 1.0% carbon solution of KHP.

The acceptable recovery QC range for the ICV is 80-120%.

The **ICV** is prepared by adding 10µL of *Spiking Solution* (Section 8.4), (with a 1% TOC true value). The weight recorded is the Calibration Solution only. (10µL of solution should weigh approximately 10mg).

Corrective Action: Repeat analysis once to see if an analytical error occurred. If the ICV still exceeds the control limits, re-calibrate and re-analyze all samples since last acceptable ICV.

9.4 Continuing Calibration Verification (CCV)

A CCV must be analyzed at a minimum of every 10 burns and at the close of an analytical sequence. This standard monitors instrument performance throughout the duration of the analytical run. Sample matrix of CCV is a 1.0% carbon solution of KHP.

The **CCV** is prepared by adding 10µL of *Calibration Solution* (Section 8.3), (with a 1% TOC true value). The weight recorded is the Calibration Solution only. (10µL of solution should weigh approximately 10mg).

The acceptable recovery QC range for the CCV is 80-120%.

Corrective Action: Repeat analysis once to see if an analytical error occurred. If the CCV still exceeds the control limits, re-calibrate and re-analyze all samples since last acceptable CCV.

9.5 Matrix Spike

A matrix spike must be performed once per 10 samples (10% frequency). When project specifications dictate, a Matrix Spike Duplicate (MSD) may also need to be performed at the same frequency as the MS. Prepare the MS according to Section 8.4 for the given matrix.

A **Matrix Spike** sample is spiked with 10µL of *Spiking Solution* (Section 8.4), at a 1.0 % TOC true value. The weight recorded is the sample weight prior to spiking.

The acceptable recovery QC range is 75%-125% for the MS/MSD. Calculate the %RPD as in Section 9.6 when analyzing a MS/MSD pair. The acceptable %RPD is ≤ 25% for solid samples.

Corrective Action: If sample concentration exceeds 4X the spike amount, narrate. Repeat analysis once to see if an analytical error has occurred. If the % recovery or %RPD still exceeds the criteria and the LCS is compliant; include a project narrative with the results to the client noting that there may be potential matrix effects on the accuracy or precision of the TOC/Soot results as evidenced by matrix spike recovery or %RPD outside of QC limits.

9.6 Laboratory Duplicate

Duplicate analyses (matrix duplicate) must be performed once per 20 samples (5% frequency).

Acceptable relative percent difference (RPD) of duplicates is ≤ 25%. Acceptance criterion is not applicable to sample concentrations less than 5X the reporting limit. Calculate RPD as follows:

$$\%RPD = \frac{R1 - R2}{\frac{[R1 + R2]}{2}} \times 100$$

where:

R1 = highest result
R2 = lower result

Corrective Action: Repeat analysis once to see if an analytical error has occurred. If the % RPD still exceeds the control limits; include a project narrative with the results to the client noting that there may be potential matrix effects on the precision of the TOC/Soot results as evidenced by the matrix duplicate RPD exceedance.

9.7 Method-specific Quality Control Samples

High level Initial Calibration Verification (HLICV - linearity check):

This sample consists of 4% carbon solution (high calibration point).

Aliquot 50 µL using a syringe into a tin boat, record weight and analyze. (Equivalent to a 5 mg sample containing 40% TOC).

The acceptable recovery QC range for the HLICV is 80-120%.

Corrective Action: Repeat analysis once to see if an analytical error occurred. If the HLICV still exceeds the control limits, re-calibrate.

9.8 Method Sequence

- Calibration Curve generation
- ICV
- ICB
- HLICV
- Method Blank
- LCS
- Laboratory Duplicate
- Matrix Spike
- Samples 1 – 8
- CCV
- CCB
- Samples 9 – 18
- CCV
- CCB

10. Procedure

10.1 Equipment Set-up

Samples are prioritized by the Department Manager for analysis based on hold time and client due date. Section 15.5 outlines the steps for final TOC reporting that will contain the sample analysis final results.

