

**APPENDIX A**

**QUALITY ASSURANCE PROJECT PLAN**

**UNITED NUCLEAR CORPORATION**

**NORTHEAST CHURCH ROCK SITE**

August 2006

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**UNITED NUCLEAR CORPORATION**

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## Executive Summary

This Quality Assurance Project Plan (QAPP) is a component of the Removal Site Evaluation Work Plan prepared for United Nuclear Corporation (UNC) specific to the Northeast Church Rock (NECR) site. This QAPP was prepared to describe the project requirements for all field and Contract Laboratory activities and data assessment activities associated with the Work Plan. This QAPP presents in specific terms the policies, organization, functions, and quality assurance/quality control (QA/QC) requirements designed to meet the data quality objectives for the sampling activities described in the Work Plan. Additionally, this QAPP provides guidance that establishes the analytical protocols and documentation requirements to ensure the data are collected, reviewed, and analyzed in a consistent manner.

This QAPP is based on the following:

- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5 (U.S. EPA, 2001).
- *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (U.S. EPA, 2000).
- *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).
- *EPA 100-400 - Series Methods for the Determination of Inorganic Substances in Environmental Samples* (U.S. EPA/600R-93-100, August, 1999a).
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (U.S. EPA/600/4-80-032, August, 1980)
- *Methods of Soil Analysis* (American Society of Agronomy, 1982).
- *United States department of Agriculture(USDA), Handbook No. 60*, (USDA, 1954).

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## ACRONYMS AND ABBREVIATIONS

%D	percent difference
%R	percent recovery
AAALA	Association of Laboratory Accreditation
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
C-O-C	chain-of-custody
CRADA	Cooperative Research and Development Agreement
°C	degrees Celsius
DOT	department of transportation
DQOs	data quality objectives
ICB/CCB	initial calibration blank/continuing calibration blank
ICP	inductively coupled plasma
ICS	interference check sample
LCS	laboratory control sample
LIMS	laboratory information management system
LQMP	laboratory quality management plan
MD	matrix duplicate
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NECR	Northeast Church Rock
NIST	National Institute of Standards and Technology
PARCC	precision, accuracy, representativeness, completeness, comparability
PCBs	polychlorinated biphenyls
PRGs	preliminary remediation goals
QAPP	Quality Assurance Project Plan
QA	quality assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QC	Quality Control
RCA	recommendations for corrective action
RL	reporting limit
RER	replicate error ratio

## ACRONYMS AND ABBREVIATIONS

(Continued)

RFs	response factors
RPD	relative percent difference
SOP	standard operating procedure
SSL	soil screening level
UNC	United Nuclear Corporation
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency

## **A1.0 INTRODUCTION**

This Quality Assurance Project Plan (QAPP) is a component of the Removal Site Evaluation Work Plan prepared for United Nuclear Corporation (UNC) specific to the Northeast Church Rock (NECR) site. The Work Plan contains a description of the site, site background, constituents of concern, proposed sampling activities and this QAPP, and is intended to describe the project requirements for all field, sample analysis, and data assessment activities associated with this project.

This QAPP presents in specific terms the policies, organization, functions, and quality assurance/quality Control (QA/QC) requirements to meet the project-specific data quality objectives associated with soil sample collection and analysis. The project-specific data quality objectives (DQOs) are presented in Section 3.0 of the Work Plan. Detailed field procedures for soil sample collection and field analysis are also described in Section 5.0 of the Work Plan. Redundancies between the QAPP and Work Plan have been eliminated, and references between documents made, where appropriate, to facilitate review.

### **A1.1 QAPP OBJECTIVES**

The specific objective of this QAPP is to provide the guidance that will be followed for chemical analysis of soil samples to ensure that the data are of sufficient quality to support the project DQOs and the data end uses. This QAPP also presents the project organization and QA/QC procedures to be followed by the Contract Laboratory for all sample analysis.

The procedures detailed in this QAPP are in accordance with applicable professional technical standards and the following guidance:

- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5 (U.S. EPA, 2001).

- *Guidance for the Data Quality Objectives Process, EPA QA/G-4* (U.S. EPA, 2000).
- *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).
- *EPA 100-400 - Series Methods for the Determination of Inorganic Substances in Environmental Samples* (U.S. EPA/600R-93-100, August, 1999a).
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (U.S. EPA/600/4-80-032, August, 1980)
- *Methods of Soil Analysis* (American Society of Agronomy, 1982).
- *United States department of Agriculture(USDA), Handbook No. 60,* (USDA, 1954)

The target parameters for soils included in this QAPP are based on sample results from previous sampling rounds conducted at NECR and are listed in Table A1-1. The methods were selected for compliance with U.S. Environmental Protection Agency (U.S. EPA) Region 9 Preliminary Remedial Goals (PRGs) for residential and industrial land use as well as Soil Screening Levels (SSLs) for radionuclides and to meet the DQOs for this project.

This QAPP is required reading for all MWH staff participating in the work effort. The QAPP will be in the possession of the field team during sample collection and in possession of the Contract Laboratory providing analytical services. All MWH and analytical Contract Laboratory personnel working on this project will be required to comply with the procedures documented in this QAPP to maintain comparability and representativeness of the resulting data.

## **A1.2 DOCUMENT ORGANIZATION**

The remainder of this QAPP is organized as follows:

**Section A2.0 Project Organization.** This section describes the organization for this project.

**Section A3.0 Quality Assurance Objectives for Measurement Data.** This section presents the field and Contract Laboratory analytical procedures that will be followed to ensure that all measurement data collected during this project meet the project quality assurance objectives. This section also includes the procedures for instrument calibration for all anticipated analyses performed by the Contract Laboratory. Detailed field equipment calibration procedures are described in the Work Plan.

**Section A4.0 Sampling Procedures.** This section references back to the Work Plan..

**Section A5.0 Sample Custody.** This section presents the Contract Laboratory chain-of-custody (C-O-C) procedures. Field C-O-C procedures are defined in the Work Plan.

**Section A6.0 Analytical Procedures.** The analytical procedures to be used by the Contract Laboratory are presented in this section.

**Section A7.0 Internal Quality Control Checks.** The MWH and Contract Laboratory internal QC checks are presented in this section.

**Section A8.0 Data Reduction, Reporting, Verification, and Validation.** The procedures for reducing, reporting, verifying, and validating field and chemical data are defined in this section.

**Section A9.0 Performance and Systems Audits.** The MWH and Contract Laboratory procedures for performance and systems audits are presented in this section.

**Section A10.0 Preventative Maintenance Procedures.** The preventative maintenance procedures that will be followed by the Contract Laboratory are detailed in this section. General procedures for field-related tasks are presented in this section; specific details will be included in the Work Plan.

**Section A11.0 Corrective Actions.** This section defines the corrective actions that will be implemented in the event of field or Contract Laboratory non-conformances.

**Section A12.0 Quality Assurance Reports to Management.** The quality assurance reporting requirements for this project are presented in this section.

**Attachment 1 Quality Control Procedures, Frequency of QC Sample Analysis and Acceptance Criteria, and Laboratory Corrective Action Procedures, and Reporting Limit Criteria.** This attachment includes the following information for all methods included in Table A1-1:

- Control limits that will be used for matrix spike (MS), matrix spike duplicate (MSD), and laboratory control sample (LCS),- standard assessment.
- Method specific calibration requirements, QC sample analysis frequency, and corrective action procedures.
- Method specific reporting limit (RL) requirements.

The specific criteria that will be used for data assessment are as follows:

**Control Limits.** The control limits for this project are based on the referenced analytical method or current industry standards.

**Calibration Requirements, QC Sample Analysis Frequency, and Corrective Action Procedures.** The analytical methods listed in Table A1-1 were used as the source for establishing instrument calibration, QC sample analysis frequency, and corrective action requirements for this project.

**Reporting Limits.** The analyte RLs listed in Attachment 1 of this QAPP are for reference only. The RLs for this project will reflect the RLs established by the Contract Laboratory. All RLs will be compared to the U.S. EPA Region 9 PRGs for residential and industrial land use and EPA SSLs for radionuclides (as applicable). If the RL exceeds the

PRG or SSL the sample results will be reported to the method detection limit (MDL) or an alternate method of analysis will be used.

## **A2.0 ORGANIZATION**

At the direction of the UNC or their appointed representative, MWH will have the overall responsibility for the implementation of this project. MWH responsibilities include preparing the project plans and conducting the field activities. Descriptions of the responsibilities and authorities for the key positions as they relate to project QA and QC are provided below. In addition, the following paragraphs describe the Contract Laboratory organization and training requirements.

### **A2.1 UNC**

The UNC Representative and Site Manager have the overall responsibility for the successful completion of the sampling program. They are responsible for:

- Developing scopes of work.
- Defining project objectives and schedules.
- Reviewing and analyzing overall task performance with respect to planned requirements and authorizations.
- Interfacing with the federal and state regulatory agencies.
- Approving all reports (deliverables) before their submission to the federal and state regulatory agencies.

## **A2.2 MWH ORGANIZATION**

### **A2.2.1 MWH Project Manager**

The MWH Project Manager is responsible for implementing the project, and will have the authority to commit the resources necessary to meet project objectives and requirements. In addition, the MWH Project Manager will be responsible for:

- Acquiring and applying technical and corporate resources as needed to ensure performance within budget and schedule constraints.
- Defining project objectives and developing the project schedules.
- Establishing project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Orientation of all project staff regarding project-specific considerations.
- Developing and meeting ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Reviewing the work performed on each task to ensure quality, responsiveness, and timeliness.
- Reviewing and analyzing overall task performance with respect to planned requirements and authorizations.
- Reporting any significant conditions adverse to quality and obtaining concurrence by the Project Quality Assurance Manager on proposed resolutions.
- Reviewing quality assurance audit reports and any resulting corrective action disposition.
- Approving all reports (deliverables) before their submission to UNC.

### **A2.2.2 MWH Technical Leader**

The MWH Technical Leader for the project will have overall responsibility for the technical aspects associated with the project and will also be responsible for:

- Implementation of QC for technical data provided by the field staff including field measurement data.
- Adherence to work schedules provided by the project manager.
- Generation, review, and approval of text and graphics required for field team efforts.
- Identification of problems at the field-team level and discussion of resolutions with the Project Manager.
- Day-to-day coordination with the Project Manager on technical issues.
- Development and implementation of field-related work plans.
- Coordination and management of field staff.
- Report preparation.

### **A2.2.3 MWH Field Team Leader**

The field team leader will have overall responsibility for ensuring that the work performed in the field meets the quality standards defined in this QAPP. The Field Team Leader will report directly to the MWH Project Manager.

### **A2.2.4 MWH Field Team**

Under the direction of the MWH Field Team Leader, all field staff are responsible for the planning, coordinating, performing, and reporting of specific technical tasks. Field staff will have the responsibility of applying the QAPP and Work Plan to their assigned activities. Their specific responsibilities include:

- Develop and maintain technical activity files
- Implement technical procedures applicable to tasks.

#### **A2.2.5 Quality Assurance Manager**

The MWH Quality Assurance Manager (QAM) for this project will remain independent of direct job involvement and day-to-day operations, and will have direct access to corporate staff as necessary, to resolve any QA disputes. The QAM is responsible for auditing the implementation of the QA program in reference to project-specific requirements, and report any findings to the MWH Project Manager as shown in Figure 2-1. Specific functions and duties will include:

- Conducting QA audits on various phases of the field operations (as necessary).
- Reviewing and approving of QA plans and procedures.
- Providing QA technical assistance to project staff on chemistry and field sampling.
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to appropriate staff.

#### **A2.2.6 MWH Project Chemist**

The MWH Project Chemist like the QAM, reports to an individual outside the project team, however, he is responsible for interfacing with the project team and the Contract Laboratory and will provide direction and support for all sampling activities, including sample collection, handling, storage, preservation, and shipment. Other responsibilities will include:

- Interfacing with the Contract Laboratory Project Manager on matters concerning chemical sampling and analysis, laboratory readiness, sampling

schedules, sample containers, laboratory reports, data verification, and the resolution of nonconforming activities or data.

- Reviewing analytical data to ensure conformance with quality assurance testing and standards.
- Identifying, reporting, and recommending solutions for nonconforming sampling or analytical activities or data.
- Serving as the main point of contact for all issues related to sample analysis.

### **A2.3 ENERGY LABORATORIES ORGANIZATION**

Energy Laboratories, Inc. of Casper Wyoming will perform the analytical work for this project. Energy Laboratories performs the standard methods of analysis required for this project, meets the criteria specified in this QAPP, holds applicable certifications, and is organized as described in the following paragraphs. The organizational structure of Energy Laboratories is listed in Appendix D of their Laboratory Quality Assurance Plan (LQAP) which is contained in Attachment 2.

#### **A2.3.1 Energy Laboratories Project Manager**

Energy Laboratories will assign a specific individual to assume Project Management responsibilities for all activities that relate to the analysis program for this project. This individual will be the primary contact for MWH and will be responsible for ensuring that the project requirements as they relate to the Contract Laboratory are met. This individual will be responsible for the following:

- Scheduling sample analysis and ensuring that the data are generated in accordance with the specifications presented in this QAPP.
- Monitoring the progress and timeliness of the work.
- Reviewing work orders and the laboratory reports.

- Processing any changes in the scope of work.

This individual will also be responsible for ensuring that project-specific corrective action is taken when necessary to address problems identified by the QC sample results or QA audit results and for approving final analytical reports prior to submission to the MWH.

### **A2.3.2 Energy Laboratories Quality Assurance Officer**

Energy Laboratories's quality assurance officer (QAO) will be responsible for ensuring that the laboratory QA/QC activities are performed in accordance with the requirements specified in both this QAPP and the laboratory's internal QAPP. Responsibilities will include (but not be limited to) preparing QA documents that define QA/QC procedures, reviewing and approving laboratory QC procedures, and oversight of inter-laboratory testing programs and laboratory certifications. This individual will also be responsible for monitoring method operation through periodic data reviews and technical system audits. Unacceptable findings will be reported to the appropriate individuals for corrective action.

### **A2.3.3 Energy Laboratories Sample Custodian**

Energy Laboratories's sample custodian will report directly to the Laboratory Manager and will be responsible for:

- Receiving and inspecting samples.
- Recording information regarding sample condition on and signing the appropriate forms.
- Verifying the chain-of-custody and documenting any discrepancies.
- Notifying the Laboratory Project Manager or other appropriate laboratory personnel of sample receipt and inspection.

- Assigning a unique identification number and customer number to each sample and logging it into the sample receiving log book and laboratory management information system (LIMS).
- Transferring samples to the appropriate laboratory sections
- Controlling and monitoring access and storage of samples and extracts.

#### **A2.3.4 Energy Laboratories Staff**

Energy Laboratories staff involved with sample preparation and analysis will consist of experienced professionals who possess the degree of specialization and technical competence to perform the required work in an effective and efficient manner.

#### **A2.4 ENERGY LABORATORIES TRAINING REQUIREMENTS**

Energy Laboratories staff associated with the project will have sufficient training to safely, effectively, and efficiently perform their assigned tasks. Training records are available in the LQAP (Attachment 2).

### **A3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA**

Data quality refers to the level of reliability associated with a particular data set or data point. The data quality associated with environmental measurement data is a function of the sampling plan rationale, the sample collection procedures, and the analytical methods and instrumentation used in making the measurements. The overall QA objective is to develop and implement procedures for field sampling, C-O-C, Contract Laboratory analysis, and data reporting that will provide data that meet task-specific DQOs and that are legally defensible. Data quality objectives are qualitative and quantitative statements that specify the field and Contract Laboratory data quality necessary to support specific decisions or regulatory actions. The DQOs describe which data are needed, why the data are needed, and how the data are to be used to meet the needs of this sampling program. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine whether the data collected are of sufficient quality for their intended use.

The DQOs for this project are included in Section 3.0 of the Work Plan. The DQOs were developed in accordance with the *Guidance for the Data Quality Objectives Process, EPA QA/G-4* (U.S. EPA, 2000). The remainder of this section defines how the data will be assessed to meet the task-specific DQOs and the criteria that will be used to define acceptable limits of uncertainty.

#### **A3.1 DATA TYPES**

The data types required for this project are based on the task-specific DQOs, the end-use of the analytical data, and the level of documentation. Both screening and definitive data will be collected. The specific type of data that will be collected for each sampling task are defined in the Work Plan. Whether data are considered screening or definitive is based on the method of sample collection, preparation, and analysis. Definitive data include data that are collected using standard sampling methodology and analytical methodology of known precision and accuracy. Screening data include data that are collected using non-standard sampling methodology or collected using rapid, less precise methods of analysis with less rigorous sample preparation or quality control as compared

to analytical methods from which definitive data are generated. For this project all data from the Contract Laboratory are considered definitive.

### **A3.2 DATA QUALITY DEFINITION AND MEASUREMENT**

To determine the overall quality of definitive data, the results of QC sample analysis will be evaluated in terms of the precision, accuracy, representativeness, completeness, and comparability (PARCC) DQOs established in this QAPP. The QC samples that will be used to assess the quality of both the field and Contract Laboratory data (prepared both in the laboratory and in the field) are described later in this section. A summary of the chemical data quality control evaluation program in terms of the DQOs is presented in Table A3-1. Method specific quality control procedures, frequency of QC sample analysis and acceptance criteria, and laboratory corrective action summaries that will be used as guidance for this project are included in Attachment 1.

