# INTERIM FINAL
# QUALITY ASSURANCE SAMPLING PLAN
# WATER AND SEDIMENT SAMPLING AND MONITORING

# FOR

# GOLD KING MINE SPILL
# FARMINGTON, SAN JUAN COUNTY, NEW MEXICO

Prepared for

**U.S. Environmental Protection Agency Region 6**
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Revision 1

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# 1. INTRODUCTION

The Superfund Technical Assessment and Response Team (START) contractor has been tasked by the U.S. Environmental Protection Agency (EPA) Region 6 Prevention and Response Branch (PRB) to conduct water and sediment sampling and water monitoring associated with the Gold King Mine Spill in San Juan County, Colorado. Resulting mine drainage has flowed south along Cement Creek in Colorado and entered the Animas River near the border with New Mexico in the jurisdiction of EPA Region 6. The START field team will mobilize the equipment required for the emergency response initially from the EPA warehouses. Additional equipment will be provided through Weston-owned resources.

Sampling activities will consist of surface water and sediment sampling at specific locations downstream from the Gold King Mine site (Figure 1-1) on the Animas River. This QASP has been prepared as part of the emergency response activities for the site.

The purpose of this QASP is to describe site-specific tasks that will be performed in support of the stated objectives. This QASP includes generic tasks common to all data collection activities including routine procedures for sampling and analysis, sample documentation, equipment decontamination, sample handling, data management, assessment, and data review.

## 1.1 PROJECT TEAM

The Project Team will be divided into multiple locations and multiple teams based upon site conditions and operations. As the operational situations change, sampling and monitoring teams and operations will adapt, based upon direction from the Unified Command. EPA, On-scene Coordinators (OSCs) and START, personnel from Region 6 will have responsibility for sampling and monitoring in northwestern New Mexico. EPA will coordinate among parallel responses being conducted in Regions 6, 8, and 9.

## 1.2 PROBLEM DEFINITION

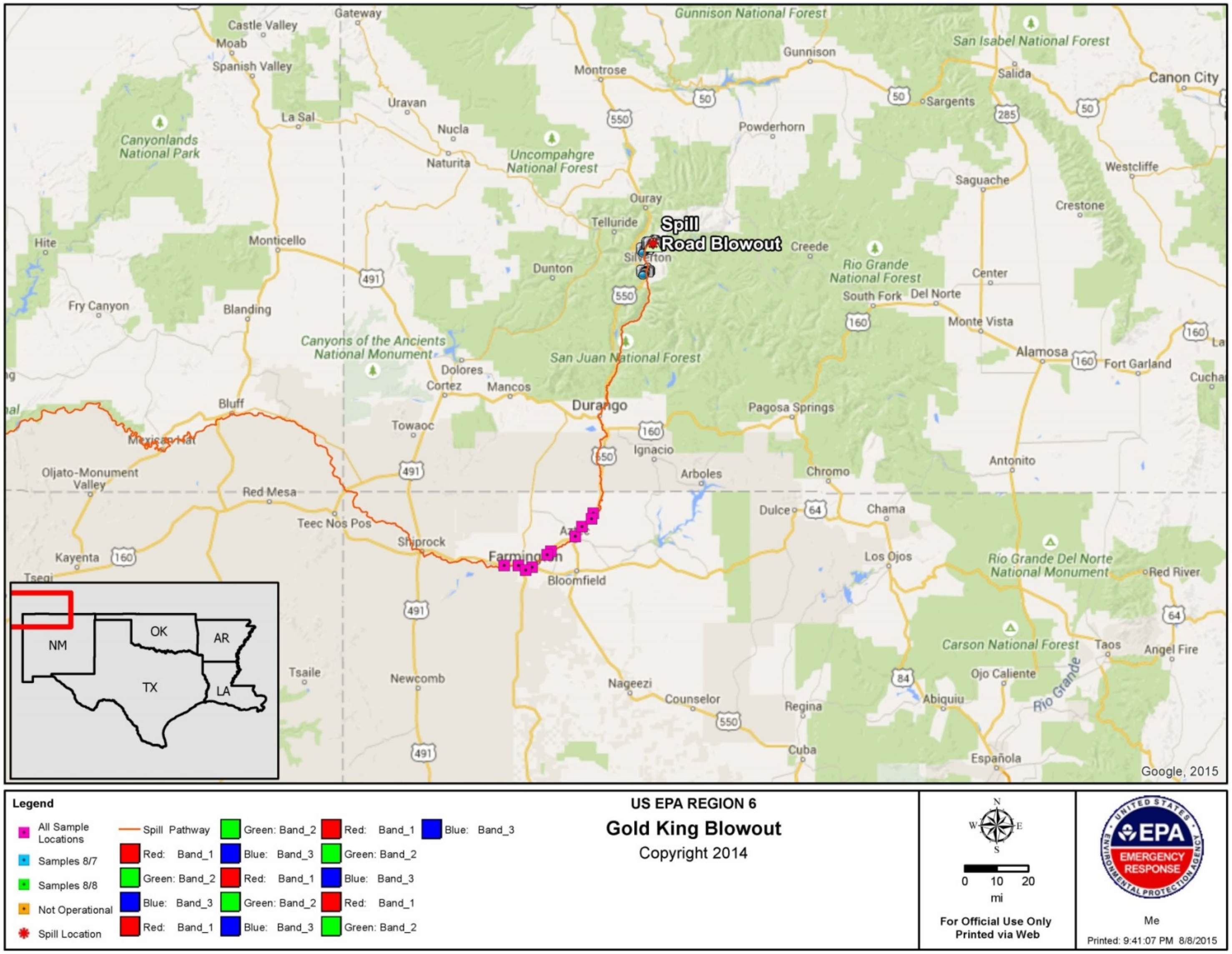
The Gold King Mine site consists of a mine adit and waste rock piles in the Cement Creek watershed. The mine historically discharged low pH, metals-laden water at a flow rate of approximately 100 gallons per minute (gpm). The water flowed through a concrete channel, through a Parshall flume, through a plastic conduit, over a steep waste rock pile, and either into the subsurface (low flow), or toward North Fork Cement Creek. A pond was constructed at the base of the waste rock pile to collect water during 2014 site activities. North Fork Cement Creek flows into Cement Creek, which discharges to the Animas River in Silverton, Colorado.

