

**FINAL**

**QUALITY ASSURANCE PROJECT PLAN**

**FOR THE EMPIRE MINE STATE HISTORIC PARK**  
**2006 PRIORITY ACTION WORK PLANS**  
**GRASS VALLEY, CALIFORNIA**

**JULY 2006**

*Prepared by:*

**MFG, INC.**  
consulting scientists and engineers

3801 Automation Way, Suite 100  
Fort Collins, Colorado 80525  
(970) 223-9600  
Fax: (970) 223-7171

MFG Project No. 180156/102

## TABLE OF CONTENTS

|             |  |           |
|-------------|--|-----------|
| <b>1.0</b>  | <b>INTRODUCTION .....</b>                                  | <b>1</b>  |
| <b>2.0</b>  | <b>PROJECT/TASK ORGANIZATION AND RESPONSIBILITIES.....</b> | <b>2</b>  |
| <b>3.0</b>  | <b>DATA QUALITY OBJECTIVES AND CRITERIA.....</b>           | <b>5</b>  |
| 3.1         | Precision.....   | 5         |
| 3.2         | Accuracy .....   | 6         |
| 3.3         | Completeness .....   | 6         |
| <b>4.0</b>  | <b>SAMPLING PROCESS DESIGN .....</b>                       | <b>8</b>  |
| 4.1         | Sampling Methods .....                                     | 8         |
| 4.2         | Sample Containers, Preservation and Holding Times .....    | 8         |
| 4.3         | Field Sample Handling and Custody .....                    | 9         |
| 4.4         | Laboratory Sample Handling and Custody.....                | 11        |
| <b>5.0</b>  | <b>DOCUMENTS AND RECORDS .....</b>                         | <b>12</b> |
| 5.1         | Field Operation Records .....                              | 12        |
| 5.2         | Laboratory Records.....                                    | 12        |
| <b>6.0</b>  | <b>CALIBRATION PROCEDURES .....</b>                        | <b>13</b> |
| 6.1         | Field Instruments and Equipment .....                      | 13        |
| 6.2         | Laboratory Instruments .....                               | 13        |
| <b>7.0</b>  | <b>ANALYTICAL PROCEDURES .....</b>                         | <b>14</b> |
| <b>8.0</b>  | <b>QUALITY CONTROL.....</b>                                | <b>15</b> |
| 8.1         | Field Quality Control.....                                 | 15        |
| 8.2         | Laboratory Quality Control .....                           | 15        |
| <b>9.0</b>  | <b>DATA REPORTING, VALIDATION AND MANAGEMENT .....</b>     | <b>17</b> |
| 9.1         | Data Reporting Format .....                                | 17        |
| 9.2         | Data Review and Validation .....                           | 18        |
| 9.3         | Data Management.....                                       | 19        |
| <b>10.0</b> | <b>CORRECTIVE ACTIONS .....</b>                            | <b>20</b> |

## TABLES

|         |   |
|---------|---|
| Table 1 | Summary of Quality Control Limits for Analyses                  |
| Table 2 | Sample Holding Times, Volume Requirements and Preservation      |
| Table 3 | Sample Analysis Parameters, Methods and Method Detection Limits |

## **1.0 INTRODUCTION**

This Quality Assurance Project Plan (QAPP) was developed to assure that the data collected at the Empire Mine State Historic Park (SHP) meets appropriate Data Quality Objectives (DQOs), and to describe the policies and procedures for data collection and evaluation activities associated with the corresponding work plans. A summary of the site description, background, and objectives for any anticipated sampling can be found in the corresponding work plans.

The data collected through implementation of the Sampling and Analysis Plans (SAP) that corresponds to the sampling activities described in each work plan will be used to evaluate the priority actions to be implemented.

## 2.0 PROJECT/TASK ORGANIZATION AND RESPONSIBILITIES

The following individuals who will be involved and the tasks for which they are responsible are discussed below. The responsibilities for the Project Health and Safety Plan (HASP) personnel are discussed in detail within the HASP.