#### **A3.2.1 Precision**

Precision is the reproducibility of measurements under a given set of conditions. For large data sets, precision is expressed as the variability of a group of measurements compared to their average value (i.e., standard deviation). For duplicate measurements, precision is expressed as the relative percent difference (RPD) of a data pair and is calculated using the following equation:

$$RPD = \frac{|A - B|}{\frac{(A + B)}{2}} \times 100$$

Where A and B are the reported concentrations for duplicate sample analyses.

For radionuclide methods precision can also be expressed using the replicate error ratio (RER). The RER is used when the sample concentration is less than five times the minimum detectable activity (MDA). The RER is determined as follows:

$$RER = \frac{(S - R)}{\left[ \left( \sqrt{0.15 * S} \right)^2 + E^2 \right] + \left( \sqrt{0.15 * R} \right)^2 + ER^2},$$

where:

RER = replicate error ratio

S = sample value

E<sub>S</sub> = sample counting error (at 2 standard deviations)

R = replicate value

E<sub>R</sub> = replicate counting error (at 2 standard deviations).

**Contract Laboratory Precision.** Contract laboratory precision will be assessed using the calculated RPD between the following sample data:

- MS/MSD sample data.
- Parent and associated field replicate sample data.
- Parent and matrix duplicate (MD) sample data (as applicable).

In addition, precision will be evaluated using the response factors for calibration standards (three or more replicated analyses) by calculating the relative standard deviation RSD as follows:

$$(S / \bar{X}) \times 100$$

Contract laboratory precision will also be assessed for metals using the calculated percent difference (%D) for serial dilutions. The %D will be calculated using the following equation:

$$\%D = \left( \frac{C_c - E_c}{E_c} \right) \times 100$$

Where: C<sub>c</sub> = Calculated concentration

Ec = Expected Concentration.

### A3.2.2 Accuracy

Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Accuracy will be evaluated using the percent recovery (%R) calculated using the following equation:

$$\%R = \frac{|X_s - X_u|}{K} \times 100\%$$

Where:  $X_s$  is the measured value from the spiked sample

$X_u$  measured value of the unspiked sample

K is the known amount of the spike in the sample.

The background level ( $X_u$ ) is set to zero when percent recovery is calculated for the laboratory control sample or other standard reference materials.

**Contract Laboratory Accuracy.** Contract Laboratory accuracy will be assessed quantitatively through the analysis of MS/MSD samples LCS, interference check samples (metals analysis only), post digestion spikes, and response factors for calibration standards, and internal standard recoveries.

### A3.2.3 Representativeness

Representativeness is a qualitative expression of the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an

environmental condition. Representativeness is maximized by ensuring that, for a given task, the number and location of sampling points and the sample collection and analysis techniques are appropriate for the specific investigation, and that the sampling and analysis program provides information that reflects "true" site conditions.

**Contract Laboratory Data.** Contract Laboratory data will be evaluated for representativeness by assessing whether the laboratory followed the specified analytical criteria in this QAPP and their standard operating procedures (SOPs). In addition representativeness will be evaluated by assessing compliance with sample preservation and holding time criteria, and the results of method and instrument blank sample results, ICB/CCB results (metals analysis only), trip blanks, equipment rinsate blanks, source water blanks, and field replicate sample analyses.

#### **A3.2.4 Comparability**

Comparability is a qualitative parameter that expresses the confidence with which one data set may be compared to another. Comparability is dependent on similar QA objectives and is achieved through the use of standardized methods for sample collection and analysis, the use of standardized units of measure, normalizing results to standard conditions, and the use of standard and comprehensive reporting formats as defined by this QAPP.

**Contract Laboratory Data.** Laboratory data comparability is dependent on the use of similar sampling and analytical methodology and standard units of measure between different tasks at a specific site. For this project, chemical data will be collected using standard sampling and analyses procedures. Data comparability will also be assessed by comparing investigative sample data to QA or QC sample data.

#### **A3.2.5 Completeness**

Completeness is the measure of the amount of valid data obtained from a measurement system relative to the amount of data scheduled for collection under correct, normal

conditions. Completeness measures the effectiveness of the overall investigation in collecting the required samples, completing the required analyses, and producing valid results. Completeness will be calculated on a per analyte basis using the following equation:

$$\% \text{ completeness} = \frac{\text{number of valid results}}{\text{number of possible results}}$$

Where: The number of valid data points is the total number of valid analytical measurements based on the precision, accuracy, and holding time evaluation.

**Contract Laboratory Data.** Contract Laboratory data completeness is a quantitative measure of the percentage of valid data for all analytical data as determined by the precision, accuracy, and holding time criteria evaluation. Completeness will be calculated using the completeness equation by dividing the total number of valid data points by the total number of data points. The Contract Laboratory completeness goal for data collected under this QAPP is 95 percent.

If the 95 percent completeness goal is not met for field or laboratory data, the UNC Project Manager will be immediately notified. The determination regarding the need for corrective action will be based upon how critical the data are to the project DQOs and will be made by the MWH and the UNC Project Managers in conjunction with federal and state regulatory agencies Project Manager.

### **A3.3 METHOD DETECTION LIMITS, REPORTING LIMITS, AND INSTRUMENT CALIBRATION REQUIREMENTS**

#### **A3.3.1 Method Detection Limits**

The MDL is an empirically derived value that is used to estimate the lowest concentration

a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

The Contract Laboratory will at a minimum perform MDL studies during initial method setup, annually, or whenever the basic chemistry of a procedure is changed. The MDLs will be method specific and include any cleanup method used. The MDLs will be established for all target analytes in an interference-free matrix using the procedures in 40 Code of Federal Regulations (CFR), Part 136, Appendix B, or an equivalent statistical approach. To ensure that the valid MDL values are determined, the laboratory will analyze an MDL check sample by spiking an interference-free matrix with all target analytes at approximately two times the calculated MDL. The MDL check sample will be taken through all the preparatory and determinative steps used to establish the calculated MDL values to verify a response is detected. If any of the target analytes are not detected, then the concentration will be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detectable. The detectable target analyte concentrations will be used in lieu of the calculated MDL values to establish the lowest detected concentration for samples taken through all appropriate method procedures. The laboratory may demonstrate continued method detection capability by analyzing the check sample on a quarterly basis, in lieu of the annual MDL study. When multiple instruments or confirmation columns are used for the same method, separate MDL studies may be replaced by the analysis of an MDL check sample on all instruments/columns. The MDL check sample will be analyzed after major instrument maintenance or changes in instrumentation or instrumental conditions to verify the current sensitivity of the method.

### **A3.3.2 Reporting Limits**

The RL is the lowest concentration that can be reliably achieved within limits of precision and accuracy during routine operating conditions and is based on the MDL for each analyte. The RL is established at a factor of five to ten times the MDL, but no lower than three times the MDL for any target analyte. Example RLs for the analytical methods

included in this QAPP are presented in Attachment 1. The laboratory-specific RLs for each method included in this QAPP will be back checked against the project objectives to ensure that data usability goals are met. Data reporting requirements are described in Sections A7.0 and A9.0 of the QAPP.

### **A3.4 INSTRUMENT CALIBRATION**

The following sub-section describes the procedures that will be used for instrument calibration by the Contract Laboratory. The procedures that will be followed for field meter or instrument calibration are detailed in the Work Plan. Analytical quality control requirements, evaluation criteria, acceptance criteria, preventative maintenance, and corrective actions are discussed later in this QAPP.

#### **A3.4.1 Contract Laboratory Instrument Calibration Procedures**

Instrument calibration is necessary to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet the required RLs. Calibration establishes the dynamic range of an instrument, establishes response factors to be used for quantitation, and demonstrates instrument sensitivity. Criteria for calibration are specific to the instrument and the analytical method. The following paragraphs describe procedures that will be followed by the Contract Laboratory for instrument calibration.

**Standard/Reagent Preparation.** All instruments will be calibrated in accordance with the Contract Laboratory's SOPs. To ensure the highest quality standard, primary reference standards will be used by the Contract Laboratory and will be obtained from the National Institute of Standards and Technology (NIST), EPA Cooperative Research and Development Agreement (CRADA) vendors, American Association of Laboratory Accreditation (AALA) vendors, or other reliable commercial sources. When standards are received at the Contract Laboratory, the date received, supplier, lot number, purity, concentration, and expiration date will be recorded in a standards logbook. Vendor certifications for the standards will be retained in the files and made available upon request.

Standards will be obtained in their pure form or in a stock or working standard. Dilutions will be made from the vendor standards. All records regarding standards will unambiguously trace their preparation, use in calibration, expiration dates, and quantitation of sample results. All standards will be given a standard identification number, and the following information recorded in the appropriate file (standards logbook): source of standard, the initial concentration of the standard, the final concentration of the standard, the volume of the standard that was diluted, the solvent and the source and lot number of the solvent used for standard preparation, the expiration date of the standard, and the preparer's initials. All standards will be verified prior to use.

After preparation and before routine use, the identity and concentration of the standards will be verified. Verification procedures include verification of the standard's concentration by comparing its response to a standard of the same analyte prepared or obtained from a different source. Reagent purity will be assessed by analyzing an aliquot of the reagent lot using the analytical method in which it will be used; for example, every lot of laboratory grade water is analyzed for undesirable contaminants prior to use in the laboratory. Standards will be routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentration), and will be discarded if deterioration is suspected or the expiration date has passed. Expiration dates will be taken from the vendor recommendation, the analytical methods, or from internal research.

**Instrument Calibration.** Criteria for calibration are specific to the instrument and the analytical method. Each instrument will be calibrated according to the analytical methods following manufacturer's guidelines and using standard solutions appropriate to the type of instrument and the linear range established for the method. All reported analytes will be present in both initial and continuing calibrations, which must meet the acceptance criteria specified in the analytical method and are summarized in Attachment 1. The instrument calibration will be from lowest to the highest calibration standard and the lowest calibration standard concentration will be at the RL for each target analyte.

Multipoint calibrations will contain the minimum number of calibration points specified in the method with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed will be included in the initial calibration. The only exception is the dropping of a standard from the calibration that that has been statistically determined as an outlier, providing that the requirement for the minimum number and RL standard criteria are met.

All instrument calibration information will be documented, and at a minimum include the equipment to be calibrated, the reference standards used for calibration, the calibration techniques, actions, acceptable performance tolerances, frequency of calibration, and calibration documentation format. The Contract Laboratory will maintain records of standard preparation and instrument calibration. Calibration records will include daily checks using standards prepared independently of the calibration standards, and instrument response will be evaluated against established criteria. The analysis logbook, maintained for each analytical instrument, will include at a minimum the date and time of calibration, the initials of the person performing instrument calibration, and the calibrator reference number and concentration. Calibration procedures for the methods included in this QAPP are presented in Attachment 1 and are from the following:

- *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).
- *EPA 100-400 - Series Methods for the Determination of Inorganic Substances in Environmental Samples* (U.S. EPA/600R-93-100, August, 1999a).
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (U.S. EPA/600/4-80-032, August, 1980)

A summary of calibration procedures, corrective actions, and QC acceptance limits are provided in Attachment 1.

### **A3.5 CONTRACT LABORATORY BATCH QUALITY CONTROL LOGIC**

The frequency of instrument calibration and QC sample analysis for the analytical methods are batch controlled. All sample data for this project will be associated with sample batch QC samples that were extracted or prepared concurrently with the site samples and analyzed in the same analytical batch (analyzed on the same instrument relative to the primary sample results). The identity of each preparation or analytical batch will be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples. The following paragraphs define sample and instrument batches.

**Sample Batch.** For this project, a sample batch is a group of twenty or less environmental samples of the same matrix which are extracted or prepared within the same time period (concurrently) or in limited continuous sequential time periods with the same lot of reagents. Keeping batches “open” for more than two hours will not be accepted; samples and their associated QC samples (method blank, LCS, MD, and MS/MSD) will be prepared in a continuous process. The sample batch will be analyzed sequentially on a single instrument (as practicable).

**Analytical Batch.** The analytical batch is a group of 20 or less environmental samples that are analyzed together within the same analytical run sequence as defined by the method calibration criteria or in continuous sequential time periods. Samples in each batch will be of similar matrix, will be treated in a similar manner, and will use the same reagents.

### **A3.6 ELEMENTS OF QUALITY CONTROL**

The quality control parameters and samples that will be used to evaluate analytical data in terms of the PARCC criteria are described in this section. These include QC samples prepared both in the field and by the Contract Laboratory. A summary of QC sample evaluation in relation to the PARCC parameters is presented in Table A3-1. Method specific quality control procedures, frequency of QC sample analysis, acceptance criteria

(control limits), and corrective action procedures are included in Attachment 1.

### **A3.6.1 Field Elements of Quality Control**

For field sampling, quality control samples are used to assess sample collection techniques and to assess environmental conditions during sample collection and transport. For this project, field QC samples will include temperature blanks and field replicate samples (samples that are submitted blind to the laboratory).

**Temperature Blanks and Cooler Temperature.** Temperature blanks will be used to evaluate the internal temperature of the cooler and assess whether the sample temperature criterion of  $4^{\circ}\text{C} \pm 2$  degrees Celsius ( $^{\circ}\text{C}$ ) was met during sample shipment. The temperature of the blank is measured at the time the samples are received by the Contract Laboratory and recorded on the C-O-C. Temperatures that exceed the temperature criterion indicate that the samples may not have been handled or transported properly.

**Trip Blanks.** Trip blanks will be analyzed for VOCs to detect any potential cross-contamination of samples that may occur from sample containers, during sample transit to the laboratory, or during sample storage at the laboratory. Trip blanks will be prepared by the laboratory and consist of 40 milliliter (ml) amber glass vials filled with acidified reagent-grade water and then sealed with a cap with a Teflon™ septum. The trip blanks samples will accompany the empty sample bottles from the laboratory to the site. One set of trip blank samples will be placed in the sample cooler at the start of each day of sampling and remain in the cooler throughout the day. The trip blanks will then be shipped with the samples to the laboratory. Trip blanks will not be submitted with soil samples.

**Equipment Rinseate Blank Samples.** Equipment rinseate blank samples will be used to evaluate representativeness and will be prepared in the field (after decontamination of sampling equipment is complete) by collecting the final rinse water into the appropriate sample container. Equipment rinseate blanks will be collected on a daily basis for groundwater or surface water samples when non-dedicated equipment is used for

sampling.

**Field Replicate Samples.** Field replicate samples are soil samples that are submitted blind to the Contract Laboratory to assess variability in the sample media and to assess sampling and analytical precision. A field replicate sample is a single grab sample that is replicated into two samples during collection. For each field replicate sample pair, one of the samples is labeled with the correct sample identification and the other is labeled with fictitious sample identification. This replicate sample pair is then submitted to the same Contract Laboratory as two separate samples. Precision will be evaluated by calculating the RPD between the field replicate sample pairs for all analytes detected at or above the RL. RPD calculations will not be performed when either one or both of the sample results for the field replicate sample pairs are reported as less than the RL.

Although the RPD will be calculated between field replicate samples, the results will not be used as a basis for qualifying data or accepting or rejecting data. The RPD and actual results will be evaluated qualitatively to assess precision of field sample collection procedures. An RPD within  $\pm 30$  percent will be used as an indication of good agreement between the parent and replicate sample results and that good field procedures were followed.

### **A3.6.2 Contract Laboratory Elements of Quality Control**

The Contract Laboratory will, as a minimum, analyze internal QC samples at the frequency specified by the analytical method and in this QAPP. Method-specific quality control procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are provided in Attachment 1. The following paragraphs discuss holding time and the QC samples that will be used to assess laboratory data quality.

**Sample Holding Time.** Sample holding time reflects the length of time that a sample or sample extract remains representative of environmental conditions. For methods that do not require sample extraction one holding time will be evaluated, the length of time from sample collection to analysis. For methods that require sample extraction prior to

analysis two holding times will be evaluated; the length of time from sample collection until sample extraction, and the length of time from sample extraction to sample analysis. These holding times will be compared to the holding times specified by the respective analytical method. The holding times for each analytical method included in this QAPP are listed in Table A3-2. Samples will not be analyzed outside of the specified method holding times without approval by the MWH Project Chemist.

**Method Blanks.** Method blanks will be used to monitor the Contract Laboratory preparation and analytical systems for interferences and contamination from glassware, reagents, sample manipulations, and the general laboratory environment. The method blank is an analyte-free matrix (reagent grade water or laboratory grade sand) to which all reagents will be added in the same volumes or proportions as used in sample processing. Method blanks will be taken through the entire sample preparation/extraction and analytical process. Method blanks will be prepared and analyzed with each analytical or preparation batch of environmental samples up to a maximum of 20 samples of a similar matrix. No analytical data will be corrected for the presence of analytes in blanks.