On August 5, 2015, approximately 3 million gallons of acidic metals-laden water was unexpectedly released from the Gold King Mine. The mine water flowed across the site and to Cement Creek and then to the Animas River in Silverton, Colorado. Historically, EPA and the State of Colorado Division of Mining Reclamation and Safety (DRMS) had been working to control the existing flow from the Gold King Mine along with similar discharge emanating from the nearby Red and Bonita Mine site. The project team was setting up to incorporate the flow from the Gold King Mine into the ongoing treatment of the flow from the Red and Bonita Mine when water that had been dammed in the Gold King Mine behind a collapsed section of adit broke through rock and debris.

The primary environmental concern of the Gold King Mine Spill is the release and transport of heavy metals and low pH water from the mine to the Animas River and the potential risk to environmental and human health receptors downstream. These include the public who use these waters for drinking, bathing, crop irrigation, and recreation (e.g., fishing, rafting), as well as ecological resources (fish and wildlife) that inhabit the river project objectives.

The overall objective of this monitoring effort is to assess the potential human health and ecological risks associated with this release and determine the need for remedial action to protect the drinking water supply and other human and ecological water use requirements of the Animas River downstream of the Gold King Mine. To determine these potential risks, EPA Region 6 will assess the water and sediment quality of the Animas River as it flows from the Colorado border south into northwestern New Mexico. Surface water and sediment samples will be collected for metal analysis at a variety of locations to obtain spatial coverage. In addition, these locations will be sampled on a routine basis to provide an understanding of the temporal trend of potential impact following the August 5th spill. Conventional water quality parameters will also be measured at these locations with multi-parameter water quality instruments.

## Figure 1-1
## Site Location



# 2. SITE DESCRIPTION

The Gold King Mine Spill occurred in San Juan County, Colorado (37.8945˚ N, -107.6384˚ W) and is flowing downstream into La Plata County. The source is the Gold King Mine, which released into Cement Creek and is flowing downstream in the Animas River.

## 2.1 SITE HISTORY

The Red and Bonita Mine and the Gold King Mine are in the Cement Creek watershed, which originates high in the San Juan Mountains of southwestern Colorado near the San Juan County and Ouray County line on the south slopes of Red Mountain Number 3 and the north slopes of Storm Peak (Figure 2-1).