### Project Coordinator

The Project Coordinator will be responsible for overall management and direction of the project, including:

- Primary responsibility for the completion of the project activities
- Establish policies and procedures to address the needs of the project as a whole
- Overall control of planning, scheduling, and cost
- Submittal of all project reports and documents
- Primary contact for communications with the California Department of Parks and Recreation (CDPR), Department of Toxic Substances Control (DTSC), Central Valley Regional Water Quality Control Board (CVRWQCB), and the community

### Project Manager

The Project Manager will report directly to the Project Coordinator. In consultation with the Project Coordinator, the Project Manager will:

- Coordinate and schedule day-to-day activities necessary to complete project tasks, such that the objectives of each task are met
- Orient the project team concerning project requirements and special considerations
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product
- Review the work performed on each task to help ensure its quality, responsiveness and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Develop technical reports and other project documents
- Represent the project team at meetings, if necessary
- Make certain the HASP, Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), and any necessary corrective actions are implemented

### **Field Supervisor**

The Field Supervisor will be responsible for all aspects of fieldwork performed as part of the SAPs. Duties of the Field Supervisor will include:

- Ensuring that all field activities, including measurements, data collection, and field recording activities are performed in accordance with the work plans, SAPs and the project QAPP
- Ensuring that field personnel are properly trained, equipped, and familiar with Standard Operating Procedures and the HASP
- Overseeing sample collection, handling and shipping, and ensuring proper functioning of field equipment
- Ensuring that appropriate personal protective equipment will be worn and disposed of according to the HASP
- Report directly to the Project Manager and if necessary to the Project Coordinator, providing the principal point of contact and control for matters concerning the field investigation implementation

### **Project Staff**

Each member of the project staff will be responsible for understanding, implementing, and completing their project tasks in conformance with the project QAPP and HASP.

### **Quality Assurance Manager**

The Project Quality Assurance Manager (QAM) ensures that the project's QA program is conforming to the project requirements. Duties will include:

- Coordination of the receipt of data from the laboratory
- Ensuring that all data is properly reviewed, verified and validated
- Evaluation of the data and any concerns that may arise with laboratory, and communicates with the Project Manager regarding laboratory data reports or data validation concerns
- Performing QA audits on various phases of the project's operations as necessary, and providing QA technical assistance to project staff
- Notifying the Project Manager of particular circumstances that may adversely affect the quality of data and ensure implementation of corrective actions needed to resolve nonconformance's noted during assessments

**Analytical Lab Project Manager**

The Laboratory Project Managers will work directly Laboratory QAM and will be responsible for the following:

- Reviews and approves QAPP
- Supervising in-house chain of custody (COC)
- Scheduling sample analyses
- Coordinating laboratory analyses
- Defining appropriate laboratory QA procedures
- Overseeing laboratory QA and QA/QC documentation
- Ensuring all resources of the laboratory are available to meet project schedules
- Determining whether to implement laboratory corrective actions, if required
- Overseeing laboratory data review
- Overseeing production and final review of analytical reports

### 3.0 DATA QUALITY OBJECTIVES AND CRITERIA

Measurement performance criteria are established for each field and laboratory measurement parameter. Measurement performance criteria are established by defining acceptance criteria and quantitative or qualitative goals (e.g., control limits) for accuracy, precision and completeness. Quality control acceptance criteria for accuracy and precision of data to meet the data quality objectives of the project are shown in Table 1. Definitions for data accuracy, precision, and completeness are provided below along with the project's data usability criteria and guidelines.

#### 3.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Determining the agreement among replicate measurements of the same sample assesses the precision of the analytical method; combined precision of sampling and analysis methods is assessed from the agreement between measurements of duplicate samples.

##### Field Precision Objectives

Precision of sampling and analysis methods will be assessed through the collection of field duplicate samples. Field duplicates are collected to measure the sampling and analytical variability or imprecision associated with the sample results. The relative percent difference (RPD) in the results for each analyte will be computed for each field duplicate pair using the equation provided in Section 8.2. The goal for precision of field duplicate results is  $\pm 50$  percent RPD for soil samples and  $\pm 35$  percent RPD for water samples. However, if one or both samples in a field duplicate pair have a concentration less than ten times the method detection limit (MDL), the field precision goal will be  $\pm 5$  x the MDL. It is noted here that natural variation in soil will affect how closely these goals are met; that is, if variation is high, then these goals are unrealistic. Consequently, RPD results from field duplicates of soil samples will not be used as a basis of invalidating any analytical data.