**Internal Standards.** Internal standards are compounds that behave similarly to the target analytes during analysis and will be used to assess accuracy for gas chromatography/mass spectroscopy (GC/MS) analysis. Internal standards will be prepared and added to the initial calibration standard (ICAL), the continuing calibration verification standard (CVS), and all samples (field and QC) prior to analysis. Internal standard data will be reviewed for compliance with the analytical method acceptance criteria presented in Attachment 1.

**Surrogate Spikes.** Surrogate spikes will be used to evaluate the accuracy of analytical instrument performance for all organic analysis. Surrogate spikes will be added to each sample for organic compound analysis, including QC samples, prior to extraction as specified in the laboratory's standard operating procedure (SOP). The percent recovery of each surrogate spike will be calculated and compared to the project acceptance criteria (Attachment 1).

**Initial and Continuing Calibration Blanks.** Initial and continuing calibration blank (ICB/CCB) samples are analyzed with each sample batch for method this method SW-846 6020 (ICP) to determine whether metals are introduced into samples during preparation by the laboratory. The same criteria that used to evaluate method are used to evaluate the ICB/CCB and associated sample data.

**Laboratory Control Samples.** Laboratory control samples will be used to measure laboratory accuracy in the absence of matrix interference. Laboratory control samples are prepared in the laboratory and consist of samples of a known matrix (reagent grade water or laboratory grade sand) spiked with a known quantity of specific target analytes at a level less than or equal to the midpoint of the calibration curve for each analyte. The midpoint is defined as the median point in the curve, not the middle of the range. These samples are taken through the entire sample preparation and analytical process. LCSs will be prepared and analyzed with each analytical or preparation batch of environmental samples up to a maximum of 20 samples of a similar matrix. If more than one LCS is analyzed in an analytical batch, results from all LCSs analyzed will be reported.

**Matrix Spikes and Matrix Spike Duplicates.** Matrix spikes measure matrix-specific method performance and will be used to assess accuracy and precision. Unlike LCSs, MS/MSD samples will be used to assess the influence of the sample media (media interference) on sample analysis. Samples for MS/MSD analysis will be collected from each sampling location and will be media specific (e.g., sediment, sludge, and groundwater). A minimum of one MS/MSD sample pair will be analyzed with every batch of UNC samples in a sample delivery group of up to 20 field samples. Each MS/MSD sample will be spiked with the compounds specified by this QAPP prior to sample extraction or analysis at a concentration less than or equal to the midpoint of the calibration curve for each analyte. The sampled scheduled for MS/MSD analyses will be designated on the C-O-C form.

**Matrix Duplicate Samples.** Matrix duplicate samples are identical to field replicates, except that the duplicate sample does not have a false identification. Precision will be evaluated by calculating the RPD between the MD and parent sample pairs for all

analytes detected at or above the RL. RPD calculations will not be performed when either one or both results is less than the RL.

**Interference Check Sample.** The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations and is analyzed at the beginning and end of each run sequence. The ICS is used to verify background and interelement correction factors.

**Serial Dilution.** Serial dilutions are conducted for metals analysis to assess positive or negative interferences when the concentration of a metal detected in a sample is ten times greater than the instrument detection limit (after sample dilution). A five-fold dilution of the sample is analyzed and compared to the results of the original analysis. If the difference between the original and diluted sample results is greater than 10 percent, a chemical or physical interference is suspected.

**Field Replicates.** As discussed previously, field replicates will be used to assess both sampling and analytical precision. The purpose of submitting samples "blind" to the Contract Laboratory is to assess the consistency or precision of the laboratory's analytical system. Precision will be evaluated by calculating the RPD between the parent and field replicate samples.

As discussed previously, although the RPD will be calculated between field replicate samples, the results will not be used as a basis for qualifying data or accepting or rejecting data. The RPD and actual results will be evaluated qualitatively as additional evidence to support data comparability and quality. An RPD within  $\pm 30$  will be used as an indication of good agreement between the parent and duplicate sample results and that good laboratory procedures were followed.

## **A4.0 SAMPLING PROCEDURES**

### **A4.1 SAMPLE COLLECTION PROCEDURES**

The sample collection procedures are defined in Section 5.0 of the Work Plan.

## **A5.0 SAMPLE CUSTODY AND SHIPPING**

To ensure that samples are identified correctly and remain representative of the environment, the sample documentation and custody procedures outlined in this section will be used during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. Field sampling personnel will be responsible for ensuring that proper documentation and custody procedures are initiated at the time of sample collection, and that individual samples can be tracked from the time of sample collection until custody of the samples is transferred to the Contract Laboratory. The Contract Laboratory will be responsible for maintaining sample custody and documentation from the time the laboratory receives the samples until final sample disposition.

To minimize common problems such as labeling errors, chain of custody errors, transcription errors, preservation failures, etc., detailed procedures for properly recording sample information and analytical requests on C-O-C records, for preserving samples as appropriate, and for sample packaging and shipment are described in Section 5.0 of the Work Plan. The remainder of this section focuses on Contract Laboratory C-O-C procedures

### **A5.1 CHAIN-OF-CUSTODY**

C-O-C procedures provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in an authorized person's immediate possession
- It is in view of an authorized person after being in physical possession
- It is in a secure area after having been in an authorized person's physical possession

- It is in a designated secure area, restricted to authorized personnel only.

### **5.1.1 Contract Laboratory Chain-of-Custody Procedures**

Upon receipt by the Contract Laboratory, the integrity of the shipping container will be checked by verifying that the custody seal is not broken. The cooler will be opened and examined for evidence of proper cooling, and the presence of temperature blanks. The individual sample containers will be checked for breakage, damage, or leakage. The contents of the shipping container will then be verified against the C-O-C. If any problems are found, they will be documented on the sample custody form(s) and the MWH Project Chemist will be notified immediately. The shipping receipts will be placed with the C-O-C records and stored in the project files.

If the samples and documentation are acceptable, each sample container will be assigned a unique laboratory identification number and entered into the laboratory's sample tracking system. Sample tracking will be documented in the LIMS, or other appropriate tracking system. Other information that will be recorded includes date and time of sampling, sample description, due dates, and required analytical tests.

When sample log-in has been completed, the samples will be transferred to limited-access temperature controlled storage areas. The sample storage areas (coolers, refrigerators) will be kept at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and their temperatures will be recorded daily with thermometers calibrated against NIST thermometers.

The Contract Laboratory will follow their SOPs for sample log-in, storage, tracking, and control (Attachment 2). Sample custody will be maintained within the laboratory's secure facility until the samples are disposed. The Contract Laboratory will be responsible for sample disposal, which will be conducted in accordance with all applicable local, state, and federal regulations. All sample disposals will be documented and the records maintained by the Contract Laboratory in the project file.

## 5.2. SAMPLE PACKAGING AND SHIPPING PROCEDURES

All samples will be shipped in accordance with all applicable State and Federal Department of Transportation (DOT) requirements. The following paragraphs describe general sample packaging requirements.

All samples will be packaged and shipped to Casper, Wyoming the same day of sample collection via a commercial carrier using the following procedures:

- Sample labels will be completed and attached to sample containers as described in Section 5.0 of the Work Plan.
- The samples will be placed upright in a waterproof metal (or equivalent strength plastic) ice chest or cooler.
- Wet ice in double Ziploc™ bags (to prevent leakage) will be placed around, among, and on top of the sample bottles. Enough ice will be used so that the samples will be chilled and maintained at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  during transport to the laboratory.
- To prevent the sample containers from shifting inside the cooler, the remaining space in cooler will be filled with inert cushioning material, such as shipping peanuts, additional bubble pack, or cardboard dividers.
- The original copy of the completed C-O-C Form will be placed in a waterproof plastic bag and taped to the inside of the cooler lid.
- The lid will be secured by wrapping strapping tape completely around the cooler in two locations.
- “This Side Up” labels will be placed on two sides of the cooler.
- Custody seals will be placed in two locations (the front right and back left of the cooler) across the cooler closure to ensure that any tampering is detected. The date and initials of the sampler will be written on the custody seal.

- A copy of the C-O-C record and the signed air bill will be retained for the project files.
- The samples will be shipped priority (next day arrival by 10:00AM) to:

Energy Laboratories  
2393 Salt Creek Highway (82601)  
Casper, WY 82602-3258  
Phone: 307-234-1639

### **A5.3 FINAL PROJECT FILES CUSTODY PROCEDURES**

The final project files will be maintained by MWH and will be under the custody of the Project Manager in a secured area. At a minimum, the project file will contain all relevant records including:

- Field logbooks
- Field data and data deliverables
- Photographs
- All original field logs
- Clean container certifications from laboratory
- Contract Laboratory data deliverables
- Data verification reports
- Data assessment reports
- Progress reports, QA reports, interim study reports, etc
- All custody documentation (tags, forms, airbills, etc.).

## **A6.0 ANALYTICAL PROCEDURES**

This section describes the analytical procedures that will be used for the acquisition of chemical data and includes the relevant aspects of field and Contract Laboratory procedures (sample preparation and extraction procedures, and instrumentation). Analytical quality control requirements, evaluation criteria, acceptance criteria, calibration procedures, preventative maintenance, and corrective actions are discussed in following sections.

### **A6.1 CONTRACT LABORATORY ANALYTICAL PROCEDURES**

#### **A6.1.1 Analytical Methodology**

The specific analytical methods for this project are from the following:

- *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).
- *EPA 100-400 - Series Methods for the Determination of Inorganic Substances in Environmental Samples* (U.S. EPA/600R-93-100, August, 1999a).
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (U.S. EPA/600/4-80-032, August, 1980)
- *Methods of Soil Analysis* (American Society of Agronomy, 1982).
- *United States department of Agriculture(USDA), Handbook No. 60*, (USDA, 1954)

The analytical methods are briefly described in Table A6-1. All samples will be prepared and analyzed in accordance with this QAPP, the referenced analytical method, and in accordance with the Contract Laboratory's SOPs.

### **A6.1.2 Data Reporting Requirements**

The following criteria for reporting data will apply for all samples:

- MDLs and sample results will be reported to one decimal place more than the corresponding RL, unless the appropriate number of significant figures for the measurement dictates otherwise.
- All target compound non-detections will be reported (at a minimum) as less than the RL.
- If the Region 9 PRG or EPA SSL of a specific compound is greater than the RL, the sample data will be reported to the MDL.
- If target analytes are detected between the MDL and RL, they will be reported as quantified and qualified with a “T” flag to indicate the data are estimated.
- If target analytes are detected at or above the RL, they will be reported as quantified.

**Additional Reporting Requirements for Definitive Data.** The Project Chemist will be notified immediately regarding the failure of sample data to meet the RL to assess potential corrective action. The decision to implement corrective action will be based on whether there are any analytical alternatives or clean up steps that would improve the reporting limit and whether the elevated reporting limits will adversely affect data use. Any data that do not meet the MDLs or RLs due to sample dilution will be included in the case narrative and the supporting documentation (chromatograms) will be included in the data packages.

## **A7.0 INTERNAL QUALITY CONTROL CHECKS**

Internal quality control checks are used to evaluate whether field measurements and sampling procedures and laboratory analytical method performance is within acceptable limits of precision and accuracy. The following sections describe the internal QC that will be followed for both field and Contract Laboratory activities.

### **A7.1 SAMPLE COLLECTION**

The accuracy and precision of the field sampling procedures will be assessed as described in Section A3.0 of this QAPP. Sample representativeness will be assessed by the analysis of field replicate samples. These samples are described in Section A3.0.

### **A7.2 CONTRACT LABORATORY ANALYSIS**

The general objectives of the internal Contract Laboratory QC program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.
- Ensure that all analytical procedures are validated and conducted according to method guidelines and laboratory SOPs.
- Monitor the performance of the laboratory using a systematic inspection program.
- Ensure that all data are properly reported and archived.

The Contract Laboratory will conduct internal quality control checks for analytical methods in accordance with their SOPs, the individual method requirements, and this QAPP. The Contract Laboratory will notify the Project Chemist in writing before making significant changes resulting from corrective actions to this QAPP or analytical methodology. The MWH Project Manager and the UNC Project Managers will be notified if the data impacts the task specific DQOs.

Contract Laboratory quality control consists of two distinct components, a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific media on the method performance. The QC samples that will be used to assess the laboratory component and the media component of analysis are described Section A3.0 of this QAPP. The criteria against which the QC data will be evaluated are listed in Attachment 1. Corrective actions for instrument calibrations or QC sample data out of compliance are listed in the corrective action summary tables included in Attachment 1.

## **A8.0 DATA REDUCTION, REVIEW, REPORTING, VERIFICATION, VALIDATION, AND RECORD-KEEPING**

The data reduction, review, reporting, verification, and validation procedures are described in this section to ensure that; (1) complete documentation is maintained, (2) transcription and data reduction errors are minimized, (3) the data are reviewed and documented, and (4) the reported results are qualified if necessary. Laboratory data reduction and verification procedures are required to ensure the overall objectives of analysis and reporting meet method and project specifications.

### **A8.1 DATA REDUCTION**

#### **A8.1.1 Contract Laboratory Data Reduction**

The Contract Laboratory will reduce all analytical data (both screening and definitive) in accordance with the analytical methods and the guidance presented in Sections A3.0 of this QAPP. Refer to Section A3.0 of this QAPP for equations that will be used by the Contract Laboratory to assess precision and accuracy, and refer to Section A3.0 and Attachment 1 regarding instrument calibration and target analyte quantitation.

### **A8.2 DATA REVIEW**

#### **A8.2.1 Contract Laboratory Data Review**

Prior to the release of data to MWH, the Contract Laboratory will perform in-house data review under the direction of the Contract Laboratory Project Manager and/or the laboratory QAO and will prepare and retain full analytical and QC documentation. In general, the Contract Laboratory data review will be conducted as described in the following paragraphs.

The bench analyst will conduct the initial data review based on established protocols specified in laboratory SOPs and analytical method and this QAPP. At a minimum this

review will include the following:

- An assessment of sample preparation procedures and documentation for accuracy and completeness.
- An assessment of sample analysis procedures and documentation for accuracy and completeness.
- Assessments of whether the appropriate SOPs were followed.
- An assessment analytical results for accuracy and completeness.
- An assessment of whether QC samples are within established control limits and method blank data are acceptable.
- An assessment of whether documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, out-of-control forms, if required, are complete, holding times are documented, etc.).

The calculations that will be used to evaluate precision and accuracy are defined in Section A3.0 of this QAPP. The acceptance criteria for calibration, precision, and accuracy assessment and the corrective action summaries are provided in Attachment 1.

When an analysis of a QC sample (blank, spike, or similar sample) indicates that the analysis of that batch of samples is not in control, the analyst will immediately bring the matter to the attention of the appropriate designated Contract Laboratory QC staff (QAO, Project Manager, Section Leader, etc.). This individual will determine whether the analysis can proceed, or if selected samples should be rerun, or specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria will be documented. A Nonconformance Report will be prepared for all Contract Laboratory analysis out of control events that require documentation. The MWH Project Chemist will be notified as soon as feasibly possible to determine the appropriate corrective action for out-of-control events resulting in unacceptable data.

After this review is complete, the analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer. This reviewer (department manager, QAO, etc.) will be responsible for review and approval of the analytical control documentation associated with each analytical batch, as well as any corrective action explanations provided by the analyst. This individual will also be responsible for determining whether the analytical data meet quality control criteria established by the analytical methods and by this QAPP and for identifying QC problems that require further resolution. A permanent record of any corrective actions will be maintained in the Contract Laboratory files.

The Contract Laboratory Project Manager will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The Contract Laboratory Project Manager will also be responsible for reviewing all final data reports for proper format and reporting consistency prior to release of the reports to the MWH. This review will include the following as a minimum:

- Contract Laboratory name and address.
- Sample information (includes unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis).
- Analytical results reported with an appropriate number of significant figures.
- Reporting limits reflecting dilutions, interferences, and corrections for dry weight as applicable.
- Method references.
- Appropriate QC results and correlations for sample batch traceability and documentation.
- Data qualifiers with appropriate references and narrative on the quality of results.

- Confirmation that QAPP requirements have been met.

The Contract Laboratory Project Manager and/or QAO will also be responsible for qualifying any data that may be unreliable. Data qualifications will be based on the analytical method, and this QAPP. The flags that will be used by the Contract Laboratory for data qualification are listed in Table A8-1.

### **A8.3 DATA REPORTING**

#### **A8.3.1 Contract Laboratory Data**

The hard-copy analytical data will be reported in a format organized to facilitate data verification using Contract Laboratory Program- (CLP) like forms. The information that will be included in the Contract Laboratory data packages is listed in Table 8-2.

The Contract Laboratory will provide an electronic deliverable report in a format as specified by the MWH. The Contract Laboratory will provide the electronic deliverable via ASCII files in via electronic mail or compact disk.

### **A8.4 DATA VERIFICATION**

As described in Section 3.0, the field and analytical data will be evaluated using the DQOs, which are quantitative and qualitative statements that describe data quality. To determine whether the DQOs of for this project have been met, the QC sample results and standard procedures will be compared to the acceptance criteria established in this QAPP. The MWH Project Chemist will conduct a Level III verification as described in Section A8.4.1 for all definitive project data and Level IV verification for 10 percent of the data.