The rugged and relatively inaccessible western San Juan Mountains were first prospected in the area around Silverton in 1860. The extension of the railroad from Silverton up Cement Creek to Gladstone in 1899 encouraged the mining of low-grade ores, and the establishment of a lead-zinc flotation plant in 1917 allowed for the treatment of the low-grade complex ores found in the area. Over a 100-year period between 1890 and 1991, mining activities in the upper Animas River Basin, including Cement Creek, produced the waste rock and mill tailings sources from which contamination spread throughout the surface water pathway. Over 18 million tons of ore were mined from the Upper Animas River Basin area, with more than 95 percent of this being dumped directly into the Animas River and its tributaries in the form of mill waste. Older waste rock piles and stope fillings were reworked and sent to mills as technology allowed lower grade ores to be processed economically. A great deal of abandoned waste was also milled during World War II when many older mining and milling structures were cannibalized for scrap metal. The last producing mine in the area was the Sunnyside Mine, which ceased production in 1991. The closing of the Sunnyside mine occurred after Lake Emma drained into the mine and out the American Tunnel into Cement Creek in 1978. The flood water from the Lake Emma “blow-out” was reported to have flowed down Cement Creek in a 10-foot wall of water that would have transported a large quantity of tailings and other mine waste down Cement Creek to the Animas River.

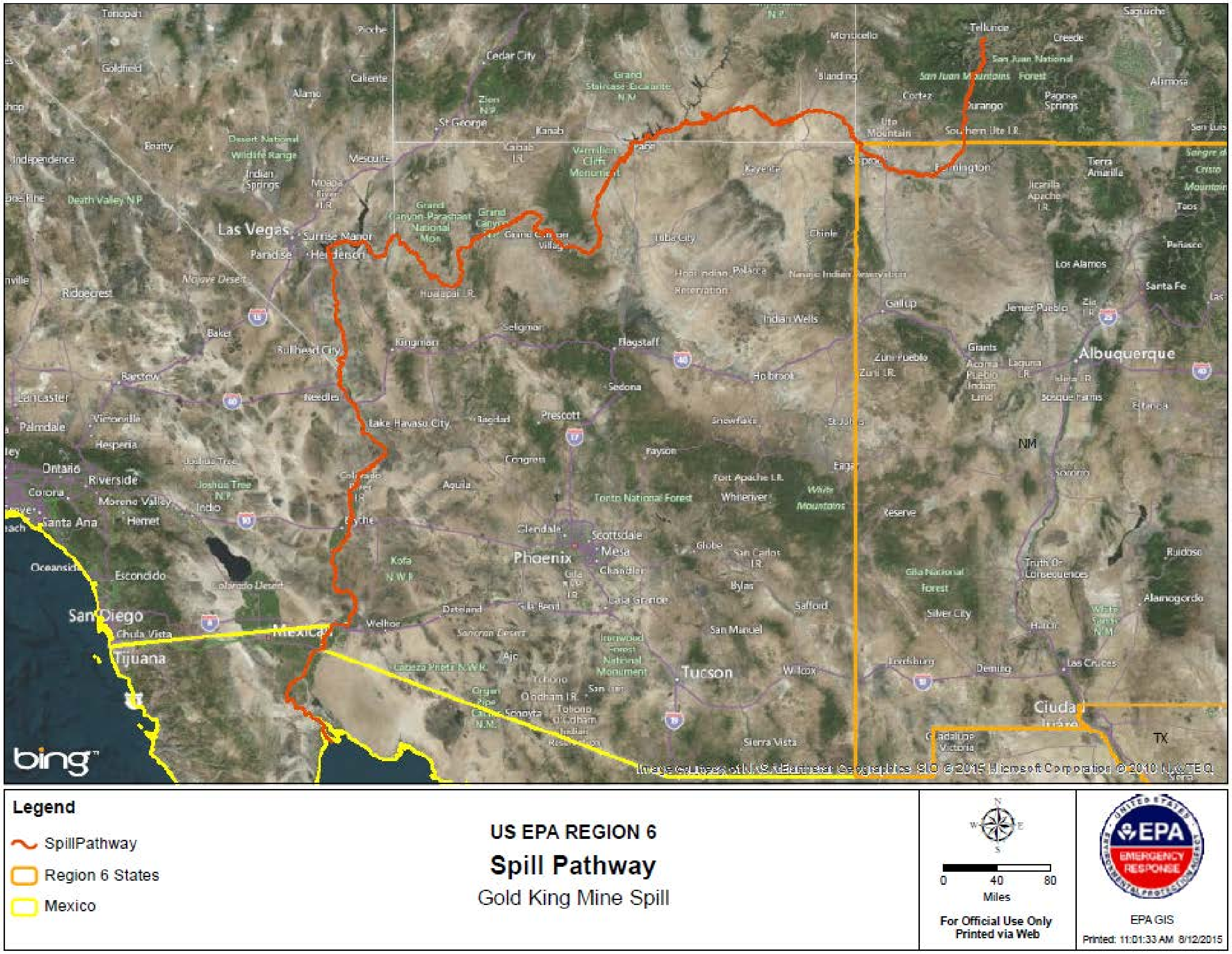
Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River. The confluence of Cement Creek and the Animas River is located approximately eight miles downstream of Gladstone.