The analyst initials, date, sample ID #'s, sample weights (solids), or volumes (aqueous), of all Standards, QC samples and field samples, are entered into the TOC logbook. Include the standard, LCS and MS IDs and concentrations. Use TOC weight spreadsheet to record all information.

10.1.1 Pretreatment for Total Organic Carbon:

This procedure is used to remove the inorganic compounds in the sample prior to the determination of Total Organic Carbon. If Total Carbon is to be determined, addition of the acid solution is omitted.

10.1.1.1 Aliquot 10-15g of wet solid sample into a weighing vessel. Remove shells, rocks and other large non-representative materials with tweezers. Record weight of vessel and vessel + wet sample.

10.1.1.2 Heat for 4 hours at 75 +/- 2 °C. Return sample to oven if additional drying time is required(in ½ hour increments) Record time in and out of oven. Cool sample to room temperature in dessicator. Record weight of vessel + dry sample.

10.1.1.3 Add 10% HCl (Section 8.2) dropwise to dry sample to induce effervescence (removal of inorganic carbon). Do not use excessive acid.. Only add enough acid to exhaust the effervescence. In lieu of additional acid, use DI water to wet the sample in order to form a slurry if necessary, to distribute the acid throughout the sample. Record the volume of HCl used for each sample.

10.1.1.4 Return the sample to the oven. Heat for 4 hours at 75 +/- 2 °C. Return sample to oven if additional drying time is required(in ½ hour increments) Record time in and out of oven. Cool to room temperature in dessicator. Record final weight of dry sample + vessel. The change in weight of dry sample after acidification is used to adjust the weight of the aliquots used for analysis.

10.1.1.5 Take a sub-aliquot of approximately 2-3 g of dry sample and perform moisture content using SM2540D. The corrected sample weight (CSW, see Section 11.4) is corrected using this result (see Section 11.4 for calculations)

10.1.1.6 Grind sample with mortar and pestle to homogenize. Place ground sample into a 4 mL vial.

10.1.1.6.1 If Soot analysis is required, take a portion of the dried sample aliquot(prior to acidification), approximately 5-10 gm, and place into a muffle furnace at 375°C for 24 hours. Once the sample aliquot is cooled to room temperature, proceed to the acid addition step, Section 10.1.1.3. Samples for Soot are read analytically in the same way as Routine TOC.

10.1.1.7 Weigh (and record weight of) each replicate into a tin capsule (see Section 10.3 for appropriate weight range). Record the weight and use the TOC weight spreadsheet to calculate the corrected sample weight (CSW) which is entered into the analyzer.

10.2 Initial Calibration

On the accompanying computer, or "PC", Perkin Elmer software has been loaded to collect and save sample and standard analysis data. Create a file to store the data from each day's analytical sequence by clicking on the PE 2400 icon, go to "new" and "save" the file "as" the name of the date of the analysis (*i.e.,* 060503.chn). Data from each standard or sample analysis will be automatically stored in this file for future reference

10.2.1 Follow the instrument Manufacturers User's Manual for instrument set up and see Sections below for an outline of the initial, daily calibration procedure.

See the Manufacturers User's Manual, page 5-69, for the default instrument conditions when in the CHN operating mode.

10.2.2 *Lloyd Kahn* Calibration Method: **Note:** The *Routine* instrument calibration procedure (Section 10.2.2) must be established before the Linear Regression method is used, otherwise, the raw data will not reflect results that approximate the results from the curve..

Prepare a curve for *Lloyd Kahn* calibration as outlined below. Additionally, see page 5-82 and 5-83 of the Manufacturers User's Manual for proper set-up of this calibration method.

Analyze each point of the calibration curve following Section 10.3. On an Excel spreadsheet, plot *Carbon (mg*) vs. *Instrument Response*, using five standards and a blank covering the analytical range of interest. See Section 8.3 for Calibration Standard preparation. Standards are solutions of KHP.