##### Laboratory Precision Objectives

Precision of the analytical method will be assessed through duplicate analyses of laboratory QC and field samples. The relative percent difference (RPD) in the results for each analyte will be computed for each analytical duplicate pair using the equation provided in Section 8.2. Data for duplicate analysis will be evaluated only if the both of the samples in the duplicate pair have a concentration greater than the laboratory MDL. Where appropriate, laboratory precision goals for each method and each sample type are included in the Table 1. The frequency at which laboratory duplicates should be analyzed is to be at a minimum rate of one duplicate per sample media (water, soil, and dust), provided there is sufficient sample.

### 3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. Data accuracy will be evaluated using the results from laboratory control samples (LCS) and matrix spikes (MS), expressed as the percent recovery or the percentage of the true (known) concentration that is measured.

#### Field Accuracy Objectives

Accuracy in the field will be assessed through collection of equipment blanks and field blanks and adherence to all sample handling, preservation and holding time requirements. The accuracy objective for equipment and field blanks will be non-detect results (<MDL) for all analytical parameters of interest.

#### Laboratory Accuracy Objectives

Laboratory accuracy may be evaluated by the analysis of laboratory control samples (LCS) and matrix spike (MS) samples, with results expressed as a percentage recovery measured relative to the true (known) concentration. Laboratory LCS, MS, and MSD recovery goals are provided in the Table 1. In addition, laboratory preparation blank results may be used to measure any contamination introduced during the analytical process. The accuracy objective for laboratory preparation blanks will be non-detect results (<MDL).

### 3.3 Completeness

Completeness is the percentage of valid measurements or data points obtained, as a proportion of the number of measurements or data points planned for the project. Completeness is affected by such factors as sample bottle breakage and acceptance/non-acceptance of analytical results. Percentage completeness (C) is calculated by the following equation:

$$C(\%) = \frac{V}{P} \times 100$$

where: V = number of valid measurements/data points obtained  
P = number of measurements/data points planned

Laboratory completeness will be affected by factors such as sample bottle breakage and acceptance/rejection of the analytical results during the data validation process. The laboratory completeness goal is 95 percent.



**Table 1 Summary of Quality Control Limits for Analyses**

| Sample Media                | Analyte  | Accuracy Measures and Control Limits <sup>1</sup>   | Precision Measures and Control Limits <sup>1</sup>   |
|-----------------------------|--|---|--|
| Household Non-Potable Water | CAM-17 Metals  | LCS Recovery: 80-100%,<br><br>MS/MSD Recovery:<br>water samples 75-125%,<br>solid samples 70-130% | Analytical Duplicate RPD:<br>water samples <20%,<br>solid samples <30%<br><br>MS/MSD RPD:<br>water samples <20%,<br>solid samples <30%<br><br>Field duplicate RPD:<br>water samples <35%<br>soil samples <50%, |
| Household Dust              | Lead   |   |  |
| Household Soils             | CAM-17 Metals, Al  |   |  |
| RDP and AWR Soil            | ABA <sup>2</sup> , MWMP-modified WET –Total metals (CAM-17 Metals), Paste pH |   |  |
| Trail Soil                  | CAM-17 Metals  |   |  |

<sup>1</sup> Note: Due to the nature of solid samples (i.e. homogeneity difficulties), a broader control limit for MS recoveries and higher RPD limits are acceptable.

<sup>2</sup> ABA-Acid Base Accounting

## 4.0 SAMPLING PROCESS DESIGN

### 4.1 Sampling Methods

Field sampling methods, equipment utilized, decontamination procedures, sample identification, and sample handling and custody procedures for this effort are documented in the SAPs attached to each work plan to which they correspond. The sampling procedures provided in these documents are designed to provide the type and quality of data consistent with the objectives of this project. Table 2 provides volume, container-type, preservation and holding time specifications for each sample type and analytical method.

### 4.2 Sample Containers, Preservation and Holding Times

Proper sample preparation practices will be observed to minimize sample contamination and potential repeat analyses due to anomalous analytical results. Sample containers depend on sample type, and are described in the corresponding SAP for each individual sampling activity and media. Sample containers will be labeled as described in the following Section 4.3.