#### **A8.4.1 Level III Data Verification**

The MWH Project Chemist will perform a Level III data verification for all metal, organic, and radionuclide data. Because there are no DQOs attached to the agronomic

data, it will not be verified. The objective of the data verification is to provide a data review that verifies the laboratory QC results. The verification will be based on guidance outlined in this QAPP. The verification will be structured to assess whether the acceptance criteria for instrument calibration and QC sample analysis (Attachment 1) have been met. The calculations that will be used to assess data quality are presented in Section 3.0 and the criteria that will be used to assess data quality are described in Attachment 1.

Level III data verification techniques include accepting, rejecting, or qualifying the data on the basis of acceptance criteria defined in Attachment 1. The flags that will be used to qualify data are listed on Table 8A-1 and the qualification procedures that will be followed are described in Tables A8-3 through A8-5.

The Level III data verification will be documented on Data Verification Forms (examples are shown on Figures A8-1A and B) that also include the signature of the reviewer and the date of the verification. The Data Verification Forms lists the parameters that must be verified to constitute Level II data verification. Data will not be released for use prior to completion of the data verification.

#### **A8.4.2 Level IV Data Verification**

Level IV verification will be conducted for 10 percent of the data. In addition to the QC parameters reviewed during the Level III verification process, a review of raw data from the instrument (i.e. chromatograms, quantitation reports, spectra), a back check of all calculations, and a review of sample preparation and analytical logs will occur.

### **A8.5 DATA VALIDATION**

The objective of the data validation is to assess whether the field and chemical data are of sufficient quality to support the task-specific DQOs (i.e. end use). The data will be qualitatively and quantitatively assessed on a project-wide, task-specific, matrix-specific, parameter-specific, and unit-specific basis. Factors that will be considered during this

evaluation will include, but not be limited to the following:

- Were all samples collected using the methodologies included in this QAPP and the Work Plan?
- Were all proposed analyses performed in accordance with this QAPP and the Contract Laboratory's SOPs?
- Were the RLs elevated and what impact if any to data usability occurred?
- Were samples obtained from all proposed sampling locations and depths?
- Do any data exhibit elevated detection limits due to matrix interference or contaminants present at high concentrations?
- Were all field and laboratory data verified in accordance with the verification protocols, including the project-specific QC objectives specified in this QAPP?
- Which data sets were found to be unusable ("R" qualified) based on the data verification results?
- Which data sets were found to be usable for limited purposes ("UJ" qualified) based on the data verification?
- What effect do qualified data have on the ability to implement the project decision rules?
- Can valid conclusions be drawn for all matrices for each specific task?
- Were all issues requiring corrective action fully resolved?

## **A8.6 DATA MANAGEMENT**

The individuals responsible for data management for this project include all personnel responsible for identifying, reporting, and documenting activities affecting data quality. In general, the qualifications of the individuals associated with data management

activities will be commensurate with the level of expertise necessary to ensure the intended level of evaluation.

All project files will provide a traceable record for all data management activities. The Contract Laboratory will maintain a project file that includes but is not limited to the following; formulas used for data reduction, computer programs, which data transfers are electronic or manual, data review protocol, raw data files, etc. All data acquired electronically will be transferred and manipulated electronically to reduce errors inherent in manual data manipulation. Data entered, transferred or calculated by hand will be spot checked for accuracy by someone who did not perform the original entries or calculations.

The Contract Laboratory will preserve all electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to this project. The minimum records the Contract Laboratory will keep include the following:

- C-O-C forms.
- Initial and continuing calibration records including standards preparation traceable to the original material and lot number.
- Instrument tuning records (as applicable).
- Method blank results
- Spike and spike duplicate records and results
- Laboratory records.
- Raw data, including instrument printouts.
- Bench work sheets, and/or chromatograms with compound identification and quantitation reports.
- Corrective action reports.
- Other method and project required QC samples and results.

- Laboratory-specific written SOPs for each analytical method.
- QA/QC function in place at the time of analysis of project samples.

Computer acquired data will also be stored on magnetic tape, disks, or other media, that can be accessed using industry-standard hardware and software for data processing, retrieval, or reporting. The laboratory will maintain all data collected for this project sampling for a minimum of seven years following submission of the data reports.

## **A9.0 PERFORMANCE AND SYSTEM AUDITS**

Technical systems and performance audits will be performed as independent assessments of sample collection and analysis procedures. Audit results will be used to evaluate the ability of the Contract Laboratory to (1) produce data that fulfill the objectives established for this project, (2) comply with the QC criteria presented in this QAPP, and (3) identify any areas requiring corrective action. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of a measurement system, and includes both internal and external audits. MWH personnel will conduct internal audits. External audits are the responsibility of federal and state regulatory agencies. Definitive data verification and validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Data verification is discussed in Section A8.0.

### **A9.1 LABORATORY PERFORMANCE AND SYSTEMS AUDITS**

In-house and regulatory agency audits of laboratory systems and performance will be a regular part of the laboratory's QA program. Internal audits will be conducted by the laboratory's QAO or designee, and consist of a review of the entire laboratory system and at a minimum include: examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures; sample preparation and analysis; and instrumentation procedures.

An internal audit of the laboratory may be performed by MWH, at the discretion of the UNC Representative, within six months of field investigation start up and will include a review of the following items:

- Sample custody procedures.
- Calibration procedures and documentation.
- Completeness of data forms, notebooks, and other reporting requirements.

- Data review and verification procedures.
- Data storage, filing, and record keeping procedures.
- QC procedures, tolerances, and documentation
- Operating conditions of facilities and equipment
- Documentation of training and maintenance activities.
- Systems and operations overview.
- Security of laboratory automated systems.

Magnetic tape audits involve the examination of the electronic media used by the Contract Laboratory to collect, analyze, report, and store data. These audits are used to assess the authenticity of the data generated, and assess the implementation of good automated laboratory practices. The MWH Project Chemist may perform magnetic tape audits of the Contract Laboratory if warranted by on-site audit results.

MWH will forward audit results to appropriate management and the UNC Representative. Deficiencies and corrective action procedures will be clearly documented in the audit report.

External field audits are the responsibility of the federal and state regulatory agencies. Field audits will be conducted at any time during the field operations and will be based upon the information presented in the Work Plan and this QAPP. The audits may or may not be announced, at the discretion of the auditing agency.

## **A10.0 PREVENTIVE MAINTENANCE PROCEDURES**

A preventive maintenance program will be in place to promote the timely and effective completion of a measurement effort. The preventive maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts will be focused in three primary areas: (1) establishment of maintenance responsibilities, (2) establishment of maintenance schedules for major and/or critical instrumentation and apparatus, and (3) establishment of an adequate inventory of critical spare parts and equipment.

### **A10.2 CONTRACT LABORATORY EQUIPMENT**

Preventive maintenance of all laboratory equipment and instruments is essential to ensure the quality of the analytical data produced. The objective of preventive maintenance is to ensure instrument operation is appropriate for both task-specific and method DQOs. The Contract Laboratory has a routine preventive maintenance program to minimize the occurrence of instrument failure and other system malfunctions and will have designated individuals who perform routine scheduled maintenance for each instrument system and required support activity. The following paragraphs focus on maintenance responsibilities, maintenance schedules, record keeping, and inventory of spare parts and equipment.

**Maintenance Responsibilities.** Maintenance responsibilities for Contract Laboratory equipment will be assigned to designated personnel. These individuals establish maintenance procedures and schedules for each major equipment item. The instrument manufacturer service engineers will perform instrument maintenance and repair, as scheduled/needed. The analysts will perform other routine preventive maintenance tasks. Only qualified individuals will perform any maintenance activities.

**Maintenance Schedules.** Maintenance schedules are based on the manufacturers' recommendations and/or sample load. Maintenance activities for each instrument will be documented in a maintenance logbook, as described below.

**Record Keeping.** All instrument maintenance will be documented in instrument-specific bound logbooks, which are kept with the instrument. The date, initials of the individual performing the maintenance and the type of maintenance will be recorded in this logbook. Receipts from routine maintenance performed by the manufacturer's representative will be filed in the appropriate laboratory department (e.g., ion chromatograph maintenance receipts are stored in the organic section). This logbook will serve as a permanent record that documents any routine preventive maintenance performed, as well as any service performed by external individuals such as manufacturers' service representatives. In addition, all receipts from routine maintenance performed by manufacturers' representatives will be maintained in the laboratory's file. These records will be made available upon request during external audits.

**Spare Parts.** An adequate inventory of spare parts is maintained to minimize equipment down time. This inventory will include those parts (and supplies) which are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner.

**Contingency Plan.** In the event of instrument failure, every effort will be made to analyze samples by an equivalent alternate means within holding times. If the redundancy in equivalent instrumentation is insufficient to handle the affected samples, MWH will be immediately notified and the corrective action to be taken will be determined by the MWH Project Chemist and Project Manager and UNC Project Manager (as applicable).

## **A11.0 CORRECTIVE ACTIONS**

### **A11.1 CORRECTIVE ACTION REQUIREMENTS**

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of control performance that may affect data quality. All proposed and implemented corrective action will be documented in the regular quality assurance reports to the appropriate project management as defined in Section 2.0 of this QAPP. The MWH Project Manager or designee will implement corrective action only after approval. If immediate corrective action is required, approvals secured by telephone from the UNC Project Manager will be documented in an additional memorandum.

For each incidence of noncompliance, a formal corrective action program will be established and implemented at the time the problem is identified. The individual who identifies the problem will be responsible for notifying the MWH Project Manger, who in turn will notify other applicable personnel. Implementation of corrective action will be confirmed in writing as described previously.

Any nonconformance with the established QC procedures specified in the Work Plan or this QAPP will be identified and corrected in accordance with the QAPP. Corrective actions will be implemented and documented in the field logbook. No staff member will initiate corrective action without prior communication of findings through the proper channels.

#### **A11.1.1 Contract Laboratory Corrective Action**

Corrective actions are required whenever unreliable analytical results prevent the quality control criteria from being met, as specified by the analytical method; the Contract Laboratory's SOPs, or this QAPP. The corrective action taken depends on the analysis and the nonconformance. A summary of corrective actions that will be undertaken for problems associated with specific laboratory analyses is provided in Attachment 1 of this

## QAPP.

Corrective action will be undertaken if one of the following occurs:

- Blanks consistently contain target analytes above acceptance levels.
- Undesirable trends are detected in spike recoveries, spike recoveries are outside the QC limits, or RPDs between duplicate analyses are consistently outside QC limits.
- There are unusual changes in RLs.
- Deficiencies are detected during QA audits.
- Inquiries concerning data quality are received from the MWH Project Chemist.

The analyst who reviews the sample preparation or extraction procedures, and performs the instrument calibration and analysis will handle corrective actions at the bench level (primarily). If the problem persists or its cause cannot be identified, the matter will be referred to the department supervisor or QA department for further investigation. Once resolved, full documentation of the corrective action procedure will be filed with the appropriate Contract Laboratory QA department. A summary of the corrective actions will be included in the data reports.

### **A11.1.2 Data Verification Corrective Actions**

Corrective action may be initiated during data verification or data assessment. Potential types of corrective action include resampling by the field team or reanalysis of samples by the Contract Laboratory.

Corrective actions that will be taken are dependent upon the ability to mobilize the field team, how critical the data are to the task-specific DQOs, and whether the samples are still within holding time criteria. When a corrective action situation is identified by the

MWH Project Chemist, the MWH Project Manager will have responsibility for authorizing the implementation of the corrective action, including resampling and documenting the corrective action and notifying the UNC Project Manager for authorization.

#### **A11.2 CORRECTIVE ACTION SYSTEM**

A system for issuing, tracking, and documenting completion of formal Recommendations for Corrective Action (RCA) exists for addressing significant and systematic problems. Recommendations for corrective actions are issued only by a member of the QA group, or a designee in a specific QA role. Each RCA addresses a specific problem or deficiency, usually identified during QA audits of Contract Laboratory or project operations. An RCA requires a written response from the party to whom the RCA was issued. A summary of unresolved RCAs is included in the monthly QA report to management. The report lists all RCAs that have been issued, the manager responsible for the work area, and the current status of each RCA. An RCA requires verification by the QA group that the corrective action has been implemented before the RCA is considered to be resolved. In the event there is no response to an RCA within 30 days, or if the proposed corrective action is disputed, the recommendation and/or conflict is pursued to successively higher management levels until the issue is resolved.

## **A12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT**

Deliverables associated with this project will contain separate QA sections in which data quality information collected during specific tasks is summarized. Deliverables include reports that summarize the sampling program findings. Submission of these reports is the responsibility of the MWH Project Manager. Quality assurance sections will identify all QA samples collected and the corresponding primary samples and will report accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

### A13.0 REFERENCES

- American Society of Agronomy, 1982, *Methods of Soil Analysis*
- U.S. Environmental Protection Agency, 1986. *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).
- U.S. Environmental Protection Agency, 1999. *EPA 100-400 - Series Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600R-93-100.
- U.S. Environmental Protection Agency, 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA/600/4-80-032.
- U.S. Environmental Protection Agency, 2000. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. EPA/600/R-96/055.
- U.S. Environmental Protection Agency, 2001. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5
- United States department of Agriculture(USDA), 1954. *Handbook No. 60*.

## **TABLES**

**TABLE A1-1**

**CONTRACT LABORATORY ANALYTICAL METHODS FOR SAMPLE ANALYSIS  
UNC - NORTHEAST CHURCH ROCK  
(Page 1 of 2)**

<b>Target Parameter</b>	<b>Analytical Method<sup>(a)</sup></b>
Metals	SW6020/EPA200.8
SPLP Metals	SW1312/SW6020/EPA200.8
TCLP Metals (except mercury)	SW1311/SW6020/EPA200.8
Mercury	SW7471A
TCLP Mercury	SW1311/7470A
Uranium	SW6020/EPA200.8
SPLP Uranium	SW1312/SW6020/EPA200.8
Radium-226	EPA901.1
SPLP Radium-226	SW1312/EPA903.0
Volatile Organic Compounds	SW846/8260B
Semi-Volatile Organic Compounds	SW846/8270C
<b>Agronomic Analyses</b>	
pH	ASA No. 9, Method 10-3.2
Electrical Conductivity	ASA No. 9, Method 10-3.3
Saturation Percentage	USDA Handbook 60, Method 27A
Texture	ASA No. 9, Method 15-5
Rock Fragment Percentage	ASA No. 9, Method 15-5
Sodium Adsorption Ratio	ASA No. 9, Method 10-3.4/SW 6010B
Nitrate	ASA No. 9, Method 33-3.1/EPA 353.2
Phosphorus	ASA No. 9, Method 24-5.1/EPA 365.1
Potassium	ASA No. 9, Method 13-3.5/SW6010B
Chloride	ASA No. 9, Method 10-2.3.2/EPA300
Sulfate	ASA No. 9, Method 28-5.1/EPA300
Organic Carbon	ASA No. 9, Method 29-3.5.2 (Walkley-Black)

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).

Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA/600/4-80-032, August, 1980)

EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

**TABLE A1-1**

**CONTRACT LABORATORY ANALYTICAL METHODS FOR SAMPLE ANALYSIS**

**UNC - NORTHEAST CHURCH ROCK**

**(Page 2 of 2)**

<b>Target Parameter</b>	<b>Analytical Method<sup>(a)</sup></b>
Methods of Soil Analysis, American Society of Agronomy, 1982.	
United States department of Agriculture(USDA), Handbook No. 60, Method 23C, USDA, 1954	
SPLP Synthetic precipitation leaching procedure	
TCLP Toxicity characteristic leach procedure	

TABLE A3-1

**QUALITY CONTROL SAMPLE DATA EVALUATION IN TERMS OF DATA QUALITY INDICATORS**  
(Page 1 of 1)

Parameter	Quality Control Program	Evaluation Criteria
Precision	Field Duplicate Sample Pairs	Relative Percent Difference
	Field Duplicate Sample Pairs	Replicate Error Ratio
	Matrix Spike/Matrix Spike Duplicate Sample Pairs	Relative Percent Difference
	Matrix Duplicate Sample Pairs	Relative Percent Difference
	Serial Dilution	Percent Difference
Accuracy	Matrix Spike	Percent Recovery
	Matrix Spike Duplicate	Percent Recovery
	Laboratory Control Samples	Percent Recovery
	Interference Check Samples	Percent Recovery
	Initial Calibration Standards	Relative Standard Deviation
	Initial Calibration Verification	Percent Difference
	Alibration Verification Standards	Percent Difference
	Internal standards	Percent Recovery
Post digestion spike	Percent Recovery	
Representativeness	Sample Preservation and Holding Time	Qualitative, Degree of Confidence
	Method Blanks	Qualitative, Degree of Confidence
	Equipment Rinseate Blank Samples	Qualitative, Degree of Confidence
	Initial Calibration and Continuing Calibration Blanks	Qualitative, Degree of Confidence
	Field Duplicates	Quantitative/Qualitative, Degree of Confidence
Comparability	Standard Field Procedures	Qualitative, Degree of Confidence
	Standard Analytical Methods	Qualitative, Degree of Confidence
	Standard Units of Measure	Qualitative, Degree of Confidence
Completeness	Valid Data	Percent Acceptable Data

**TABLE A3-2**  
**LABORATORY ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATIVES,**  
**UNITS OF MEASURE, AND HOLDING TIME CRITERIA**  
 (Page 1 of 1)

Laboratory Analysis (Method)	Sample Container	Preservative	Unit of Measure	Holding Time
<b>Soil Samples</b>				
Metals (SW-846 6020/EPA200.8)	4-oz or 8-oz glass wide-mouth with Teflon™ lined cap	NA	mg/kg	180 days from sample collection to analysis
SPLP Metals (SW-846 1312/6020)	4-oz or 8-oz glass wide-mouth with Teflon™ lined cap	NA	mg/kg	180 days from sample collection to leaching 180 days from sample leaching to analysis
TCLP Metals (except mercury) (SW-846 1311/6020)	4-oz or 8-oz glass wide-mouth with Teflon™ lined cap	NA	mg/kg	180 days from sample collection to leaching 180 days from sample leaching to analysis
TCLP Mercury (SW-846 1311/7470A)	4-oz or 8-oz glass wide-mouth with Teflon™ lined cap	NA	mg/kg	28 days from sample collection to leaching 28 days from sample leaching to analysis
Radium 226 (901.1)	Gallon Ziploc™ Bag	NA	pCi/g	180 days from sample collection to analysis
Volatile Organic Compounds (SW-846 8260B)	Three EnCore Samplers 4-oz or 8-oz glass wide-mouth with Teflon™ lined cap for moisture	Sodium bisulfate/Methanol within 48 hours of sample collection. Chill to 4°C	µg/kg	14 days from sample collection to analysis
Semi-Volatile Organic Compounds (SW-846 8270C)	4-oz or 8-oz glass wide-mouth with Teflon™ lined cap; no head space	Chill to 4°C	µg/kg	14 days from sample collection to extraction 40 days from sample extraction to analysis
<b>Water Samples</b>				
Metals (except mercury) (SW-846 6020/EPA200.8)	1-liter polyethylene bottle with a Teflon™ lined cap	HNO <sub>3</sub> ; pH < 2 Chill to 4°C	µg/l	180 days from sample collection to analysis
Mercury (SW-846 7470A)	1-liter polyethylene bottle with Teflon™ lined cap	HNO <sub>3</sub> ; pH < 2	µg/l	28 days from sample collection to analysis
Radium 226 (903.0)	2-liter amber glass bottle with a Teflon™ lined cap	Chill to 4°C	pCi/l	180 days from sample collection to analysis
Volatile Organic Compounds (SW-846 8260B)	2, 40-ml amber glass bottles with a Teflon™ septum cap; No head space	HCL; pH < 2 Chill to 4°C	µg/l	14 days from sample collection to analysis
Semi-Volatile Organic Compounds (SW-846 8270C)	1-liter amber glass bottle with a Teflon™ lined cap	Chill to 4°C	µg/l	7 days from sample collection to extraction 40 days from sample extraction to analysis

EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (U.S. EPA Third edition, Final Update III, December 1996).

EPA 100-400 Series Methods for the Determination of Inorganic Substances in Environmental Samples, (EPA/600R-93/100. August 1999).

°C	Degrees celsius	mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram	pCi/g	picocuries per gram
µg/l	micrograms per liter	pCi/l	picocuries per liter
HCL	hydrochloric acid	SPLP	Synthetic precipitation leaching procedure
HNO <sub>3</sub>	nitric acid	TCLP	Toxicity characteristic leaching procedure

**TABLE A6-1**  
**ANALYTICAL METHOD SUMMARY**  
 (Page 1 of 3)

Method	Analytical Procedure
SW-846 1312 Synthetic Precipitation Leaching Procedure	The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase by tumbling for 18 hours. The extraction fluid is separated from the solid phase by filtration. The extraction fluid is then analyzed as a water sample.
SW-846 1311 Toxicity Characteristic Leach Procedure	The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase by tumbling for 18 hours. The extraction fluid is separated from the solid phase by filtration. The extraction fluid is then analyzed as a water sample.
SW-846 6010B Metals by Inductively Coupled Plasma (ICP)	The ICP method measures element-emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line 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 photo-sensitive devices.
EPA 903.0 Radium-226 by Alpha Spectrometry	Radium is collected by co-precipitation with barium sulfate. The precipitate is purified and directly deposited on a stainless steel planchet. Following a ten day in-growth period the sample is counted for alpha activity on a low background alpha/beta proportional scaler and the radium concentration is calculated from the count rate.
EPA 901.1 Radium-226 by Gamma Spectrometry	A homogeneous aliquot of sample is put into a standard geometry for gamma counting, and set aside for 21 day in-growth period. Samples are counted long enough to meet the required sensitivity of measurement.
SW-846 6020 Metals by ICP/Mass Spectrometer	Metals in solution is analyzed using ICP/Mass Spectrometer.
SW-846 7470A Mercury by Cold Vapor Atomic Adsorption	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 adsorption spectrophotometer. Absorbency (253.7 nm) is measured as a function of mercury concentration.
SW-846 8260B VOCs by Gas Chromatography/Mass Spectrometry (GC/MS)	Volatile compounds are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation ) ion relative to an internal standard using a 5-point calibration curve.

**TABLE A6-1**  
**ANALYTICAL METHOD SUMMARY**  
**(Page 2 of 3)**

<b>Method</b>	<b>Analytical Procedure</b>
SW-846 8270C SVOCs by GC/MS	Semi-volatile compounds (including PAHs) are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation ) ion relative to an internal standard using a 5-point calibration curve.
<b>Agronomic Analyses</b>	
ASA No. 9, Method 10-3.2 pH	A saturated paste is made by mixing the soil with water in a 1:1 ratio. pH is measured using a calibrated pH probe
ASA No. 9, Method 10-3.3 Electrical Conductivity	A saturated paste is made by mixing the soil with water in a 1:1 ratio. Conductivity is measured using a calibrated conductivity meter
USDA Handbook 60, Method 27A Saturation Percentage	A portion of the saturated paste is collected and dried @ 105 degrees Celsius. The loss of water weight divided by the dry weight of the soil is expressed in percent.
ASA No. 9, Method 15-5 Texture	Texture is determined by mixing a weighed portion of the sample with enough water to bring the volume to one liter. After mixing density is measured using a hydrometer at seven timed intervals as the sample settles.
ASA No. 9, Method 15-5 Rock Fragment Percentage	A weighed amount of sample is sent through a series of sieves and percentage is determined by weighing the amount of samples left on each sieve.
ASA No. 9, Method 10-3.4/SW 6010B Sodium Adsorption Ratio (SAR)	A saturated paste is made by mixing the soil with water in a 1:1 ratio. The liquid portion is then analyzed for sodium using ICP.
ASA No. 9, Method 33-3.1/EPA 353.2 Nitrate	Nitrate is extracted from soil using a 2M potassium chloride solution. Extract is then analyzed for nitrate by colorimetry.
ASA No. 9, Method 24-5.1/EPA 365.1 Phosphorus	Phosphorus is extracted from soil using a solution consisting of 0.03 N ammonium fluoride and 0.025 N hydrochloric acid. Extract is analyzed for phosphorus by colorimetry.
ASA No. 9, Method 13-3.5/SW6010B Potassium	A saturated paste is made by mixing the soil with water in a 1:1 ratio. The liquid portion is then analyzed for potassium using ICP.
ASA No. 9, Method 10-2.3.2/EPA300 Chloride	Chloride is extracted from soil using distilled water. Extract is analyzed for chloride by ion chromatography.

**TABLE A6-1**  
**ANALYTICAL METHOD SUMMARY**  
**(Page 3 of 3)**

Method	Analytical Procedure
ASA No. 9, Method 28-5.1 Sulfate	Sulfate is extracted from soil using distilled water. Extract is analyzed for sulfate by ion chromatography
ASA No. 9, Method 29-3.5.2 (Walkley-Black) Organic Carbon	Walkley-Black was developed specifically for soils and consists of a wet oxidation method using potassium dichromate, which is back-titrated with iron <sup>+2</sup> . This method targets organic matter in soil, which is the primary source of organic carbon in soil.

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).

Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA/600/4-80-032, August, 1980)

EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

Methods of Soil Analysis, American Society of Agronomy, 1982.

United States department of Agriculture(USDA), Handbook No. 60, Method 23C, USDA, 1954

**TABLE A8-1**  
**DATA QUALIFIERS**

<b>Qualifier</b>	<b>Description</b>
J	The analyte was positively identified, the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL.
T	The analyte was positively identified but the associated numerical value is below the RL.
R	The data are rejected and may not be usable due to QC deficiencies.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
S	To be applied to all field screening data.

MDL    Method detection limit  
 RL     Reporting limit  
 QC     Quality control  
 GC/MS Gas chromatography/mass spectroscopy

TABLE A8-2

**DATA REPORTING REQUIREMENTS**  
(Page 1 of 2)

Data Type	Analysis Type	Data Reporting Requirement	Report Format
<b>Agronomic Analyses</b>	pH	pH data	—Hard copy of data report
	Electrical Conductivity	Electrical Conductivity data	—Hard copy of data report
	Saturation Percentage	Saturation Percentage data	—Hard copy of data report
	Texture	Texture data	—Hard copy of data report
	Rock fragment Percentage	Rock fragment Percentage data	—Hard copy of data report
	Sodium Adsorption Ratio	Sodium Adsorption Ratio data	—Hard copy of data report
	Nitrate	Nitrate data	—Hard copy of data report
	Phosphours	Phosphours data	—Hard copy of data report
	Potassium	Potassium data	—Hard copy of data report
	Chloride	Chloride data	—Hard copy of data report
	Surlfate	Surlfate data	—Hard copy of data report
	Organic Carbon	Organic Carbon data	—Hard copy of data report
	<b>Metals, Radionuclide, and organic data</b>	Level III data package for standard methods of analysis	Case narrative (including samples not meeting QC criteria, out of control conditions, corrective actions, and matrix effects with justification)
Completed C-O-C and sample receipt and log in forms			—Hard copy of data report
Target compound results for all samples, including field QC samples and dilution factors, reanalysis, batching information, and bracketing information			—Hard and electronic copy of data report
Method blank results			—Hard and electronic copy of data report
MS/MSD results (spike concentration, actual values, and percent recovery)			—Hard and electronic copy of data report
Matrix duplicate data			—Hard and electronic copy of data report
LCS results (spike concentration, actual values, and percent recovery)			—Hard and electronic copy of data report
Surrogate results, organic analysis (spike concentration, actual values, and percent recovery)			—Hard and electronic copy of data report
Initial calibration summary form			—Hard copy of data report
Continuing calibration summary form			—Hard copy of data report
Internal standard area and retention time summary (if applicable)			—Hard copy of data report
Injection logs			—Hard copy of data report
Raw data for all samples where matrix			—Hard copy of data report

TABLE A8-2

DATA REPORTING REQUIREMENTS  
(Page 2 of 2)

Data Type	Analysis Type	Data Reporting Requirement	Report Format
		interference is invoked as the reason for MS/MSD, surrogate spike, or internal standard failure	
		ICP interference check sample data	—Hard copy of data report
		Post digestions spike sample data	—Hard copy of data report
		Method of standard addition data (if required)	—Hard copy of data report
		Holding time summary	—Hard copy of data report
		Manually integrated data	—Hard copy of data report
	Level IV data package for standard methods of analysis	Level III data package plus raw data for all samples and associated quality control samples	—Hard copy of data report

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846; U.S. EPA Third Edition, Final Update III, December 1996).

—Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA/600/4-80-032, August, 1980)

—EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

Methods of Soil Analysis, American Society of Agronomy, 1982.

TABLE A8-3

GENERAL FLAGGING CONVENTIONS

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time <sup>(a)</sup>	Time exceeded for extraction or analysis	J- for the positive results UJ for the non-detects	All analytes in the sample
LCS <sup>(a)</sup>	% R > Upper Control Limit (UCL)	J+ if high bias for the positive results None if high bias for non-detects	The specific analyte(s) in all samples in the associated analytical batch
	%R < Lower Control Limit (LCL)	J- if low bias for the positive results UJ if low bias for non-detects	
Method Blank	Analyte(s) detected ≥ Reporting Limit (RL)	B	The specific analyte(s) in all samples in the associated analytical batch with results above the RL
Matrix duplicates	Matrix duplicates > RLs and relative percent difference (RPD) outside CL	J for the positive results	The specific analyte(s) in all samples collected on the same sampling date
Matrix spike or Matrix Spike Duplicate (MS/MSD)	MS or MSD % recovery (R) > UCL or	J+ if high bias for the positive results None if high bias for non-detects	The specific analyte(s) in the parent sample. If parent sample concentration greater than 4 times the spiking concentration, no data will be qualified.
	MS or MSD % R < LCL or	J- if low bias for the positive results UJ if low bias for non-detects	
	MS/MSD RPD > CL	J for the positive results	
Sample Preservation/Collection <sup>(a)</sup>	Preservation/collection requirements not met	J- for the positive results UJ for the non-detects	All analytes in the sample
Sample Storage <sup>(a)</sup>	< 2 Degrees Celsius (°C) or > 6°C or as required	J- for the positive results UJ for the non-detects	All analytes in the sample

(a) Data will be rejected if a gross exceedence occurs.

TABLE A8-4

FLAGGING CONVENTIONS SPECIFIC TO ORGANIC METHODS

QC Requirement	Criteria	Flag	Flag Applied To
Initial Five Point Calibration (GC/MS methods)	SPCC or CCC criteria not met	R	All analytes in all samples associated with the initial calibration
	Linearity criterion not met	J for the positive results None for non-detects if RL verified by RF > 0.05	The specific analyte(s) in all samples associated with the initial calibration
Calibration Verification (GC/MS methods)	SPCC or CCC criteria not met	R	All analytes in all samples associated with the calibration verification
	CL for non SPCC or CCC compounds exceeded	J+ if high bias for the positive results None if high bias for non-detects	The specific analyte(s) in all samples associated with the calibration verification
Surrogates	Surrogate % R > UCL or Surrogate % R < LCL	J- if low bias for the positive results UJ if low bias for non-detects	All analytes in the sample associated with the surrogate
		J+ for the positive results None for non-detects	
	Surrogate recovery < 10%	R for all results	
Mass Spectrometer Tune	Ion abundance criteria not met	R for all results	All analytes in all samples associated with the tune
Internal Standard	Retention time not within ±30 seconds; EICP area not within -50% to +100% of last calibration verification	J+ if positive bias for the positive results None for non-detects	Apply to all results for specific analytes associated with the IS
		J- if low bias for the positive results UJ if low bias for the non detects	

CCC Continuing calibration compound  
 CL Control limit  
 EICP Extracted ion current profile  
 GC/MS Gas chromatography/mass spectroscopy

RL Reporting limit  
 SPCC System performance check compound  
 UCL Upper control limit

TABLE A8-5

## FLAGGING CONVENTIONS SPECIFIC TO INORGANIC METHODS

QC Requirement	Criteria	Flag	Flag Applied To
Initial multipoint calibration	Correlation coefficient (r) < 0.995	J for the positive results None for non-detects if reporting limit (RL) is detectable by instrument	All results for specific analyte(s) for all samples associated with the initial calibration
Calibration blank	Analyte concentration in sample < than five times method blank concentration	UB	The specific analyte(s) in all samples in the associated analytical batch.
	Analyte concentration in sample $\geq$ five times method blank concentration.	B	
Calibration verification standard	Control limit exceeded	J+ if high bias for the positive results None if high bias for non-detects	All results for specific analyte(s) in all samples since the last acceptable calibration verification
		J- if low bias for the positive results UJ if low bias for non-detects	
Interference check solution (ICS)	Control limit exceeded	R	All results for specific analyte(s) in all samples associated with the ICS
Dilution test	Control limit exceeded	J	Apply to parent sample results if the new matrix check was not run or relative percent difference $\geq$ 10%
Recovery test (GFAA methods)	Control limit exceeded	J	All samples in digestion batch if method of standard addition is not performed
Post digestion spike addition (ICP method)	Control limit exceeded	J	Parent sample results for specific analyte(s) for all samples associated with the post digestion spike addition
	% Recovery < 10%	R	

ICP Inductively coupled plasma  
GFAA Graphite furnace atomic absorption

## **FIGURES**

**FIGURE A8-1**

**EXAMPLE INORGANIC DATA VERIFICATION FORM**  
(Page 1 of 2)

**Analytical Method/Analytes:** \_\_\_\_\_ **Sample Collection Date(s):** \_\_\_\_\_

**Laboratory:** \_\_\_\_\_ **MW Job Number:** \_\_\_\_\_

**Batch Identification:** \_\_\_\_\_ **Matrix:** \_\_\_\_\_

**QC Identification<sup>(a)</sup>:** \_\_\_\_\_ **Page: 1 of** \_\_\_\_\_

**Validation Complete: (Signature and Date)** \_\_\_\_\_

	<b>Sample Identification</b>	<b>Lab Identification</b>	<b>Hits (Y/N)</b>	<b>Qualifications</b>	<b>Comments</b>
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