## 2.2 BACKGROUND INFORMATION

Contaminants found in the Red and Bonita Mine discharge, which is located on the mountain below Gold King Mine, include low pH and metals. Cadmium concentrations from the mine discharge ranged from 33.3 micrograms per liter (µg/L) to 39.3 µg/L, copper concentrations ranged from 4.5 µg/L to 50.6 µg/L, iron concentrations ranged from 76,700 µg/L to 97,600 µg/L, lead concentrations ranged from 34 µg/L to 71.2 µg/L, and zinc concentrations ranged from 13,600 µg/L to 17,500 µg/L.

Contaminants in the Gold King Mine discharge water include low pH and metals. From 2009 to 2011, cadmium concentrations from the mine discharge ranged from 38 micrograms per liter (µg/L) to 136 µg/L, copper concentrations ranged from 2400 µg/L to 12,000 µg/L, lead concentrations ranged from 2 µg/L to 29 µg/L, and zinc concentrations ranged from 14,500 µg/L to 44,700 µg/L.

# Figure 2-1
## Spill Pathway



# 3. PROJECT TASKS AND SCHEDULE

**Table 3-1**
**Project Tasks and Schedule**

| Activity | Responsible Party | Planned Start Date | Planned Completion Date | Deliverable(s) | Deliverable Due Date |
|---|---|---|---|---|---|
| Project Initiation | EPA/START | August 6, 2015 | August 6, 2015 | N/A | August 6, 2015 |
| Develop a QASP for Emergency Response | START | August 7, 2015 | August 12, 2015 | QASP for Emergency Response Activities | August 9, 2015 |
| Develop Health and Safety Plan (HASP) | START | August 6, 2015 | August 6, 2015 | HASP | N/A |
| Mobilization | START | August 6, 2015 | August 6, 2015 | Field Notes | N/A |
| Sample Collection Tasks | START | August 7, 2015 | TBD | Field Notes | TBD |
| Analytical Tasks | START/ Laboratory | August 6, 2015 | TBD | Field Notes/Laboratory Reports | TBD |
| Quality Control Tasks | START | August 6, 2015 | TBD | Report of Analyses/Data Package | TBD |
| Validation | START | August 10, 2015 | TBD | Validation Summary Report | TBD |

## 3.1 HEALTH AND SAFETY IMPLEMENTATION

The monitoring will be conducted in accordance with the site-specific health and safety plan (HASP). START personnel will conduct monitoring in Level D personal protective equipment (PPE) as stated in the site HASP. The Field Safety Officer (FSO) will be responsible for implementation of the HASP during this assessment and clean-up action. In accordance with the START general health and safety operating procedures, START personnel will be instructed in the route to the hospital specified in the HASP prior to initiating sampling activities.

# 4. SAMPLING APPROACH AND PROCEDURES

Samples collected by EPA will be used to evaluate the nature of the contaminants present. EPA will collect water and sediment samples as necessary, including background water and sediment sampling in northwestern New Mexico. Samples collected as part of this emergency response (ER) will be obtained in accordance with the *START and ERT Standard Operating Procedures (SOPs)* as presented in Appendix D of this QASP.

## 4.1 OVERVIEW OF SAMPLING ACTIVITIES

EPA will conduct surface water and sediment samples at specific locations. Sample locations will be determined in coordination with the EPA Region 6 OSCs in collaboration with a New Mexico Environment Department (NMED) representative. START will use EPA Scribe Environmental Sampling Data Management System (SCRIBE) software to manage sample data. Data will be managed according to the *Data Management Plan* developed for this response by the START Region 6 Data Team (Appendix A).

## 4.2 DATA QUALITY OBJECTIVES

The objective of surface water and sediment sampling is to obtain data of sufficient quantity and quality to assess the potential risk to human health and ecological resources from the acid mine waste spill into the Animas River. Surface water results will be compared with drinking water standards and other surface water criteria including ecological screening levels. Sediment results will be compared with modified human health screening values to determine the risk associated with recreational exposure as well as ecological screening levels for sediments. EPA Region 6 and New Mexico criteria and screening values are provided in Appendix B - *Surface Water and Sediment Sample Analyte List and Benchmarks* of this QASP.

### *STATE THE PROBLEM*

On August 5, 2015, approximately 3 million gallons of acidic metals-laden water and sludge was unexpectedly released from the Gold King Mine. The mine water flowed across the site and into

Cement Creek and then into the Animas River in Silverton, Colorado and downstream into New Mexico.