#### Sample Preservation

Samples are preserved in order to prevent or minimize chemical changes that could occur during transit and storage. Sample preservation should be performed immediately upon sample collection to ensure that laboratory results are not compromised by improper coordination of preservation requirements and holding times. Descriptions of sample preservation and storage are summarized in Table 2 and can also be found in the corresponding SAP.

#### Holding Times

Sample holding times are established to minimize chemical changes in a sample prior to analysis and/or extraction. A holding time is defined as the maximum allowable time between sample collection and analysis and/or extraction, based on the nature of the analyte of interest and chemical stability factors. Samples should be shipped to the laboratory as soon as possible after collection or processing. There are currently no USEPA guidelines for holding times for solid samples, but a six-month holding time is recommended. Holding times for the chemical constituents for which samples will be analyzed are summarized in Table 2.

**Table 2 Sample Holding Times, Volume Requirements and Preservation**

| Sample Media   | Analyte           | Holding Time (days) | Minimum Sample Volume | Preservation                                |
|----------------|-------------------|---------------------|-----------------------|---|
| Water          | Metals            | 180                 | 250 ml                | HNO <sub>3</sub> to pH < 2;<br>Cool at 4° C |
|                | Mercury           | 28                  | 100 ml                |   |
| Soil           | ABA               | 180                 | 225 g                 | Cool at 4° C for transport (where possible) |
|                | Mercury           | 28                  | 500g                  |   |
|                | CAM-17 Metals, Al | 180                 |                       |   |
| Household Dust | Lead              | 180                 | 225g                  | Cool at 4° C for transport                  |

### 4.3 Field Sample Handling and Custody

#### Sample Labeling and Identification

Samples are labeled on labels with an indelible, waterproof marker. The sample numbering and nomenclature system is based on the sample location, rep, media type, and sample type (primary, duplicate or blank). The required label information and specific sample nomenclature is outlined in the SAP for each sampling activity and Section 5.0.

#### Sample Preparation and Shipping

After collection, samples will be labeled and prepared as described in the previous discussion, and placed on ice in an insulated cooler or suitable shipping container as outlined in the SAP for the media being shipped. The sample bags will be placed in re-closeable freezer-type plastic storage bags. Samples will then be placed in a cooler with ice for delivery to the laboratory. The ice in the cooler will be double-bagged. The coolers will be taped shut and chain-of-custody seals will be attached to the outside of the cooler to ensure that the cooler cannot be opened without breaking the seal. Large samples (5 gallon buckets) do not need to be cooled.

All samples will be shipped for laboratory receipt and analysis within the holding times specified in Table 2. Prompt shipping and analysis should be done to minimize the possibility of exceeding holding times.

#### Chain of Custody

After samples have been collected, they will be maintained under strict chain-of-custody protocols. The field sampling personnel will complete a chain-of-custody record (COC) form for each shipping container (i.e., cooler, ice chest or other container) of samples to be delivered to the laboratory for analysis. The sampler is responsible for initiating and filling out the COC form. The COC will be signed by the sampler when he or she relinquishes the samples to anyone else. The COC for a shipping container will list only those samples in that shipping container.

Information contained on the triplicate, carbonless COC form will include the following:

- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers/bags for each sample
- Sampler's signature and affiliation
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if the samples are shipped)
- Condition of samples and cooler temperature upon receipt by laboratory
- Any additional instructions to the laboratory

The sample collector will cross out any blank spaces on the COC below the last sample number listed. Each sample container will be carefully packaged in a shipping container, typically an ice chest, with Styrofoam<sup>®</sup> peanuts, vermiculite or other packing material to prevent breakage during shipment. A labeled temperature blank may also be included with each cooler shipped, if temperature-sensitive samples were collected. Custody seals will be attached to the outside of the cooler or shipping container to ensure that the container cannot be opened without breaking the seal, and will be signed and dated by the sample custodian prior to shipment. If the custody seal is broken, the laboratory will immediately notify MFG.

The sampling personnel whose signature appears on the COC is responsible for the custody of the samples from the time of sample collection until custody of the samples is transferred to a designated laboratory, a courier, or to another project employee for the purpose of transporting the sample to the designated laboratory. The sample is considered to be in custody when the sample is: (1) in the direct possession of the sample custodian; (2) in plain view of the sample custodian; or (3) is securely locked in a restricted-access area by the sample custodian.