Blank = 10 ul of DI water from Barnstead

Point 1 = 0.1% (1,000mg/Kg) Standard

Point 2 = 0.5% (5,000mg/Kg) Standard Point 3 = 1.0% (10,000mg/Kg) Standard Point 4 = 2.0% (20,000mg/Kg) Standard

Point 5 = 4.0% (40,000 mg/Kg) Standard

This is the calibration curve for Linear Regression analysis. The corrected response (Y-axis) is calculated by subtracting the nitrogen response from the carbon response. This is plotted against concentration.

The correlation coefficient (r) of the initial calibration curve must be ≥0.995. The slope of the line must be ± 10% of historical curves.

For Lloyd Kahn analysis, one sample per 20 (or per batch) must be analyzed in quadruplicate.

Corrective Action: If the correlation coefficient or slope QC criteria are not met, the standard curve must be re-prepared and re-analyzed until the correlation coefficient and/or slope are acceptable.

10.3 Equipment Operation and Sample Processing

Prepare a Calibration Curve per Section 10.2.

An ICV/ICV and LCS/Method Blank are analyzed immediately following the third K-Factor of the Routine Calibration, provided the instrument is "in tolerance". The LCS and method blank must be run with the same number of replicates that are required for the samples in the run.

Remove all pretreated samples from the oven, and allow to cool in a dessicator.

Weigh approximately 5-10mg (to an accuracy of 0.01 mg) (masses less than 5 mg must be avoided since balance is not calibrated below 5 mg) of sample into a tin boat using the Perkin-Elmer Microbalance, Model AD-6, which is linked to the instrument. Samples that are known to be high in TOC may use a lesser sample aliquot. Samples where it is observed that the TOC may be low, weight as much as 20-25mg. Record the weights in the TOC/Soot logbook. Matrix Duplicate and Matrix Spike samples are weighed as separate samples, with their own replicates. As noted in Section 10.1.1.6, use the TOC weight spreadsheet to correct the sample weights for all replicates and re-analyses.

Any observations regarding the sample composition must be noted in the TOC/Soot logbook such as: sandy, contains shells or rocks, contains grass or roots, is light/white in coloration, etc.

Analyze a CCV/CCB (Section 9.4 and 9.1.3) after every 10 “burns”, and at the end of the analytical sequence.

If following the *Lloyd Kahn* Calibration method, analyze the first set of batch QC samples, the ICV/LCS and Method Blank, followed by field samples with a CCV/CCB analyzed every 10 “burns”, and at the end of the analytical sequence.

10.3.1 Multiple Sample Instrument Loading:

10.3.1.1 Each tin boat is carefully folded with anti-magnetic tweezers, and placed into its respective holding tray position. (See the Manufacturer User’s Manual SOP, Section 1.2, page 4, for tin boat folding details.) Weights, sample tray position and Autosampler location are recorded in the TOC/Soot logbook. The analyst must be very careful when transferring samples. Documentation of sample consistency is very important. See Figure 1 for an example logbook page.

10.3.1.2 Adjust the Autosampler tray to begin sampling at auto-slot #1 and carefully transfer the folded tins containing the samples to the correct auto-slot, using tweezers. All Instrument Calibration Standards (Blanks, K-Factors and/or *Lloyd Kahn* Calibration Standards) are loaded first. Immediately following will be the first batch QC samples, the ICV/LCS and Method Blank for the run, followed by field samples. Rotate the Autosampler in a *counter clockwise* manner.

10.3.1.3 A maximum of 60 tins can be held on the Autosampler at one time. The instrument only allows for 100 total samples (including calibration/blank samples) to be programmed for any given run.

10.3.2 Sample Analysis

10.3.2.1 Select the *Auto Run* option on the keypad on the instrument. The following menu appears:

AUTO RUN NO. 1
1B 2K 3S
where: B = Blank
K = K-Factor
S = Sample

Assuming the *Instrument Standardization* occupies auto-slots 1-6, Enter “3” for Sample, then select “Enter”. Enter the weight of the “Primer” Standard (position 1) and select “Enter”.

10.3.2.2 You will be prompted for AUTO RUN NO. 2 as in Section 10.3.3.1, except now there is a function “4NP” which allows the analyst to stop/erase everything by selecting this feature.

- Enter “1” for the Blank. The weight will not be asked for.