**FIGURE A8-1**

**EXAMPLE  
INORGANIC DATA VERIFICATION FORM  
(Page 2 of 2)**

**Analytical Method/Analytes:** \_\_\_\_\_

Page 2 of \_\_\_\_\_

**Laboratory:** \_\_\_\_\_

**Batch Identification:** \_\_\_\_\_

**QC Identification<sup>(a)</sup>:** \_\_\_\_\_

<b>Data Validation Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	
<b>Hardcopy vs. Chain of Custody</b>																					
Holding Time																					
Analyte List																					
Reporting Limits																					
Initial Calibration																					
Initial Check Blank (ICP & AA only)																					
Continuing Calibration																					
Continuing Check Blank (ICP & AA only)																					
Analysis Time																					
Interference Check Standard (ICP only)																					
ICP Serial Dilution																					
Method of Standard Additions (ICP & AA only)																					
Method Blank																					
Laboratory Control Sample																					
Laboratory Control Sample Duplicate (lab specific)																					
Matrix Spike/Matrix Spike Duplicate																					
Matrix Duplicate (lab specific)																					
Field Duplicate/Replicate																					
Equipment Rinseate Blanks																					
Filter Blanks																					
Electronic Deliverable vs. Hardcopy																					
Electronic Deliverable vs. Chain of Custody																					

- (a) List QC batch identification if different than Batch ID
- A indicates validation criteria were met
- X indicates validation criteria were not met
- N indicates data review were not a project-specific requirement
- N/A indicates criteria are not applicable for the specified analytical method

**ATTACHMENT 1**

**QUALITY CONTROL PROCEDURES  
FREQUENCY OF QC SAMPLE ANALYSIS AND ACCEPTANCE CRITERIA  
LABORATORY CORRECTIVE ACTION PROCEDURES**

TABLE 1-1a

METALS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY – SW-846 6020/EPA200.8  
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method <sup>(a)</sup>	Spiking Compounds	Accuracy <sup>(a)</sup>		Precision <sup>(a)</sup>	
		Percent Recovery (%)		(RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Duplicate<sup>(b)</sup></b>					
Metals—SW-846 6020/ EPA 200.8	Arsenic	70-130	70-130	20	20
	Barium	70-130	70-130	20	20
	Cadmium	70-130	70-130	20	20
	Chromium	70-130	70-130	20	20
	Lead	70-130	70-130	20	20
	Molybdenum	70-130	70-130	20	20
	Manganese	70-130	70-130	20	20
	Selenium	70-130	70-130	20	20
	Silver	70-130	70-130	20	20
	Vanadium	70-130	70-130	20	20
	Uranium	70-130	70-130	20	20
<b>Laboratory Control Sample</b>					
Metals—SW-846 6020/ EPA 200.8	Arsenic	85-115	85-115	NA	NA
	Barium	85-115	85-115	NA	NA
	Cadmium	85-115	85-115	NA	NA
	Chromium	85-115	85-115	NA	NA
	Lead	85-115	85-115	NA	NA
	Molybdenum	85-115	85-115	NA	NA
	Manganese	85-115	85-115	NA	NA
	Selenium	85-115	85-115	NA	NA
	Silver	85-115	85-115	NA	NA
	Vanadium	85-115	85-115	NA	NA
	Uranium	85-115	85-115	NA	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).

—EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

(b) RPD calculated between parent sample and matrix duplicate.

TABLE 1-1b

METALS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY - SW-846 6020/EPA 200.8  
CALIBRATION SPECIFICATION AND CORRECTIVE ACTION PROCEDURES

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 6020 Inductively Coupled Plasma/Mass Spectrometry (ICP/MS)	Metals	Instrument tune standard (5 replicate analysis )	Daily prior to analysis	%RSD $\leq$ 5% Resolution of low mass (Mg isotopes 24, 25, 26) and high mass (Pb isotopes 206, 207, 208) 0.75 atomic mass unit at 5% peak height; mass calibration $<$ 0.1 amu	<ul style="list-style-type: none"> <li>• Retune instrument</li> </ul>
		Initial calibration (ICAL) (1 point + blank minimum, use average of at least three integrations)	Daily prior to analysis	None	<ul style="list-style-type: none"> <li>• None</li> </ul>
		Continuing calibration verification (CCV)	After the ICAL	$\pm$ 10% ICAL	<ul style="list-style-type: none"> <li>• Recalibrate and continue analysis</li> </ul>
		Initial calibration blank (ICB)	Every 10 samples and end of run sequence	$\pm$ 15% ICAL	<ul style="list-style-type: none"> <li>• Recalibrate</li> <li>• Reanalyze all samples from last compliant CCV</li> </ul>
		Initial calibration verification (ICV) Internal Standards (IS)	After ICAL	All analytes $<$ Practical Quantitation Limit (PQL)	<ul style="list-style-type: none"> <li>• Recalibrate and continue analysis</li> </ul>
		Method blank	Every CCV, initial calibration blank, continuing calibration blank, and sample	$\pm$ 10% of ICAL	<ul style="list-style-type: none"> <li>• Recalibrate and continue analysis</li> <li>• Recalibrate and verify calibration</li> <li>• Flush instrument and reanalyze ICAL</li> <li>• Reanalyze affected samples</li> <li>• Flush instrument and reanalyze ICAL</li> <li>• Dilute sample 2x and reanalyze</li> <li>• Repeat until within limits</li> </ul>
		Matrix spike (MS)	1 per preparation batch ( $\leq$ 20 samples)	Recoveries 30-120% of ICAL	<ul style="list-style-type: none"> <li>• Reprep and analyze method blank and samples until criteria are met</li> </ul>
		Matrix duplicate (MD)	1 per preparation batch ( $\leq$ 20 samples)	10% or more of the sample analyte level or 2.2 times the method detection limit (MDL)	<ul style="list-style-type: none"> <li>• Assess data (<math>&lt;</math>30% rule)</li> <li>• Report and note outliers</li> </ul>
Laboratory control sample (LCS)	1 per preparation batch ( $\leq$ 20 samples)	Relative percent difference $<$ 20%	<ul style="list-style-type: none"> <li>• Assess data</li> <li>• Report and note outliers</li> </ul>		
					<ul style="list-style-type: none"> <li>• Reanalyze LCS</li> <li>• Reprep/reanalyze LCS and affected samples</li> <li>• Narrate all outliers</li> </ul>

a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).  
EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

TABLE 1-1c

METALS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROSCOPY – SW-846 6020/  
EPA200.8 REPORTING LIMITS

Analysis	Analytical Method <sup>(a)</sup>	Analyte	SPLP or TCLP Water		Soil	
			TCLP Regulatory Limit (mg/l)	RL (mg/l)	PRG (mg/kg)	RL (mg/kg)
Metals	SW-846 6020/ EPA 200.8	Arsenic	5.0	0.001	0.39	0.4
		Barium	100		NA	NA
		Cadmium	1.0	0.001	NA	NA
		Chromium	5.0	0.001	NA	NA
		Lead	5.0	0.001	NA	NA
		Molybdenum		0.001	390	0.5
		Selenium	1.0	0.001	390	0.3
		Silver	5.0	0.001	NA	NA
		Vanadium		0.005	78	1
		Uranium		0.0003	16	0.15

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).  
EPA Methods for the Determination of Inorganic Substances in Environmental Samples (EPA 100-400 Series) (EPA/600R-93/100, August 1993)

PRG Preliminary remediation goal

NA Not Applicable

**TABLE 1-2a**

**RADIUM-226 BY ALPHA AND GAMMA SPECTROMETRY – EPA 903.0 and 901.1  
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION**

<b>Analytical Method<sup>a</sup></b>	<b>Spiking Compounds</b>	<b>Accuracy Percent Recovery (%)</b>	<b>Precision RPD/(RER)<sup>b</sup></b>
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate	Radium-226	70-130	30%/<1.00
<b>Laboratory Control Sample</b>	Radium-226	70-130	NA

Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA/600/4-80-032, August, 1980)

NA not applicable

RPD relative percent difference

RER replicate error ratio (calculated between parent sample and matrix duplicate).

**TABLE 1-2b**

**RADIUM-226 BY ALPHA AND GAMMA SPECTROMETRY – EPA 903.0 and 901.1  
CALIBRATION SPECIFICATION AND CORRECTIVE ACTION SUMMARY**

<b>Analytical Method<sup>(a)</sup></b>	<b>Parameter</b>	<b>QC Element</b>	<b>Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
EPA 903.0 and 901.1	Radium-226	Method blank	1 per preparation batch (≤20 samples)	Result ≤ Reporting limit	Recount/reanalyze preparation blank and all associated samples or NCM and note in narrative, as appropriate
		Matrix spike	See chemical recovery below	60-140 percent (guidance limits)	If not in guidance limits, flag and note in narrative
		Matrix Duplicate	1 per preparation batch (≤20 samples)	RPD ≤ 40 percent RER ≤ 1.0 (for values >MDA)	Recount/reanalyze sample and duplicate, if not in control limits, reanalyze batch or flag and note in narrative, as appropriate
		LCS	1 per preparation batch (≤20 samples)	63-128 percent	Recount LCS, and if fails second time, reanalyze LCS and all associated samples or NCM and note in narrative, as appropriate

LCS = laboratory control sample  
MDA = minimum detectable activity  
RER = relative error ratio  
RPD = relative percent difference

TABLE 1-2c

**RADIUM-226 BY ALPHA AND GAMMA SPECTROMETRY – EPA 901.1 and 903.0 REPORTING LIMIT**

<b>Analytical Method<sup>a</sup></b>	<b>Analyte</b>	<b>SPLP Water RL (pCi/l)</b>	<b>Soil RL (pCi/g)</b>
EPA 901.1 and 903.0	Radium-226	0.1	0.5

a) Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA/600/4-80-032, August, 1980)

SPLP Synthetic precipitation leaching procedure

pCi/l picocuries per liter

pCi/g picocuries per gram

RL Reporting limit

TABLE 1-3a

**VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY – SW-846 8260B  
CONTROL CRITERIA FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES  
(Page 1 of 3)**

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Spike Duplicates</b>					
SW-846 8260B	1,1,1,2-Tetrachloroethane	70 - 130	70 - 130	20	20
	1,1,1-Trichloroethane	70 - 130	70 - 130	20	20
	1,1,2,2-Tetrachloroethane	70 - 130	70 - 130	20	20
	1,1,2-Trichloroethane	70 - 130	70 - 130	20	20
	1,1-Dichloroethane	70 - 130	70 - 130	20	20
	1,1-Dichloroethene	70 - 130	70 - 130	20	20
	1,1-Dichloropropene	70 - 130	70 - 130	20	20
	1,2,3-Trichlorobenzene	70 - 130	70 - 130	20	20
	1,2,3-Trichloropropane	70 - 130	70 - 130	20	20
	1,2,4-Trichlorobenzene	70 - 130	70 - 130	20	20
	1,2,4-Trimethylbenzene	70 - 130	70 - 130	20	20
	1,2-Dibromo-3-chloropropane	70 - 130	70 - 130	20	20
	1,2-Dibromoethane	70 - 130	70 - 130	20	20
	1,2-Dichlorobenzene	70 - 130	70 - 130	20	20
	1,2-Dichloroethane	70 - 130	70 - 130	20	20
	1,2-Dichloropropane	70 - 130	70 - 130	20	20
	1,3,5-Trimethylbenzene	70 - 130	70 - 130	20	20
	1,3-Dichlorobenzene	70 - 130	70 - 130	20	20
	1,3-Dichloropropane	70 - 130	70 - 130	20	20
	1,4-Dichlorobenzene	70 - 130	70 - 130	20	20
	2,2-Dichloropropane	70 - 130	70 - 130	20	20
	2-Chloroethyl vinyl ether	70 - 130	N/A	20	N/A
	2-Chlorotoluene	70 - 130	70 - 130	20	20
	4-Chlorotoluene	70 - 130	70 - 130	20	20
	Benzene	70 - 130	70 - 130	20	20
	Bromobenzene	70 - 130	70 - 130	20	20
	Bromochloromethane	70 - 130	70 - 130	20	20
	Bromodichloromethane	70 - 130	70 - 130	20	20
	Bromoform	70 - 130	70 - 130	20	20
	Bromomethane	70 - 130	70 - 130	20	20
	Carbon tetrachloride	70 - 130	70 - 130	20	20
	Chlorobenzene	70 - 130	70 - 130	20	20
	Chlorodibromomethane	70 - 130	70 - 130	20	20
	Chloroethane	70 - 130	70 - 130	20	20
	Chloroform	70 - 130	70 - 130	20	20
	Chloromethane	70 - 130	70 - 130	20	20
	cis-1,2-Dichloroethene	70 - 130	70 - 130	20	20
	cis-1,3-Dichloropropene	70 - 130	70 - 130	20	20
	Dibromomethane	70 - 130	70 - 130	20	20
	Dichlorodifluoromethane	70 - 130	70 - 130	20	20
	Ethylbenzene	70 - 130	70 - 130	20	20
	Hexachlorobutadiene	70 - 130	70 - 130	20	20
	Isopropylbenzene	70 - 130	70 - 130	20	20
	m+p-Xylenes	70 - 130	70 - 130	20	20
	Methyl ethyl ketone	70 - 130	70 - 130	20	20
	Methyl tert-butyl ether (MTBE)	70 - 130	70 - 130	20	20
	Methylene chloride	70 - 130	70 - 130	20	20
	n-Butylbenzene	70 - 130	70 - 130	20	20
	n-Propylbenzene	70 - 130	70 - 130	20	20
	Naphthalene	70 - 130	70 - 130	20	20
	o-Xylene	70 - 130	70 - 130	20	20
	p-Isopropyltoluene	70 - 130	70 - 130	20	20
	sec-Butylbenzene	70 - 130	70 - 130	20	20
	Styrene	70 - 130	70 - 130	20	20
	tert-Butylbenzene	70 - 130	70 - 130	20	20
	Tetrachloroethene	70 - 130	70 - 130	20	20

TABLE 1-3a

**VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY – SW-846 8260B  
CONTROL CRITERIA FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES  
(Page 2 of 3)**

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Spike Duplicates (continued)</b>					
	Toluene	70 - 130	70 - 130	20	20
	trans-1,2-Dichloroethene	70 - 130	70 - 130	20	20
	trans-1,3-Dichloropropene	70 - 130	70 - 130	20	20
	Trichloroethene	70 - 130	70 - 130	20	20
	Trichlorofluoromethane	70 - 130	70 - 130	20	20
	Vinyl chloride	70 - 130	70 - 130	20	20
	<b><u>Surrogate Spikes</u></b>				
	Toluene-d8	80 - 120	70 - 130	N/A	N/A
	Bromofluorobenzene	80 - 120	70 - 130	N/A	N/A
	1,2-Dichloroethane-d4	80 - 120	70 - 130	N/A	N/A
	Dibromofluoromethane	70 - 130	70 - 130	N/A	N/A
<b>Laboratory Control Sample</b>					
	1,1,1,2-Tetrachloroethane	70 - 130	70 - 130	N/A	N/A
	1,1,1-Trichloroethane	70 - 130	70 - 130	N/A	N/A
	1,1,2,2-Tetrachloroethane	70 - 130	70 - 130	N/A	N/A
	1,1,2-Trichloroethane	70 - 130	70 - 130	N/A	N/A
	1,1-Dichloroethane	70 - 130	70 - 130	N/A	N/A
	1,1-Dichloroethene	70 - 130	70 - 130	N/A	N/A
	1,1-Dichloropropene	70 - 130	70 - 130	N/A	N/A
	1,2,3-Trichlorobenzene	70 - 130	70 - 130	N/A	N/A
	1,2,3-Trichloropropane	70 - 130	70 - 130	N/A	N/A
	1,2,4-Trichlorobenzene	70 - 130	70 - 130	N/A	N/A
	1,2,4-Trimethylbenzene	70 - 130	70 - 130	N/A	N/A
	1,2-Dibromo-3-chloropropane	70 - 130	70 - 130	N/A	N/A
	1,2-Dibromoethane	70 - 130	70 - 130	N/A	N/A
	1,2-Dichlorobenzene	70 - 130	70 - 130	N/A	N/A
	1,2-Dichloroethane	70 - 130	70 - 130	N/A	N/A
	1,2-Dichloropropane	70 - 130	70 - 130	N/A	N/A
	1,3,5-Trimethylbenzene	70 - 130	70 - 130	N/A	N/A
	1,3-Dichlorobenzene	70 - 130	70 - 130	N/A	N/A
	1,3-Dichloropropane	70 - 130	70 - 130	N/A	N/A
	1,4-Dichlorobenzene	70 - 130	70 - 130	N/A	N/A
	2,2-Dichloropropane	70 - 130	70 - 130	N/A	N/A
	2-Chloroethyl vinyl ether	70 - 130	N/A	N/A	N/A
	2-Chlorotoluene	70 - 130	70 - 130	N/A	N/A
	4-Chlorotoluene	70 - 130	70 - 130	N/A	N/A
	Benzene	70 - 130	70 - 130	N/A	N/A
	Bromobenzene	70 - 130	70 - 130	N/A	N/A
	Bromochloromethane	70 - 130	70 - 130	N/A	N/A
	Bromodichloromethane	70 - 130	70 - 130	N/A	N/A
	Bromoform	70 - 130	70 - 130	N/A	N/A
	Bromomethane	70 - 130	70 - 130	N/A	N/A
	Carbon tetrachloride	70 - 130	70 - 130	N/A	N/A
	Chlorobenzene	70 - 130	70 - 130	N/A	N/A
	Chlorodibromomethane	70 - 130	70 - 130	N/A	N/A
	Chloroethane	70 - 130	70 - 130	N/A	N/A
	Chloroform	70 - 130	70 - 130	N/A	N/A
	Chloromethane	70 - 130	70 - 130	N/A	N/A
	cis-1,2-Dichloroethene	70 - 130	70 - 130	N/A	N/A
	cis-1,3-Dichloropropene	70 - 130	70 - 130	N/A	N/A
	Dibromomethane	70 - 130	70 - 130	N/A	N/A
	Dichlorodifluoromethane	70 - 130	70 - 130	N/A	N/A
	Ethylbenzene	70 - 130	70 - 130	N/A	N/A
	Hexachlorobutadiene	70 - 130	70 - 130	N/A	N/A
	Isopropylbenzene	70 - 130	70 - 130	N/A	N/A