Custody is transferred when both parties to the transfer complete the portion of the COC under "Relinquished by" and "Received by." Signatures, printed names, company names, dates and times are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the

third sheet (pink copy) of the COC. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the COC. Copies, receipts and carbons of Bills of Lading will be retained as part of the permanent documentation in the project file. It is not necessary for courier personnel to sign the COC.

#### **4.4 Laboratory Sample Handling and Custody**

When the samples are received by the analytical laboratory, the COC will be immediately signed along with the date and time of receipt. The top sheet (white copy) or a copy of the COC may be returned with the final analytical report. The laboratory will follow appropriate chain-of-custody procedures when shipping any samples to a subcontracted laboratory for analysis.

Upon receipt by the laboratory, the samples will be inspected for sample integrity and preservation, including temperature. The COC will be reviewed to verify completeness. Any discrepancies between the COC and sample labels and any problems noted upon sample receipt will be communicated immediately to MFG. The laboratory will store the samples in a specially designated area which is clean and maintained at the appropriate preservation temperature. The laboratory will be responsible for following their internal custody procedures from the time of sample receipt until sample disposal. Coolers with samples are received and processed into the laboratory using the SOP from the selected lab which is maintained on file at the facility. A Sample Receipt Checklist is generated providing documented details of the sample receipt including temperature of the cooler. Acceptable cooler temperature is  $4 \pm 2^{\circ}\text{C}$ . If a temperature deviation is discovered, it will be determined if the sample needs to be chilled. If the samples need to be maintained cool, the samples will be immediately chilled to within the required temperature range. The Project manager will evaluate the length of time that the samples were likely out of the desired temperature range along with the actual temperature when discovered, to determine if the samples are suitable for analysis or should be discarded.

## **5.0 DOCUMENTS AND RECORDS**

### **5.1 Field Operation Records**

Field operation records include sample collection records, COCs, QC sample records, field procedures, and corrective action reports. Field sampling activities are documented on field data sheets and the field log book. At each site, location, sampling time, date, and sample collector's name/signature are recorded. If a field or lab QA/QC sample is to be collected at a site for a specific sample or if a split sample is to be collected, this information will be documented on the field data sheets.

COCs will be filled out for all samples collected and include the information discussed in Section 4.3.

Any problems or comments related to a specific sample will also be documented on the field data sheet. Such information would include moving a station location, or if there were any circumstances at a site that prevented a sample from being collected. If a deviation in the field sampling methods or standard operating procedure (SOP) it should be documented indicating what occurred, actions taken to correct the failure, as well as the effect of the action on the sample in question.

### **5.2 Laboratory Records**

Laboratory records will include all of the data in the data reporting package (described in section 9.1) as well as any laboratory records generated for the project samples. In addition to the items in the data reporting package, at a minimum, the following records will be maintained by the laboratory:

- Sample preparation log books
- Temperature records for storage units (standards, samples)
- Equipment calibration and maintenance records
- Instrument run logs, extraction logs, and digestion logs
- Certification records for standards
- Raw data

## **6.0 CALIBRATION PROCEDURES**

### **6.1 Field Instruments and Equipment**

Equipment used to gather, generate or measure environmental data will be calibrated each day prior to use to ensure that the accuracy and reproducibility of the results are consistent with the manufacturer's specifications. Field sampling and measurement equipment will be examined to certify that it is in good operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to ensure that maintenance requirements are being met. In the event that a field instrument cannot be calibrated to meet the manufacturer's specifications, it will be tagged "defective" and returned to the manufacturer or other supplier for service or replacement.

The GPS units will be checked daily for reproducibility by recording the coordinates for each of the four corners of the field check area. Reproducibility of the coordinates is of greater importance than the absolute accuracy. However, the accuracy of the GPS units will be checked, if possible, against known survey points on the site.

### **6.2 Laboratory Instruments**

Instruments used by the laboratory will be calibrated in accordance with the laboratory's Quality Assurance Plan (QAP), Method SOPs and any specified EPA-method requirements. When laboratory measurement instruments do not meet the calibration criteria of the QAP, Method SOP or EPA method, then the instrument will not be used for analysis of samples submitted under this QAPP. Calibration records should be accessible and demonstration of acceptable calibration results if so requested by MFG. Maintenance records should be available for inspection.