- Enter “2” for the first K-Factor, then select “Enter”. Enter the weight of your K-Factor (the standard weight should be ~ 10mg). Select “Enter”.

- Enter “1” for the second Blank, then “Enter”.

- Enter “2” for the second K-Factor, then “Enter”. Enter the weight, then “Enter”.

- Enter “2” for the third K-Factor, then “Enter”. Enter the weight, then “Enter”.

10.3.2.3 All remaining sample weights are added by entering “3” for Sample, and then by entering the sample weight. Continue adding all information to the run sequence, using the keypad. When entering sample identifications, and letters are necessary, refer to the Manufacturer’s User’s Manual, page 3-4, for instructions for converting numbers to letters.

10.3.2.4 When all sequence information is entered and complete, select “Start”. The analyses will begin. The computer will continue to display the “AUTO RUN” menu during sample analysis.

10.3.2.5 The Standard and Sample data prints out as it is collected on the line printer, and is also collected on the linked computer using the PE 2400 software. The data on the computer is saved in a file named as the date of the analysis (*i.e.,* 060503.chn) for future reference, as noted in 10.2.

10.3.2.6 When all analyses are complete, refer to the Manufacturers User’s Manual SOP, Section 3.1, page 7, for instructions to “Shut Down” the instrument.

10.3.2.7 Evaluate all batch QC samples first, to confirm or exclude the need for re-analyses. The ICV/LCS/HLICV, Method Blank, CCB/CCV samples must meet the acceptance criteria in Section 9. Follow the corrective action for any QC failures.

10.3.2.8 Evaluate the field samples, LCS/SRM, and MS/Duplicates next. If replicate “burns” vary by more than 30%, re-weigh two additional aliquots similar to the initial weights used, and re-analyze the sample. For a 2-replicate analysis, this provides a total of four burns/samples. If the second set of replicates also has RPD > 30%, report the first set. If the re-analysis has an RPD which passes, report the re-analysis. Three and four replicate analysis may be requested, and the average of the multiple burns is reported, unless otherwise indicated by the client. Analysts should use judgement in cases where there may have been an error with the autosampler or other factor (incorrect loading, etc.) which may have led to RPD failure. The Lloyd Kahn method requires that quadruplicate analysis be performed on one sample per batch of up to 20 samples and that the RSD must meet precision criteria of 3 times the standard deviation of laboratory generated sample data. One sample per batch of up to 20 must be analyzed in quadruplicate. RSD criteria is 40%. This value was generated using 30 data points of quadruplicate analysis of various concentrations and multiple instruments. The RSD was calculated for each sample in quadruplicate, and the RSD limit is based on 3 times the average standard deviation. Failure to meet this criteria requires that the entire batch be re-analyzed.

10.4 Continuing Calibration

A CCV must be analyzed as outlined in Section 10.3.3 at a minimum of every 10 burns and at the close of an analytical sequence.

10.5 Preventive Maintenance

The reduction column is changed after every 100-200 runs. The combustion column is replaced as needed.

11. Data Evaluation, Calculations and Reporting

11.1 Procedures for data and record management for TOC/Soot analysis must adhere to the Quality Systems Manual, other subordinate documents covering record keeping, and the *Document Control* SOP, 08-01. All records are stored in such a manner as to be safe and accessible for at least 10 years.

11.2 The relevant TOC/Soot laboratory notebooks must follow the specifications in the *Laboratory Notebook Usage* Work Instruction 1556, and all record keeping and document control practices.

11.3 Sample results for TOC/Soot are directly reported from the instrument printout.

11.4 **Calculations:** The following calculations are applied by the instrument when determining the percentage of Total Organic Carbon or Soot: Note: sample weights are corrected for sample mass changes due to acidification prior to analysis and entered into the instrument software as the corrected weights, therefore, no correction is required after analysis.