EPA has requested that Region 6 START assist to:

- collect surface water and sediment samples from areas potentially affected by the release, including surface water, sediment;
- provide GPS data for sampling locations; and
- provide georeferenced site photo documentation.

### *IDENTIFY THE GOAL OF THE STUDY*

The goal of the study is to determine the human health and ecological risks associated with the release on downstream waters and water users.

The primary study questions include the following:

- What areas were affected by the release from Gold King Mine?
- What are the water quality conditions, as indicated by field and laboratory analyses, in the Animas River?
- Based on laboratory analyses, are other media such as sediment, soil, or groundwater affected by the mine water release?
- What are the potential risks to human health and ecological receptors associated with the Gold King Mine release to the Animas River?

### *IDENTIFY INFORMATION INPUTS*

To support the above objectives, the following data will be collected:

- Surface water and sediment samples will be collected and analyzed for metals.  If needed, groundwater and soil may also be sampled.
- Field measurements of conventional water quality parameters in surface water (i.e., pH, turbidity, ORP, etc.
- Geospatial data of sampling locations.
- Field documentation and photographs of site activities.

### *DEFINE THE BOUNDARIES OF THE STUDY*

*Spatial Boundaries:* The study area includes the downstream locations in New Mexico potentially impacted from the Gold King release.

*Temporal Boundaries:* The study will represent conditions after the release from the Gold King Mine and ending at an as-yet undetermined date.

*Practical Constraints on Data Collection*: Scheduling adjustments will be made if physical constraints on planned field events occur due to weather, safety considerations, site access, or problems that may impact the technical quality of the measurements.

### *DEVELOP THE ANALYTICAL APPROACH*

Samples will be collected from locations designated in the field by an EPA OSC in collaboration with an NMED representative. Samples will be sent for laboratory analysis of total and dissolved TAL metals and other parameters as directed by the OSC.

The results may be compared with Water Quality Standards determined by EPA and NMED, and/or other benchmarks as directed by the EPA OSC.

### *SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA*

All data will be reviewed and verified to ensure that they are acceptable for the intended use. Data will be validated at the request of the EPA OSC.

Decision errors will be limited to the extent practicable by following approved U.S. EPA methods and applicable SOPs. Deviations from the QASP will be documented.

### *DEVELOP THE DETAILED PLAN FOR OBTAINING DATA*

Water and sediment samples will be collected at locations designated by the EPA OSC in collaboration with an NMED representative.

Field water quality parameters will be obtained using a Hanna, YSI, and/or Horiba or similar water quality meter. Field monitoring will be used to measure conventional water quality parameters including pH (primary emphasis), temperature, dissolved oxygen, conductivity, and turbidity. Visual observations of water clarity will be recorded. Hardness as CaCO3 and total suspended solids (TSS) will be obtained as a laboratory analysis.

Data from the laboratories will be delivered via an electronic data deliverable (EDD) and reported in the emergency response report. The site-specific *Data Management Plan* is provided in Appendix A.

## 4.3 SAMPLING DESIGN AND RATIONALE

The Data Quality Objectives (DQOs) (Appendix C) assist in creating a sampling design and the rationale for sample collection. START will collect surface water samples to characterize water quality and flow impacts from the Gold King Mine release. Surface water will be monitored periodically for pH. Other water quality parameters such as conductivity, turbidity, dissolved oxygen, and oxidation reduction potential will be measured as long as the additional information is helpful in evaluating site conditions.

Additional media such as sediment, soil, and/or groundwater may also be sampled, as directed by the EPA OSC in coordination with an NMED representative.

This project involves the collection of laboratory samples and field screening data. Sample points will be located with a Global Positioning System (GPS) device to be used for mapping purposes and to document sample locations selected in the field. If sampling locations become inaccessible, alternate sampling locations, which provide similarly adequate or sufficient data as the original, will be identified and sampled based upon the best judgment of the inspector/sampler, if necessary.

To augment the surface water and sediment characterization, EPA is also working with U. S. Geology Survey (USGS) and other partners to identify potential background databases. EPA will coordinate with NMED on the feasibility of using this information

### 4.3.1 Sample Locations

Sample locations will be identified in the field in coordination with the EPA OSC in collaboration with an NMED representative. In general, the sampling area extends along the Animas River in New Mexico to its confluence with the San Juan River and northwest along the San Juan River. The priority and importance of each sample will be determined by the EPA Environmental Unit (EU) in cooperation with NMED (Figure 4-1 and Figure 4-2).