## 7.0 ANALYTICAL PROCEDURES

The analytical parameters, analytical methods and required method detection limits for which the samples are to be analyzed for are summarized in Table 3. Table 2 includes holding times, preservation guidelines and required sample amounts for all sample types. A copy of these tables will be sent with each batch of samples submitted to the laboratory. Procedures for laboratory analysis, with any modifications, should be further documented in the laboratory SOPs, which are maintained at the laboratory and are listed in the laboratory's QAP. The laboratory designated for the analytical chemistry support for the project is to be a laboratory that accredited (NELAP) by the California Department of Health Services.

**Table 3 Sample Analysis Parameters, Methods and Method Detection Limits**

| Sample Media | Analyte                             | Analytical Method                                 | Target Method Detection Limit (mg/kg) <sup>2</sup> | Target Method Detection Limit (mg/l) <sup>3</sup> |
|--------------|-------------------------------------|---|--|---|
| Water        | Antimony                            | EPA 200.8   |  | 0.0002  |
|              | Arsenic                             | EPA 200.8   |  | 0.0005  |
|              | Barium                              | EPA 200.8   |  | 0.0001  |
|              | Beryllium                           | EPA 200.8   |  | 0.0001  |
|              | Cadmium                             | EPA 200.8   |  | 0.0001  |
|              | Chromium                            | EPA 200.8   |  | 0.0001  |
|              | Cobalt                              | EPA 200.8   |  | 0.00005   |
|              | Copper                              | EPA 200.8   |  | 0.0005  |
|              | Lead                                | EPA 200.8   |  | 0.00025   |
|              | Mercury                             | EPA 1669/1631                                     |  | 0.2   |
|              | Molybdenum                          | EPA 200.8   |  | 0.0001  |
|              | Nickel                              | EPA 200.8   |  | 0.0002  |
|              | Selenium                            | EPA 200.8   |  | 0.0015  |
|              | Silver                              | EPA 200.8   |  | 0.00005   |
|              | Titanium                            | EPA 200.8   |  | 0.0002  |
| Vanadium     | EPA 200.8                           |   | 0.00005  |   |
| Zinc         | EPA 200.8                           |   | 0.002  |   |
| Soil         | pH (paste)                          | USDA No. 60 (21a)                                 |  | 0.1 units   |
|              | Acid Neutralization Potential (ANP) | CaCO <sub>3</sub> Equiv. / Titration              |  | -   |
|              | Acid Generation Potential           | LECO Combustion IR <sup>4</sup>                   |  | -   |
|              | Total Sulfur                        | LECO Combustion IR <sup>4</sup>                   |  | -   |
|              | Sulfate Sulfur (HCL Extractable)    | LECO Combustion IR <sup>4</sup>                   |  | -   |
|              | Aluminum <sup>5</sup>               | EPA3050b/6010                                     | 3  | -   |
|              | Antimony                            | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 2  | 0.0002  |
|              | Arsenic                             | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 4  | 0.0005  |
|              | Barium                              | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 0.3  | 0.0001  |
|              | Beryllium                           | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 0.2  | 0.0001  |
|              | Cadmium                             | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 0.3  | 0.0001  |
|              | Chromium                            | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.00005   |
|              | Cobalt                              | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.00005   |
|              | Copper                              | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.0005  |
|              | Lead                                | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 4  | 0.0001  |
|              | Mercury                             | MWMP-WET <sup>1</sup> -EPA3050b/EPA 7470          | 0.02   | 0.0002  |
|              | Molybdenum                          | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.0001  |
|              | Nickel                              | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.0002  |
|              | Selenium                            | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 4  | 0.0015  |
|              | Silver                              | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 0.5  | 0.00005   |
|              | Thallium                            | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 20   | 0.00005   |
|              | Vanadium                            | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 0.5  | 0.00005   |
|              | Zinc                                | MWMP-WET <sup>1</sup> /EPA 6020-EPA3050b/EPA 6010 | 1  | 0.002   |

<sup>1</sup> WET test modified to use DI water instead of citric acid

<sup>2</sup> Target Method Detection Limits (mg/kg) for Total Metals (EPA 3050b/6010)