Corrected Sample Weight(CSW): Weight that is entered at the instrument, corrected for sample mass change after acidification.

$$\text{CSW} = \frac{\text{aliquot wt (mg)} * \text{total sample dry wt (g) (prior to acidification)} * \text{dry wt.@ (75°C)}}{\text{Total sample dry wt (g) (post acidification)} * \text{dry wt.@(105°C)}}$$

Carbon Blank (CB): Used to make all other determinations, namely, K-Factor and weight percent calculations. When run alternately with samples, the instrument averages the blank values.

Carbon Blank (CB) = Carbon Read – Nitrogen Read

Carbon K-Factor (C KF): K-Factor, or detector calibration factor, is determined when a known standard is analyzed to calibrate the analyzer in terms of micrograms of carbon. This calibration factor is then used to determine unknowns.

C KF = ((CR – NR) – CB x 100) / (CSW x C Theory Wt. %)

where: CR = Carbon Read
NR = Nitrogen Read
CB = Carbon Blank
CSW= Corrected Sample Weight (mg) (using corrected weight recorded in Section 10.3)

C Theory Wt % = 1% (based on the concentration of the K-Factor standard)

Carbon (mg/Kg):

Carbon (mg/Kg) = (((CR – NR) – CB) x 1000) / (SW x C KF)

where: CR = Carbon Read
NR = Nitrogen Read
CB = Carbon Blank
CSW = Corrected Sample Weight (mg)
C KF = Carbon K-Factor

To convert to % C divide result in mg/Kg by 10000

***Example Calculation** of Percent TOC/Soot from the instrument, converted to mg of TOC/Soot:*

If the result from the instrument is 1.083% and the sample weight is 10.76mg:

1.083% = 100 x [**X** / 10.76mg] (to solve for **X,** divide each side by 100)
0.01083 = **X** / 10.76mg (multiply each side by 10.76mg)
0.116mg = **X**

11.5 Reporting Results

The following procedures must be followed for reporting of TOC/Soot results:

Go to the next page in the bound TOC/Soot logbook.

Retain all computer printouts for the standard and sample analyses of this sequence.

Print the sequence from the computer and review it to make sure that no weight or sample ID transcription errors were made.

Calculate the recoveries for the QC samples (IVC/LCS, CCV, MS and RPD between the duplicate samples) and ensure the Method Blank and CCB meet the criteria. Remember any “QC Failures” require corrective action. See Section 9.0 or 12.0.

After reviewing the final logbook entries, make a copy of the logbook page for secondary review.

Go to the LIMS and “batch” and “associate” the set of QC samples and field samples that were just analyzed.

Enter the Final Results into the LIMS report sheet and check for transcription errors.

Transfer all associated sample paperwork to the Department Manager for the second level review and approval.

All TOC/Soot results are reportable without qualification if analytical holding times are met, preservation (including pH and cooler temperatures) are met, all QC criteria defined in the table below are met, and matrix interference was not suspected during analysis of the TOC/Soot samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-analysis.

QC Parameter	Acceptance Criteria
Initial Calibration Curve, *Lloyd Kahn*	r ≥ 0.995 and slope ± 10% the historical curves
Initial Calibration Verification	80-120% of True Value
Linearity check (high level ICV)	80-120% of True Value
Method Blank	< reporting limit for matrix
Laboratory Control Sample	75-125% R
Matrix Duplicate	25%RPD for results <5x reporting limit
Replicate burns (each sample)	30% RPD
Quadruplicate analysis(1 per batch)	< 40 % RSD
Matrix Spike	75-125% R
Matrix Spike Duplicate if requested	75-125%R/25%RPD
Continuing Calibration Verification	80-120% of True Value
Continuing Calibration Blank	< reporting limit for matrix

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

Section 9 outlines sample batch QC acceptance criteria. If non-compliant TOC/Soot results are to be reported, the Department Manager and/or the Laboratory Director, and the QA Manager must approve the reporting of these results. The laboratory Project Manager is notified, and may chose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst or Department Manager performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

The *Hazardous Waste and Sample Disposal* SOP (1797) must be referenced for disposal of used standards, solvents, acids, reagents or other chemicals.

Once satisfactory TOC results have been generated, the sample containers must be scanned back into LIMS and returned to the appropriate sample refrigerator and held for 30 days.