### 4.3.2 Sampling/Monitoring Approach

All surface water and sediment samples will be collected in general accordance with the START Standard Operating Procedures (SOPs) 1002-01, *SOP for Surface Water Sample Collection* and SOP 1002-04, *SOP for Sediment Sample Collection*. In addition to these SOPs, EPA's Environmental Response Team (ERT) SOP #2013 *Surface Water Sampling* and SOP #2016 *Sediment Sampling and the Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual* will be consulted. Although specific sampling procedures are outlined in the SOPs, it should be noted that water samples will be collected prior to sediment samples to avoid cross contamination. All SOPs are included in Appendix D - *START and ERT Standard Operating Procedures*. Specific sampling procedures are described below.

#### *4.3.2.1 Surface Water Sampling*

START personnel will collect surface water samples as directed by EPA. Surface water samples will be submitted to a qualified subcontracted commercial laboratory for the following analyses:

- Total and Dissolved TAL metals plus molybdenum and inorganic mercury (EPA 200.7, EPA 200.8, and EPA 245.1)
- Chloride, Sulfate, Fluoride, and Nitrate (EPA 300.0)
- Hardness by Calculation (SM2340B)
- TSS (SM2540D)
- TDS (SM2540C)
- pH (SM4500H+B)

- Alkalinity (SM2320B)

The analyte list and associated analytical methods are presented in Table 4-1. The reporting limits and method detection limits are included in Appendix B of this QASP- *Surface Water and Sediment Sample Analyte List and Benchmarks*. Laboratory methods and procedures to be used by the analytical laboratories are provided in Appendix E of this QASP – *Laboratory Methods and Procedures.*

### *4.3.2.2 Surface Water Quality Monitoring*

Surface water quality parameters will be collected at each surface water sample location. These parameters will be collected using a Multi-parameter Water Quality real-time monitor. Measurements may not be possible at all locations. Site conditions and professional judgement will be used to assess whether monitoring can take place at a location or if the area is too contaminated to collect for readings. The data collected will be electronically logged when possible, or written out in the field logbook. Data collected will include the following:

- pH (0-14 standard units)
- Temperature (°C)
- Conductivity (Siemens/meter)
- Dissolved Oxygen (milligrams/liter)
- Turbidity (NTU)
- oxidation/reduction potential (ORP)

Water Quality instruments will be used according to manufacturer’s directions and SOPs as described in Appendix D - *START and ERT Standard Operating Procedures* of this QASP. All monitors will be field calibrated prior to use or at any time sensors are changed.

### *4.3.2.3 Sediment Sampling*

Sediment samples will be collected by START personnel according to SOPs presented in Appendix D - *START and ERT Standard Operating Procedures* as well as using equipment most appropriate for the site circumstances. Samples will be collected to obtain data on areas which may be impacted by the mine waste water release. Sediment and water samples will be collected at the locations determined by the EPA OSC in collaboration with an NMED representative. The

OSC or the START Project Team Leader (PTL) will make the decision on the alternate sampling points. The collected sediment samples will be submitted to either Hall Environmental Laboratories in Albuquerque, NM or TestAmerica Laboratories in Savannah, GA for the following analyses:

- TAL metals, molybdenum, and inorganic mercury (EPA Method 6010C, EPA Method 6020A, and EPA Method 7471A)
- Anions (chloride, fluoride, nitrate, and sulfate) (EPA Method 300.0)
- Grain size will be analyzed for a representative number of samples

The analyte list and associated analytical methods are included in Table 4-1. Laboratory-specific analyte lists reporting limits and method detection limits (MDLs) are included in Appendix B - *Surface Water and Sediment Sample Analyte List and Benchmarks*. Deviations from the sample locations will be due to new observations made prior to sampling, information obtained in the field that warrants an altered sampling point, difficulty in sample collection, or limited access. The EPA OSC will be notified, and concurrence will be obtained should significant deviations from the planned sampling points be proposed. Details regarding deviations of the QASP will be documented in the site logbook.

#### *4.3.2.4 Agricultural Irrigation Ditch Sampling*

**Objective**

The Animas River in New Mexico serves as a source of water to irrigation ditches that convey water to croplands and livestock throughout the water basin. The objective of the irrigation ditch sampling is to determine the extent to which the water release from the Gold King Mine to the Animas River and associated irrigation ditches poses a potential risk to crops and livestock using these waters. Sediment samples collected from the irrigation ditches will be compared with suitable background data to determine the extent to which metals levels in the sediments of the potentially affected irrigation ditches are elevated above those metal levels observed in ditch systems not affected by the Gold King Mine release. Results of this comparison will be used to determine that 1) the quality of irrigation water meets the requirements for continued use, 2) there is a need for continued monitoring, or 3) there is need for some form of remedial action.