TABLE 1-3a

**VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY – SW-846 8260B**  
**CONTROL CRITERIA FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES**  
 (Page 3 of 3)

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Laboratory Control Sample (continued)</b>					
	m+p-Xylenes	70 - 130	70 - 130	N/A	N/A
	Methyl ethyl ketone	70 - 130	70 - 130	N/A	N/A
	Methyl tert-butyl ether (MTBE)	70 - 130	70 - 130	N/A	N/A
	Methylene chloride	70 - 130	70 - 130	N/A	N/A
	n-Butylbenzene	70 - 130	70 - 130	N/A	N/A
	n-Propylbenzene	70 - 130	70 - 130	N/A	N/A
	Naphthalene	70 - 130	70 - 130	N/A	N/A
	o-Xylene	70 - 130	70 - 130	N/A	N/A
	p-Isopropyltoluene	70 - 130	70 - 130	N/A	N/A
	sec-Butylbenzene	70 - 130	70 - 130	N/A	N/A
	Styrene	70 - 130	70 - 130	N/A	N/A
	tert-Butylbenzene	70 - 130	70 - 130	N/A	N/A
	Tetrachloroethene	70 - 130	70 - 130	N/A	N/A
	Toluene	70 - 130	70 - 130	N/A	N/A
	trans-1,2-Dichloroethene	70 - 130	70 - 130	N/A	N/A
	trans-1,3-Dichloropropene	70 - 130	70 - 130	N/A	N/A
	Trichloroethene	70 - 130	70 - 130	N/A	N/A
	Trichlorofluoromethane	70 - 130	70 - 130	N/A	N/A
	Vinyl chloride	70 - 130	70 - 130	N/A	N/A
	<b><u>Surrogate Spikes</u></b>				
	Toluene-d8	80 - 120	70 - 130	N/A	N/A
	Bromofluorobenzene	80 - 120	70 - 130	N/A	N/A
	1,2-Dichloroethane-d4	80 - 120	70 - 130	N/A	N/A
	Dibromofluoromethane	70 - 130	70 - 130	N/A	N/A

N/A Not applicable

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).
- (b) Quality control limits provided by Energy Laboratories.

TABLE 1-3b

**VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY – SW-846 8260B  
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY**

(Page 1 of 2)

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846, 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry	Volatile Organic Compounds	Tune instrument with a 4-bromofluorobenzene standard (BFB)	Every 12 hours	<ul style="list-style-type: none"> <li>• Must meet key ions and ion abundance criteria established by method (Refer to Table 1-1-d)</li> </ul>	<ul style="list-style-type: none"> <li>• Retune instrument</li> <li>• Repeat standard analysis</li> </ul>
		Initial multi-point calibration; 5 point minimum. Lowest point at or below reporting limit (RL). Includes calibration check compounds (CCC) and system performance check compounds (SPCC), and Internal Standards Compounds (IS).	Prior to analysis, and as required	<ul style="list-style-type: none"> <li>• RSD &lt; 30 % for CCC; Average RF <math>\geq</math> 0.1 for SPCC (<math>\geq</math>0.3 for chlorobenzene, 1,1,2,2-Tetrachloroethane)</li> <li>• If % RSD &lt; 15%, average RF may be used; RF &gt; 0.01 for all target analytes</li> <li>• If linear regression used <math>r &gt; 0.995</math> or <math>r^2 &gt; 0.990</math></li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate system</li> <li>• Repeat calibration</li> </ul>
		Initial calibration verification (ICV), second source	Every five point calibration curve	<ul style="list-style-type: none"> <li>• % Recovery <math>\pm</math> 20%</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate system</li> <li>• Repeat calibration</li> </ul>
		Continuing verification standard (CVS): CCC, SPCC, and IS	Every 12 hours	<ul style="list-style-type: none"> <li>• Percent difference &lt;20% for CCC; RF <math>\geq</math>0.1 for SPCC (<math>\geq</math>0.3 for chlorobenzene and 1,1,2,2-Tetrachloroethane).</li> <li>• %D or %Drift &lt; 20% for all target analytes</li> <li>• Retention time for each internal standard must be within 30 seconds of most recent ICAL and the EICP area for all internal standards must be within -50% to +100% of the most recent ICAL.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate system/standard</li> <li>• Reanalyze calibration check standard</li> <li>• Repeat initial calibration</li> <li>• Repeat all sample analysis to last acceptable CVS</li> </ul>
		Method blank	1 per preparation batch ( $\leq$ 20 samples)	<ul style="list-style-type: none"> <li>• &lt; ½ RL</li> </ul>	<ul style="list-style-type: none"> <li>• Reanalyze method blank</li> <li>• Reanalyze samples to last acceptable method blank</li> </ul>

TABLE A-1b

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY – SW-846 8260B  
 CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY  
 (Page 2 of 2)

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846, 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (continued)	Volatile Organic Compounds	Internal standards	Every sample, method blank, LCS, and MS/MSD	<ul style="list-style-type: none"> <li>Retention time for each internal standard must be within 30 seconds of most recent CVS and the EICP area for all internal standards must be within -50% to +100% of the most recent CVS</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate system/standard</li> <li>Reanalyze samples once</li> <li>Reprep/reanalyze once</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Surrogate spike	Every sample, method blank, LCS, MS/MSD	<ul style="list-style-type: none"> <li>Surrogate recoveries within QC acceptance criteria. (Refer to Table 1-1a)</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze sample once</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>Percent recovery within QC acceptance criteria (Refer to Table 1-1a)</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze sample once</li> <li>Reprep/reanalyze MS</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>% Recovery and/or RPD within QC acceptance criteria (Refer to Table 1-1a)</li> </ul>	<ul style="list-style-type: none"> <li>Same as MS</li> </ul>
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>% Recovery within QC acceptance criteria (Refer to Table 1-1a)</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze LCS</li> <li>Reprep/reanalyze LCS and all associated samples</li> <li>Narrate all outliers</li> </ul>

EICP    Extracted ion current profile                      QC    Quality control                      RF    Response factor                      RPD    Relative percent difference  
 RSD    Relative Standard Deviation

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

TABLE 1-3c

**VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846  
8260B REPORTING LIMITS**

(Page 1 of 2)

Analysis	Analytical Method <sup>(a)</sup>	Analyte	Reporting Limits <sup>(b)</sup>	
			Water (µg/l)	Soil (µg/kg)
Volatile Organic Compounds	SW-846 8260B	1,1,1,2-Tetrachloroethane	1	2
		1,1,1-Trichloroethane	1	2
		1,1,2,2-Tetrachloroethane	1	2
		1,1,2-Trichloroethane	1	2
		1,1-Dichloroethane	1	2
		1,1-Dichloroethene	1	2
		1,1-Dichloropropene	1	2
		1,2,3-Trichlorobenzene	1	2
		1,2,3-Trichloropropane	1	2
		1,2,4-Trichlorobenzene	1	2
		1,2,4-Trimethylbenzene	1	2
		1,2-Dibromo-3-chloropropane	1	2
		1,2-Dibromoethane	1	2
		1,2-Dichlorobenzene	1	2
		1,2-Dichloroethane	1	2
		1,2-Dichloropropane	1	2
		1,3,5-Trimethylbenzene	1	2
		1,3-Dichlorobenzene	1	2
		1,3-Dichloropropane	1	2
		1,4-Dichlorobenzene	1	2
		2,2-Dichloropropane	1	2
		2-Chloroethyl vinyl ether	1	N/A
		2-Chlorotoluene	1	2
		4-Chlorotoluene	1	2
		Benzene	1	2
		Bromobenzene	1	2
		Bromochloromethane	1	2
		Bromodichloromethane	1	2
		Bromoform	1	2
		Bromomethane	1	2
		Carbon tetrachloride	1	2
		Chlorobenzene	1	2
		Chlorodibromomethane	1	2
		Chloroethane	1	2
		Chloroform	1	2
		Chloromethane	1	2
		cis-1,2-Dichloroethene	1	2
		cis-1,3-Dichloropropene	1	2
		Dibromomethane	1	2
		Dichlorodifluoromethane	1	2
Ethylbenzene	1	2		
Hexachlorobutadiene	1	2		
Isopropylbenzene	1	2		
m+p-Xylenes	1	2		
Methyl ethyl ketone	20	20		
Methyl tert-butyl ether (MTBE)	2	2		

TABLE 1-3c

**VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846  
8260B REPORTING LIMITS**

(Page 2 of 2)

Analysis	Analytical Method <sup>(a)</sup>	Analyte	Reporting Limits <sup>(b)</sup>	
			Water (µg/l)	Soil (µg/kg)
Volatile Organic Compounds (continued)	SW-846 8260B	Methylene chloride	1	2
		n-Butylbenzene	1	2
		n-Propylbenzene	1	2
		Naphthalene	1	2
		o-Xylene	1	2
		p-Isopropyltoluene	1	2
		sec-Butylbenzene	1	2
		Styrene	1	2
		tert-Butylbenzene	1	2
		Tetrachloroethene	1	2
		Toluene	1	2
		trans-1,2-Dichloroethene	1	2
		trans-1,3-Dichloropropene	1	2
		Trichloroethene	1	2
		Trichlorofluoromethane	1	2
Vinyl chloride	1	2		

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

(b) Reporting limits provide by Energy Laboratories.

**TABLE 1-3d****VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY –  
SW-846 8260B  
4-BROMOFLUOROBENZENE (BFB) MASS INTENSITY CRITERIA**

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<b>Mass</b>	<b>Required Intensity (relative abundance)</b>
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5 to 9% of mass 174
176	Greater than 95%, but less than 101% of mass 174
177	5 to 9% of mass 176

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EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

TABLE 1-4a

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8270C  
 CONTROL LIMITS FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES  
 (Page 1 of 3)

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Spike Duplicates</b>					
SW-846 8270C	1,2,4-Trichlorobenzene	43-82	70 - 130	40	20
	1,2-Dichlorobenzene	37-77	70 - 130	40	20
	1,3-Dichlorobenzene	28-77	70 - 130	40	20
	1,4-Dichlorobenzene	38-74	70 - 130	40	20
	1-Methylnaphthalene	30-130	30 - 130	40	40
	2,4,5-Trichlorophenol	47-96	34 - 123	40	40
	2,4,6-Trichlorophenol	47-96	34 - 123	40	40
	2,4-Dichlorophenol	40-90	32 - 110	40	40
	2,4-Dimethylphenol	28-86	31 - 95	40	40
	2,4-Dinitrophenol	10-132	10 - 122	40	40
	2,4-Dinitrotoluene	60-102	47 - 118	40	40
	2,6-Dinitrotoluene	59-100	50 - 115	40	40
	2-Chloronaphthalene	52-89	53 - 98	40	40
	2-Chlorophenol	39-78	30 - 104	40	40
	2-Methylnaphthalene	30-130	30 - 130	40	40
	2-Nitrophenol	44-87	35 - 97	40	40
	3,3'-Dichlorobenzidine	70-130	70 - 130	40	40
	4,6-Dinitro-2-methylphenol	24-123	10 - 121	40	40
	4-Bromophenyl phenyl ether	51-105	54 - 108	40	40
	4-Chloro-3-methylphenol	50-94	41 - 116	40	40
	4-Chlorophenol	70-130	70 - 130	40	40
	4-Chlorophenyl phenyl ether	54-98	49 - 110	40	40
	4-Nitrophenol	10-95	19 - 120	40	40
	Acenaphthene	53-101	51 - 112	40	40
	Acenaphthylene	50-94	45 - 108	40	40
	Anthracene	52-109	51 - 114	40	40
	Azobenzene	10-227	10 - 227	40	40
	Benzidine	70-130	70 - 130	40	40
	Benzo(a)anthracene	57-115	53 - 119	40	40
	Benzo(a)pyrene	44-122	48 - 121	40	40
	Benzo(b)fluoranthene	54-120	48 - 122	40	40
	Benzo(g,h,i)perylene	43-121	46 - 116	40	40
	Benzo(k)fluoranthene	48-118	47 - 121	40	40
	bis(-2-chloroethoxy)Methane	45-102	29 - 121	40	40
	bis(-2-chloroethyl)Ether	13-122	20 - 116	40	40
	bis(2-chloroisopropyl)Ether	40-90	33 - 103	40	40
	bis(2-ethylhexyl)Phthalate	47-128	52 - 120	40	40
	Butylbenzylphthalate	45-130	50 - 121	40	40
	Chrysene	54-122	53 - 124	40	40
	Di-n-butyl phthalate	51-114	50 - 113	40	40
	Di-n-octyl phthalate	45-134	50 - 128	40	40
	Dibenzo(a,h)anthracene	39-120	41 - 118	40	40
	Diethyl phthalate	51-108	50 - 111	40	40
	Dimethyl phthalate	53-106	51 - 112	40	40
	Fluoranthene	50-121	54 - 119	40	40
	Fluorene	54-101	53 - 109	40	40
	Hexachlorobenzene	49-101	43 - 114	40	40
	Hexachlorobutadiene	38-94	70 - 130	40	20
	Hexachlorocyclopentadiene	17-93	21 - 98	40	40
	Hexachloroethane	43-76	31 - 106	40	40
	Indeno(1,2,3-cd)pyrene	43-125	24 - 130	40	40
	Isophorone	51-100	24 - 130	40	40
	m+p-Cresols	70-130	30 - 130	40	40
	n-Nitroso-di-n-propylamine	30-116	10 - 139	40	40
	n-Nitrosodimethylamine	12-78	17 - 109	40	40
	n-Nitrosodiphenylamine	47-109	26 - 118	40	40

TABLE 1-4a

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8270C  
 CONTROL LIMITS FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES  
 (Page 2 of 3)

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Spike Duplicates (continued)</b>					
	Naphthalene	47-109	70 - 130	40	20
	Nitrobenzene	47-87	21 - 123	40	40
	o-Cresol	70-130	30 - 130	40	40
	Pentachlorophenol	16-117	10 - 114	40	40
	Phenanthrene	52-108	57 - 109	40	40
	Phenol	10-78	22 - 115	40	40
	Pyrene	56-116	59 - 117	40	40
	Pyridine	20-130	20 - 130	40	40
	<b><u>Surrogate Spikes</u></b>				
	Nitrobenzene-d5	35 - 114	23 - 120	N/A	N/A
	2-Fluorobiphenyl	43 - 116	30 - 115	N/A	N/A
	Terphenyl-d14	33 - 141	13 - 137	N/A	N/A
	Phenol-d5	10 - 94	21 - 112	N/A	N/A
	2-Fluorophenol	21 - 100	21 - 121	N/A	N/A
	2,4,6-Tribromophenol	10 - 123	19 - 122	N/A	N/A
<b>Laboratory Control Sample</b>					
	1,2,4-Trichlorobenzene	43-82	70 - 130	N/A	N/A
	1,2-Dichlorobenzene	37-77	70 - 130	N/A	N/A
	1,3-Dichlorobenzene	28-77	70 - 130	N/A	N/A
	1,4-Dichlorobenzene	38-74	70 - 130	N/A	N/A
	1-Methylnaphthalene	30-130	30 - 130	N/A	N/A
	2,4,5-Trichlorophenol	47-96	34 - 123	N/A	N/A
	2,4,6-Trichlorophenol	47-96	34 - 123	N/A	N/A
	2,4-Dichlorophenol	40-90	32 - 110	N/A	N/A
	2,4-Dimethylphenol	28-86	31 - 95	N/A	N/A
	2,4-Dinitrophenol	10-132	10 - 122	N/A	N/A
	2,4-Dinitrotoluene	60-102	47 - 118	N/A	N/A
	2,6-Dinitrotoluene	59-100	50 - 115	N/A	N/A
	2-Chloronaphthalene	52-89	53 - 98	N/A	N/A
	2-Chlorophenol	39-78	30 - 104	N/A	N/A
	2-Methylnaphthalene	30-130	30 - 130	N/A	N/A
	2-Nitrophenol	44-87	35 - 97	N/A	N/A
	3,3'-Dichlorobenzidine	70-130	70 - 130	N/A	N/A
	4,6-Dinitro-2-methylphenol	24-123	10 - 121	N/A	N/A
	4-Bromophenyl phenyl ether	51-105	54 - 108	N/A	N/A
	4-Chloro-3-methylphenol	50-94	41 - 116	N/A	N/A
	4-Chlorophenol	70-130	70 - 130	N/A	N/A
	4-Chlorophenyl phenyl ether	54-98	49 - 110	N/A	N/A
	4-Nitrophenol	10-95	19 - 120	N/A	N/A
	Acenaphthene	53-101	51 - 112	N/A	N/A
	Acenaphthylene	50-94	45 - 108	N/A	N/A
	Anthracene	52-109	51 - 114	N/A	N/A
	Azobenzene	10-227	10 - 227	N/A	N/A
	Benzidine	70-130	70 - 130	N/A	N/A
	Benzo(a)anthracene	57-115	53 - 119	N/A	N/A
	Benzo(a)pyrene	44-122	48 - 121	N/A	N/A
	Benzo(b)fluoranthene	54-120	48 - 122	N/A	N/A
	Benzo(g,h,i)perylene	43-121	46 - 116	N/A	N/A
	Benzo(k)fluoranthene	48-118	47 - 121	N/A	N/A
	Bis(-2-chloroethoxy)Methane	45-102	29 - 121	N/A	N/A
	bis(-2-chloroethyl)Ether	13-122	20 - 116	N/A	N/A
	bis(2-chloroisopropyl)Ether	40-90	33 - 103	N/A	N/A
	bis(2-ethylhexyl)Phthalate	47-128	52 - 120	N/A	N/A
	Butylbenzylphthalate	45-130	50 - 121	N/A	N/A
	Chrysene	54-122	53 - 124	N/A	N/A