All waste generated must be transferred to the waste disposal area. Dispose all solid samples in solid waste container. Aqueous samples must be poured into a 55-gallon drum marked acidic/non-chlorinated waste.

Refer to the *Chemical Hygiene Plan* and the *Hazardous Waste & Sample Disposal SOP* (1797) for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

PE 2400 Series II CHNS/O Analyzer User’s Manual

Sample Receipt & Login SOP (1559)

Perkin-Elmer, Model AD-6 Manufacturer User’s Manual

Document Control SOP 1729

Laboratory Notebook Usage Work Instruction (WI 1556)

SOP/1732 MDL Generation

SOP/1739 IDC Generation

Hazardous Waste & Sample Disposal SOP (1797)

16. Attachments

None.

Appendix I

RESPONSIBILITIES of

OWNER and REMEDIAL PARTY

Responsibilities

The responsibilities for implementing the Site Management Plan ("SMP") for the Johnstown Landfill Site (the "Site"), NYSDEC Site number 518002**,** are divided between the Site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as:

(the "owner") City of Johnstown.

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out, the term Remedial Party ("RP") refers to any of the following: certificate of completion holder, volunteer, applicant, responsible party, and, in the event the New York State Department of Environmental Conservation ("NYSDEC") is carrying out remediation or site management, the NYSDEC and/or an agent acting on its behalf. The RP is:

City of Johnstown.

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the site.

Site Owner's Responsibilities:

1) The owner shall follow the provisions of the SMP as they relate to future construction and excavation at the site.

2) In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that all Institutional Controls set forth in an Environmental Easement remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon the RP's request, in order to allow the RP to include the certification in the site's Periodic Review Report (PRR) certification to the NYSDEC.

3) In the event the Site is delisted, the owner remains bound by the Environmental Easement and shall submit, upon request by the NYSDEC, a written certification that Environmental Easement is still in place and has been complied with.

4) The owner shall grant access to the site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the SMP and assuring compliance with the SMP.

5) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify the Site's RP and NYSDEC in accordance with the timeframes indicated in Section [2.4.2]-Notifications.

6) In the event some action or inaction by the owner adversely impacts the Site, the owner must notify the Site's RP and the NYSDEC in accordance with the time frame indicated in [Section 2.4.2] - Notifications and (ii) coordinate the performance of necessary corrective actions with the RP.

7) The owner must notify the RP and the NYSDEC of any change in ownership of the Site property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the Site property. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 2.4 of the SMP. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html.

8) The owner will maintain conditions at the Site including: maintaining fences and conduct mowing on behalf of the RP. The RP remains ultimately responsible for maintaining the engineering controls.

Remedial Party Responsibilities

1) The RP must follow the SMP provisions regarding any construction and/or excavation it undertakes at the site.

2) The RP shall report to the NYSDEC all activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to,

periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated SMPs.

3) Before accessing the Site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the SMP, a copy of any data generated during the site visit and/or any final report produced.

4) If the NYSDEC determines that an update of the SMP is necessary, the RP shall update the SMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved SMP to the owner(s).

5) The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the operation, maintenance, and monitoring of and reporting with respect to any remedial system (Engineering Controls). The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html .

6) The RP shall notify the NYSDEC of any damage to or modification of the systems as required under Section [2.4.2] - Notifications] of the SMP.

   The RP is responsible for the proper maintenance of any installed vapor intrusion mitigation systems associated with the Site.

   The RP is responsible for the proper monitoring and maintenance of any installed drinking water treatment system associated with the Site

7) Prior to a change in use that impacts the remedial system or requirements and/or responsibilities for implementing the SMP, the RP shall submit to the NYSDEC for approval an amended SMP.

8) Any change in use, change in ownership, change in Site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the Site may

result in a change in responsibilities and, therefore, necessitate an update to the SMP and/or updated legal documents. The RP shall contact the Department to discuss the need to update such documents.

Change in RP ownership and/or control and/or Site ownership does not affect the RP's obligations with respect to the Site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future Site owners and RPs and their successors and assigns are required to carry out the activities set forth above.