### Sampling Design and Rationale

#### *Sample Locations*

Irrigation systems will be sampled at 20 locations (3 samples per location) throughout the Animas River basin in New Mexico (Figure 1-1). Within selected irrigation systems, sediment samples will be collected from drainage ditches throughout the system to obtain a representative characterization of the metals distribution. Within each irrigation system, as many as 10 sediment samples will be collected. Sample points will be located with a Global Positioning System (GPS) device to be used for mapping purposes and to document sample locations selected in the field. If sampling locations become inaccessible, alternate sampling locations which provide similarly adequate or sufficient data as the original will be identified and sampled based upon best judgment. The OSC or the START Project Team Leader (PTL) in collaboration with an NMED representative will make the decision on the alternate sampling points, where necessary.

#### *Sampling and Monitoring Approach*

All irrigation ditch sediment samples will be collected in general accordance with START SOP 1002-01, *SOP for Surface Water Sample Collection* and START SOP 1002-04, *SOP for Sediment Sample Collection.* In addition to these SOPs, EPA's Environmental Response Team SOP #2016 *Sediment Sampling and the Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analysis: Technical Manual* will be consulted. SOPs are included in Appendix D and the specific sampling procedures are described below.

START personnel will collect irrigation ditch sediment samples as directed by EPA. Sediment samples will be submitted to either Hall Environmental Laboratories in Albuquerque, NM or TestAmerica Laboratories in Savannah, GA for the following analyses:

- TAL metals plus molybdenum and inorganic mercury ((EPA 6010C, EPA 6020A, and EPA 7471A)

Laboratory-specific analyte lists and reporting limits are included in Appendix B. Deviations from the sample locations will be due to new observations made prior to sampling, information obtained in the field that warrants an altered sampling point, difficulty in sample collection, or limited access. The EPA OSC will be notified, and concurrence will be obtained should significant deviations from the planned sampling points be proposed. Details regarding deviations of the QASP will be documented in the site logbook.

### 4.3.3 Sampling and Field QC Procedures

Samples will be collected using equipment and procedures appropriate to the matrix, parameters, and sampling objectives. The volume of the sample collected will be sufficient to perform the analysis requested. Samples will be stored in the proper types of containers and preserved in a manner for the analysis to be performed per laboratory guidelines. Sampling activities performed on-site will follow all applicable SOPs outlined in Appendix D of this QASP, including EPA ERT SOP 2001 "*General Field Sampling Guidelines*." Sampling is anticipated to be performed in Level D personal protective equipment (PPE).

Field water quality parameters will be obtained using a Hanna, YSI, and/or Horiba water quality meter. Field monitoring will be used to measure the quality of water discharged from the treatment system, with emphasis on pH and turbidity measurements. Visual observations of water clarity will be recorded.

Dedicated sampling equipment, sample containers, and PPE will be maintained in a clean, segregated area. Personnel responsible for sampling will change gloves between each sample collection/handling activity. Personnel will use unpowered nitrile gloves as some types of powder in the powdered gloves contain zinc which could potentially contaminate samples.

START personnel will collect field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples of surface water and QA/QC samples as needed during the sampling activities. QA/QC samples will be collected according to the following dictates as outlined on Table 4-2:

- Blind field duplicate soil samples will be collected during sampling activities at locations selected by the START PTL. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results. Efforts will be made to collect duplicate samples in locations where there is visual evidence of contamination or where contamination is suspected. One duplicate sample will be collected for this sampling activity. In general, blind field duplicate samples are collected at the rate of 1 duplicate for every 10 samples collected.

- Field Blank - Field blanks will be prepared by pouring laboratory-grade de-ionized water into pre-cleaned laboratory-grade sample containers for analysis. These samples will be prepared to demonstrate the impact the surrounding environment is having on the samples being collected. Field blank samples will be collected once per day for this particular scope of work. EPA will collect field blanks at a frequency of 5% to be consistent with the 5% frequency for equipment blanks.
- Temperature Blanks - Each sample cooler shall contain a temperature blank. The temperature blank should be supplied by the receiving laboratory and can be either a 40-mililitter (ml) volatile organic compound (VOC) vial or a 100-ml plastic bottle filled with reagent grade water. The purpose of the temperature blank is to document the temperature of the representative solution contained within the same transport cooler as the collected field sample.
- Equipment Rinsate Blanks - Rinsate blanks will be prepared by pouring laboratory-grade de-ionized water over non-disposable sampling equipment after it has been decontaminated and by collecting the rinse water in sample containers for analyses. These samples will be prepared to demonstrate that the equipment decontamination procedures for the sampling equipment were performed effectively. It is anticipated that enough pre-cleaned disposable equipment will be available and that the collection of an equipment rinsate blank is not anticipated to be collected during this sampling event. However, if field conditions change an equipment rinsate blank will be collected following equipment decontamination procedures.
- Matrix spike samples will be collected during sampling activities at locations selected by the START PTL. The data obtained from these samples will be used to assist in the quality assurance of the laboratory analytical procedure. Matrix spiking ensures that the laboratory is able to extract an acceptable percentage of a spiked constituent. At the direction of EPA, one matrix spike sample may be collected for every 20 samples submitted for analysis. The matrix spiking analysis often duplicates the spiking procedure on a separate sample volume.