TABLE 1-4a

**SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8270C  
CONTROL LIMITS FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY CONTROL SAMPLES  
(Page 3 of 3)**

Analytical Method <sup>(a)</sup>	Spiking Compounds	Control Limits <sup>(b)</sup>			
		Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Laboratory Control Sample (continued)</b>					
	Di-n-butyl phthalate	51-114	50 - 113	N/A	N/A
	Di-n-octyl phthalate	45-134	50 - 128	N/A	N/A
	Dibenzo(a,h)anthracene	39-120	41 - 118	N/A	N/A
	Diethyl phthalate	51-108	50 - 111	N/A	N/A
	Dimethyl phthalate	53-106	51 - 112	N/A	N/A
	Fluoranthene	50-121	54 - 119	N/A	N/A
	Fluorene	54-101	53 - 109	N/A	N/A
	Hexachlorobenzene	49-101	43 - 114	N/A	N/A
	Hexachlorobutadiene	38-94	70 - 130	N/A	N/A
	Hexachlorocyclopentadiene	17-93	21 - 98	N/A	N/A
	Hexachloroethane	43-76	31 - 106	N/A	N/A
	Indeno(1,2,3-cd)pyrene	43-125	24 - 130	N/A	N/A
	Isophorone	51-100	24 - 130	N/A	N/A
	m+p-Cresols	70-130	30 - 130	N/A	N/A
	n-Nitroso-di-n-propylamine	30-116	10 - 139	N/A	N/A
	n-Nitrosodimethylamine	12-78	17 - 109	N/A	N/A
	n-Nitrosodiphenylamine	47-109	26 - 118	N/A	N/A
	Naphthalene	47-109	70 - 130	N/A	N/A
	Nitrobenzene	47-87	21 - 123	N/A	N/A
	o-Cresol	70-130	30 - 130	N/A	N/A
	Pentachlorophenol	16-117	10 - 114	N/A	N/A
	Phenanthrene	52-108	57 - 109	N/A	N/A
	Phenol	10-78	22 - 115	N/A	N/A
	Pyrene	56-116	59 - 117	N/A	N/A
	Pyridine	20-130	20 - 130	N/A	N/A
	<b><u>Surrogate Spikes</u></b>				
	Nitrobenzene-d5	35 - 114	23 - 120	N/A	N/A
	2-Fluorobiphenyl	43 - 116	30 - 115	N/A	N/A
	Terphenyl-d14	33 - 141	13 - 137	N/A	N/A
	Phenol-d5	10 - 94	21 - 112	N/A	N/A
	2-Fluorophenol	21 - 100	21 - 121	N/A	N/A
	2,4,6-Tribromophenol	10 - 123	19 - 122	N/A	N/A

N/A Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

(b) Quality control limits provided by Energy Laboratories.

TABLE 1-4b

**SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8270C  
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY  
(Page 1 of 2)**

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C Semi-Volatiles by GC/MS	Semi-Volatiles	Tune the instrument using a decafluorotriphenylphosine (DFTPP) standard	Every 12 hours	<ul style="list-style-type: none"> <li>Must meet the ion abundance criteria specified in the method (Refer to Table A-2d)</li> <li>Degradation of DDT <math>\leq 20\%</math></li> <li>Benzidine and PCP present at normal response without excessive tailing</li> </ul>	<ul style="list-style-type: none"> <li>Retune instrument</li> <li>Repeat standard analysis</li> <li>Perform injection port, column maintenance as necessary</li> </ul>
		Initial multi-point calibration; 5 point minimum. Lowest point at or below reporting limit (RL). Includes calibration check compounds (CCC) and system performance check compounds (SPCC), and Internal Standards Compounds (IS).	Prior to analysis and as required	<ul style="list-style-type: none"> <li>% RSD for CCC <math>\leq 30\%</math>; average RF <math>\geq 0.05</math> for SPCC</li> <li>If % RSD <math>\leq 15\%</math> average RF may be used; RF <math>\geq 0.01</math> for target analytes</li> <li>If linear regression used <math>r &gt; 0.995</math> or <math>r^2 &gt; 0.990</math></li> </ul>	<ul style="list-style-type: none"> <li>Evaluate the system</li> <li>Repeat calibration</li> </ul>
		Initial calibration verification (ICV), second source	One per five point calibration curve	<ul style="list-style-type: none"> <li>%Recovery <math>\pm 30\%</math></li> </ul>	<ul style="list-style-type: none"> <li>Evaluate the system</li> <li>Repeat calibration</li> </ul>
		Continuing verification standard (CVS); includes CCC, SPCC, and IS	Every 12 hours	<ul style="list-style-type: none"> <li>RF <math>\geq 0.05</math> for SPCC</li> <li>%D or %Drift <math>&lt; 20\%</math> for CCCs and all target analytes</li> <li>EICP area of each internal standard -50% to +100% of all IS areas in most recent ICAL</li> <li>Retention time for each internal standard must be within 30 seconds of most recent ICAL</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate system/standard</li> <li>Reanalyze calibration check standard</li> <li>Repeat the initial calibration as necessary</li> <li>Reanalyze samples back to last acceptable CVS</li> </ul>

TABLE 1-2b

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY-METHOD SW-846 8270C  
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY

(Page 2 of 2)

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C Semi-Volatiles by GCMS (continued)	Semi-Volatiles	Internal Standard	Every sample, method blank, LCS, and MS/MSD	<ul style="list-style-type: none"> <li>The EICP area for all internal standards must be within -50% and +100% of most recent CVS</li> <li>Retention time for each internal standard must be within 30 seconds of most recent CVS</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate system/standard</li> <li>Reanalyze samples once</li> <li>Reprep/reanalyze once</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Method Blank	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>&lt; ½ RL</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze blank</li> <li>Reprep/reanalyze all associated samples</li> </ul>
		Surrogate spike	Every sample, method blank, LCS and MS/MSD	<ul style="list-style-type: none"> <li>Recovery within acceptance criteria (Refer to Table A-2a)</li> <li>One surrogate per fraction may be out if recovery &gt; 10%</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze sample once</li> <li>Reprep/reanalyze sample</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>% Recovery within QC acceptance criteria (Refer to Table 1-2a)</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze sample once</li> <li>Reprep/reanalyze MS</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>% Recovery and/or RPD within QC acceptance criteria (Refer to Table 1-2a)</li> </ul>	<ul style="list-style-type: none"> <li>Same as MS</li> </ul>
		Laboratory control sample	1 per preparation batch (≤20 samples)	<ul style="list-style-type: none"> <li>% Recovery within project QC acceptance criteria for all spiked analytes (Refer to Table 1-2a)</li> </ul>	<ul style="list-style-type: none"> <li>Reanalyze LCS</li> <li>Reprep/reanalyze LCS and all associated samples</li> <li>Narrate all outliers</li> </ul>

EICP    Extracted ion current profile                    QC    Quality control                    RF    Response factor                    RPD    Relative percent difference  
RSD    Relative standard deviation  
(a)    EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996)

TABLE 1-4c

**SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/  
MASS SPECTROMETRY – SW 846 8270C  
REPORTING LIMITS  
(Page 1 of 2)**

Analysis	Analytical Method <sup>(a)</sup>	Analyte	Reporting Limits <sup>(b)</sup>	
			Water (µg/l)	Soil (µg/kg)
Semi-Volatile Organic Compounds	SW-846 8270C	1,2,4-Trichlorobenzene	10	2
		1,2-Dichlorobenzene	10	2
		1,3-Dichlorobenzene	10	2
		1,4-Dichlorobenzene	10	2
		1-Methylnaphthalene	10	330
		2,4,5-Trichlorophenol	10	330
		2,4,6-Trichlorophenol	10	330
		2,4-Dichlorophenol	10	330
		2,4-Dimethylphenol	10	330
		2,4-Dinitrophenol	50	1670
		2,4-Dinitrotoluene	10	330
		2,6-Dinitrotoluene	10	330
		2-Chloronaphthalene	10	330
		2-Chlorophenol	10	330
		2-Methylnaphthalene	10	330
		2-Nitrophenol	10	330
		3,3'-Dichlorobenzidine	20	667
		4,6-Dinitro-2-methylphenol	50	1670
		4-Bromophenyl phenyl ether	10	330
		4-Chloro-3-methylphenol	10	330
		4-Chlorophenol	10	330
		4-Chlorophenyl phenyl ether	10	330
		4-Nitrophenol	50	1670
		Acenaphthene	10	330
		Acenaphthylene	10	330
		Anthracene	10	330
		Azobenzene	10	330
		Benzidine	20	667
		Benzo(a)anthracene	10	330
		Benzo(a)pyrene	10	330
		Benzo(b)fluoranthene	10	330
		Benzo(g,h,i)perylene	10	330
		Benzo(k)fluoranthene	10	330
		bis(-2-chloroethoxy)Methane	10	330
		bis(-2-chloroethyl)Ether	10	330
		bis(2-chloroisopropyl)Ether	10	330
bis(2-ethylhexyl)Phthalate	10	330		
Butylbenzylphthalate	10	330		
Chrysene	10	330		
Di-n-butyl phthalate	10	330		
Di-n-octyl phthalate	10	330		
Dibenzo(a,h)anthracene	10	330		
Diethyl phthalate	10	330		
Dimethyl phthalate	10	330		
Fluoranthene	10	330		

TABLE 1-4c

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/  
 MASS SPECTROMETRY – SW 846 8270C  
 REPORTING LIMITS  
 (Page 2 of 2)

Analysis	Analytical Method <sup>(a)</sup>	Analyte	Reporting Limits <sup>(b)</sup>	
			Water (µg/l)	Soil (µg/kg)
Semi-Volatile Organic Compounds (continued)	SW-846 8270C	Fluorene	10	330
		Hexachlorobenzene	10	330
		Hexachlorobutadiene	10	2
		Hexachlorocyclopentadiene	20	670
		Hexachloroethane	10	330
		Indeno(1,2,3-cd)pyrene	10	330
		Isophorone	10	330
		m+p-Cresols	10	330
		n-Nitroso-di-n-propylamine	10	330
		n-Nitrosodimethylamine	10	330
		n-Nitrosodiphenylamine	10	330
		Naphthalene	10	2
		Nitrobenzene	10	330
		o-Cresol	10	330
		Pentachlorophenol	50	1670
		Phenanthrene	10	330
		Phenol	10	330
Pyrene	10	330		
Pyridine	10	670		

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).
- (b) Reporting limits provide by Energy Laboratories.

**TABLE 1-4d**

**SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS  
SPECTROMETERY - SW-846 8270C  
DECAFLUOROTRIPHENYL PHOSPHINE (DFTPP) KEY IONS  
AND ION ABUNDANCE CRITERIA**

<b>Mass</b>	<b>Ion Abundance Criteria</b>
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present, but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

TABLE 1-5a

MERCURY BY COLD VAPOR ATOMIC ADSORPTION  
 CONTROL LIMITS FOR MATRIX SPIKE, MATRIX SPIKE DUPLICATE, AND LABORATORY  
 CONTROL SAMPLES

Analytical Method <sup>(a)</sup>	Spiking Compounds	Accuracy Percent Recovery (%)		Precision (RPD %)	
		Water	Soil	Water	Soil
<b>Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate</b>					
SW-846 7470A/7471A	Mercury	75-125	75-125	25	25
<b>Laboratory Control Sample</b>					
SW-846 7470A/7471A	Mercury	80-120	80-120	NA	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

**TABLE 1-5b**

**MERCURY BY COLD VAPOR ANALYSIS – METHOD SW-846 7470A/7471A  
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY  
(Page 1 of 2)**

<b>Analytical Method<sup>(a)</sup></b>	<b>Parameter</b>	<b>QC Element</b>	<b>Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
SW-846 7470A/7471A Cold Vapor	Mercury	Initial multipoint calibration (5 point + blank minimum)	Daily, prior to analysis	Correlation coefficient (r) $\geq 0.995$	<ul style="list-style-type: none"> <li>Recalibrate</li> </ul>
		Initial calibration verification (ICV), second source; mid-level standard	After calibration, prior to sample analysis	$\pm 10\%$ of true value	<ul style="list-style-type: none"> <li>Reanalyze ICV</li> <li>Rerun initial calibration</li> </ul>
		Continuing verification standard (CVS); mid-level standard	Every 10 samples and at end of analytical sequence	$\pm 20\%$ of true value	<ul style="list-style-type: none"> <li>Reanalyze affected samples back to last acceptable CVS</li> </ul>
		Initial and continuing calibration blank (ICB/CCB)	After calibration, and after each subsequent calibration verification	< Method Detection Limit (MDL)	<ul style="list-style-type: none"> <li>Reanalyze blank</li> <li>Clean system if still out</li> <li>Reanalyze affected samples back to last acceptable CCB</li> </ul>
		Method blank	1 per preparation batch ( $\leq 20$ samples)	< $\frac{1}{2}$ Reporting limit (RL)	<ul style="list-style-type: none"> <li>Reanalyze method blank</li> <li>If fails, analyze a calibration blank</li> <li>Reprep/reanalyze analytical batch as appropriate</li> </ul>
		Matrix spike (MS)	1 per preparation batch ( $\leq 20$ samples)	% Recovery within $\pm 25\%$ of true value	<ul style="list-style-type: none"> <li>Use method of standards addition to compensate for matrix interferences</li> <li>Rerun sample once</li> <li>If still out, report both sets of data</li> <li>Narrate all outliers</li> </ul>
		Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch ( $\leq 20$ samples)	RPD < 20%	<ul style="list-style-type: none"> <li>Same as MS</li> </ul>
Post digestion spike	1 per preparation batch ( $\leq 20$ samples) using MS sample	% Recovery $\pm 15\%$ of actual value	<ul style="list-style-type: none"> <li>Same as MS</li> </ul>		
Laboratory control samples (LCS)	1 per preparation batch ( $\leq 20$ samples)	% Recovery within $\pm 20\%$	<ul style="list-style-type: none"> <li>Reanalyze LCS</li> <li>Reprep/reanalyze LCS and affected samples</li> <li>Narrate all outliers</li> </ul>		

TABLE 1-13b

MERCURY BY COLD VAPOR ANALYSIS – METHOD SW-846 7470A/7471A  
 CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY  
 (Page 2 of 2)

Analytical Method <sup>(a)</sup>	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A/7471A Cold Vapor, continued	Mercury	Serial dilution <sup>(b)</sup>	1 per preparation batch (≤20 samples)	% Difference +/- 10% for analytes greater than RL when diluted 5 times	<ul style="list-style-type: none"> <li>J flag associated analyte as estimated</li> </ul>

MDL Method detection limit  
 RPD Relative percent difference

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).  
 (b) Optional element.

TABLE 1-5c

MERCURY COLD VAPOR ANALYSIS – METHOD SW-846 7470A/7471A  
METHOD DETECTION AND REPORTING LIMITS

Analysis	Analytical Method <sup>(a)</sup>	Analyte	Reporting Limits		
			Water (mg/l)	TCLP (mg/l)	Soil (mg/kg)
Metals	SW-846 7470A/7471A	Mercury		0.02	0.05

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996).

**ATTACHMENT 2**

**ENERGY LABORATORIES  
QUALITY MANAGEMENT PLAN**