<sup>3</sup> Target Method Detection Limits (mg/l) for MWMP and WET leachate analysis (EPA 6020) and water (200.8)

<sup>4</sup> Modified Sobek

<sup>5</sup> Aluminum analyzed only in Residences Work Plan



## 8.0 QUALITY CONTROL

Quality control may be checked by collecting and analyzing field QC samples and performing laboratory QC analyses. Both field and laboratory quality control are necessary to control the sampling and analytical process, assess the accuracy and precision of results and identify assignable causes for anomalous results. Project control limits for accuracy and precision measurements are listed in Table 1.

### 8.1 Field Quality Control

In order to assess precision of field sampling and assure that contamination has not occurred in the field, field quality control (QC) samples will be collected as follows: one field duplicate (split) will be submitted across all samples. For soil samples, a sample will be chosen and split, submitted as a field sample “duplicate”. These samples will measure sample variability, as well as be a check for laboratory precision. Field duplicates will be analyzed for the same suite of analytical parameters as the primary sample. There are no U.S. EPA criteria for evaluation of field duplicate sample comparability, however, the relative percent difference (RPD) between the original sample and field duplicate can be calculated for each parameter and compared to the precision goal. Field duplicate RPDs greater than the project-specified precision goal indicates a high variability associated within the sample.

### 8.2 Laboratory Quality Control

The appropriate type and frequency of laboratory QC samples will be dependent on the sample type/matrix, analytical methods, and the laboratory’s SOPs. With each QC batch for sample analysis, the following laboratory QC samples will be analyzed in addition to the calibration samples.

#### Method Blank Samples

No target analytes should be found in laboratory blanks. Blank contamination, if found, will be evaluated using USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA 1994) functional guidelines. The guidelines specify that sample concentrations less than five times the amount detected in associated blanks should be qualified as nondetected (“U”) at the reported concentrations.

#### Matrix Spike Samples

Laboratory matrix spike samples are used to evaluate potential matrix effects on sample analysis for inorganic parameters. Percent recoveries of target analytes from matrix spike samples should fall within control limits of 75 to 125 percent for water samples, and 70 to 130 percent for solid samples. However, if other QA/QC results are acceptable, there is no requirement to qualify sample results. Matrix interference and other effects may cause low or high percent recoveries in investigative samples; matrix

effects may be noted at the same time that recoveries from laboratory control samples indicate acceptable method performance.

#### Laboratory Control Samples

USEPA (1994) guidelines specify that percent recoveries of most metals from aqueous laboratory control samples should fall within control limits of 80 to 120 percent. An appropriate laboratory control sample will be used by the laboratory based on the sample matrix.

#### Analytical Duplicate Samples

Based on USEPA guidelines, aqueous laboratory replicate samples and the samples from which they are split (the investigative samples) should have relative percent differences (RPDs) whose absolute values do not exceed 20 percent (for water samples) or 30 percent (for solid samples) in cases where both sample values are greater than or equal to five times the reporting limit. The RPD is defined by the following equation:

$$\text{RPD} = \frac{\text{sample} - \text{duplicate values}}{\left( \frac{\text{sample} + \text{duplicate values}}{2} \right)} \times 100\%$$

If one or both values are less than five times the reporting limit, the difference between the primary and replicate values should not exceed the reporting limit.

#### Frequency

Laboratory QA/QC samples method blank, matrix spike, and laboratory control samples should be run in a QC batch of one each per 20 field samples. If less than 20 field samples are submitted, then one set of these three QA/QC samples should be run per batch. Analytical duplicates will be done at a frequency of one per sample media (i.e. one analytical duplicate each for soil samples), when sufficient sample material is available.

## 9.0 DATA REPORTING, VALIDATION AND MANAGEMENT

Field measurement values are generally reported directly in the units of final use in the field notebook or data sheets without need for additional calculations (e.g., pH, temperature, and conductivity measurements). The field data will be reviewed daily by the field supervisor to identify anomalous data and transcriptional and/or computational errors. Corrective actions will be initiated as appropriate; these actions may consist of re-measuring a particular parameter, collecting a new sample, or other applicable corrective action measures. Reviewed field data will be entered into the project database promptly upon return from the sampling event.

The laboratory's calculations and data review will be performed in accordance with procedures prescribed in their own Quality Assurance Plan and the referenced analytical method.

### 9.1 Data Reporting Format

At a minimum, the laboratory will provide the following information for each sample:

- Sample identification number
- Analytes, concentrations and units
- Analysis date
- Analysis method used
- Laboratory qualifiers and definitions
- Percent solids on a dry weight basis for soil

The laboratory QC summary should include:

- Method detection limits and sample dilution information
- Laboratory quantification limits
- Method blank data
- Analytical duplicate data
- Matrix spike data
- Laboratory control sample data
- Laboratory case narrative summarizing any method deviations or analysis problems
- Sample log-in information
- Copies of complete COCs

Data reporting packages will be prepared by the Analytical Lab Project Manager and will be submitted to the Project Manager and the Quality Assurance Manger (QAM). Results and QC summary received from

the laboratory analysis should be documented both in report form (either hard copy or as a PDF file), and in an electronic spreadsheet (Excel file) format.

## 9.2 Data Review and Validation

Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended use(s). All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives that are listed in Section 3.0.

Laboratory results will first of all be checked for completeness, in order to assure that all the requested analyses were performed along with the correct methodologies and detection limits. Data will also be evaluated to assess whether the measurement performance criteria for accuracy and precision (Table 1) have been achieved. Laboratory method blanks, matrix spike samples, laboratory duplicate samples, laboratory control samples, and holding times will be validated in accordance with USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA 1994). The laboratory will provide a QC summary suitable for this level of review (described above in Section 9.1).

Data that are not rejected during a validation process are generally considered usable with any qualifications noted in the validation results. When data validation is performed, a checklist or summary of the validation process will be prepared to document the review process and results. This checklist is transmitted to the Project Manager and also included in the project's files.

The data to be verified are evaluated against project specifications (Section 3.0) and are checked for errors, especially errors in transcription, calculations, and data input. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed. Potential outliers are identified by the Project QAM and Project Manager by examining results for unreasonable data, or identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the Field Supervisor or the Lab Project Manager responsible for generating the data is contacted to resolve the issue. Issues that can be resolved are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the QAM consults with the Project Manager to determine the appropriate course of action, or the data associated with the issue are rejected.

### 9.3 Data Management

Once the laboratory data has been validated and qualifications noted, the analytical data and qualifiers will be entered into the project database along with field measurements and sample information (ID#, sample type/species, sample location, and date).

#### Data Validation Reports

A data validation report will be issued to the Project manager from the Project QAM summarizing the data validation for each sampling event and corresponding laboratory analysis reports. It should summarize the data quality and include a list of any qualifications of data resulting from the data evaluation.

## 10.0 CORRECTIVE ACTIONS

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or poor QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All proposed corrective actions should be documented as well as the steps taken to implement the corrective action. Corrective action should only be implemented after approval by the Project Manager. If immediate corrective action is required, approvals secured by telephone from the MFG Project Manager should be documented.

All nonconforming equipment, items, activities, conditions and unusual incidents that could affect data quality and attainment of the project's quality objectives will be identified, controlled and reported in a timely manner. For the purpose of this QAPP, a nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate in meeting the project's quality objectives. If the analytical results from laboratory QC samples fall outside of the measurement performance criteria, corrective actions should be initiated immediately by the laboratory. If the laboratory cannot correct the situation that caused the nonconformance and an out-of-control situation continues to occur or is expected to occur, then the laboratory will immediately contact the Project QAM and request instructions regarding how to proceed with sample analyses. Completion of any corrective action should be evidenced by data once again falling within prescribed measurement performance criteria. If an error in laboratory procedures or sample collection and handling procedures can not be found, the results will be reviewed by the Project QAM and Project Manager to assess whether reanalysis or re-sampling is required.

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include resampling or reanalysis of samples. These actions are dependent upon the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives. If the Project QAM identifies a corrective action situation, it is the Project Manager who will be responsible for approving the implementation of corrective action. All corrective actions of this type will be documented by the Project QAM.

Any corrective actions taken will be documented in writing by either the Laboratory QA Manager or the Project QAM and reported to the Project Manager. Corrective action records will be included in the project's files.