### 4.3.4 Investigation-Derived Wastes

Attempts will be made to eliminate or minimize the generation of investigation-derived waste (IDW) during this investigation. Non-dedicated equipment will be rinsed with soap and water and attempts will be made to dispose of decontamination fluids on-site. The analytical data from collected samples will be reviewed after completion of the field activities, and disposal options will be evaluated accordingly. It is anticipated that minimal amounts of IDW will be generated during this activity.

### 4.3.5 Sampling and Sample Handling Procedures

Samples will be collected using equipment and procedures appropriate to the matrix, parameters, and sampling objectives. The volume of the sample collected must be sufficient to perform the laboratory analysis requested. Samples must be stored in the proper types of containers and preserved in a manner appropriate to the analysis to be performed.

All clean, decontaminated sampling equipment and sample containers will be maintained in a clean, segregated area. All samples collected for laboratory analysis will be placed directly into pre-cleaned, unused glass or plastic containers. Sampling personnel will change gloves between each sample collection/handling. All samples will be assembled and catalogued prior to shipping to the designated laboratory.

## 4.4 SAMPLE MANAGEMENT

Specific nomenclature that will be used by START personnel will provide a consistent means of facilitating the sampling and overall data management for the project. The START Field Team Leader (FTL) must approve any deviations from the sample nomenclature proposed below.

As stated in START SOP 0110.05, sample nomenclature will follow a general format regardless of the type or location of the sample collected.

The sediment sample nomenclature consists of the following components:

Area of Concern – ID – Depth - Collection Type + QC Type

Where:

| | |
|---|---|
| Area of Concern: | A four-digit identifier used to designate the particular Area of Concern (AOC) that the location where the sample was collected. |
| ID: | A three-letter and/or digit identifier used to designate the particular location (i.e., grid, A01, P06, or 055) in the AOC from which the sample was collected, or the center of the composite sample. |

| | |
|---|---|
| Depth: | A two-digit code used to designate what depth of sample was collected. |

| code | Assessment | Confirmation |
|---|---|---|
| 00 | 0 to 0 Surface | N/A |
| 03 | 0 to 3 inches | 3 inches below original ground surface |
| 06 | 3 to 6 inches | 6 inches below original ground surface |
| 12 | 6 to 12 inches | 12 inches below original ground surface |

| | |
|---|---|
| Collection Type: | A one-digit code used to designate what type of sample was collected: |

| | |
|---|---|
| 1 | Surface Water |
| 2 | Groundwater |
| 3 | Leachate |
| 4 | Field QC/water sample |
| 5 | Soil/Sediment |
| 6 | Oil |
| 7 | Waste |
| 8 | Other |
| 9 | Drinking Water |

| | |
|---|---|
| QC Type: | A one-digit code used to designate the QC type of the sample: |

| | |
|---|---|
| 1 | Normal |
| 2 | Duplicate |
| 3 | Rinsate Blank |
| 4 | Trip Blank |
| 5 | Field Blank |
| 6 | Confirmation, Normal |
| 7 | Confirmation, Duplicate |

The water sample nomenclature consists of the following components:

WELL OR STATION – YYMMDD - Collection Type + QC Type

Where:

| | |
|---|---|
| Well or Station: | For Wells and boreholes always assume there will be 10 or more, so Monitoring Well 1 becomes designated MW01 or MW-01. If it is anticipated that there will be over 100 wells, designate Monitoring Well 1 as MW001 or MW-001. For stations along a water pathway use stations from the farthest-most upstream point and travel downstream in 100-foot increments (i.e., point of probable entry would be Station 0+00 or ST000; 525 feet downstream would be 5+25 or ST525) |
| YYYYMMDD: | A four-digit year + two-digit month + two-digit day. |
| Collection Type: | A one-digit code used to designate what type of sample was collected. |
| QC Type: | A one-digit code used to designate the QC type of the sample. |

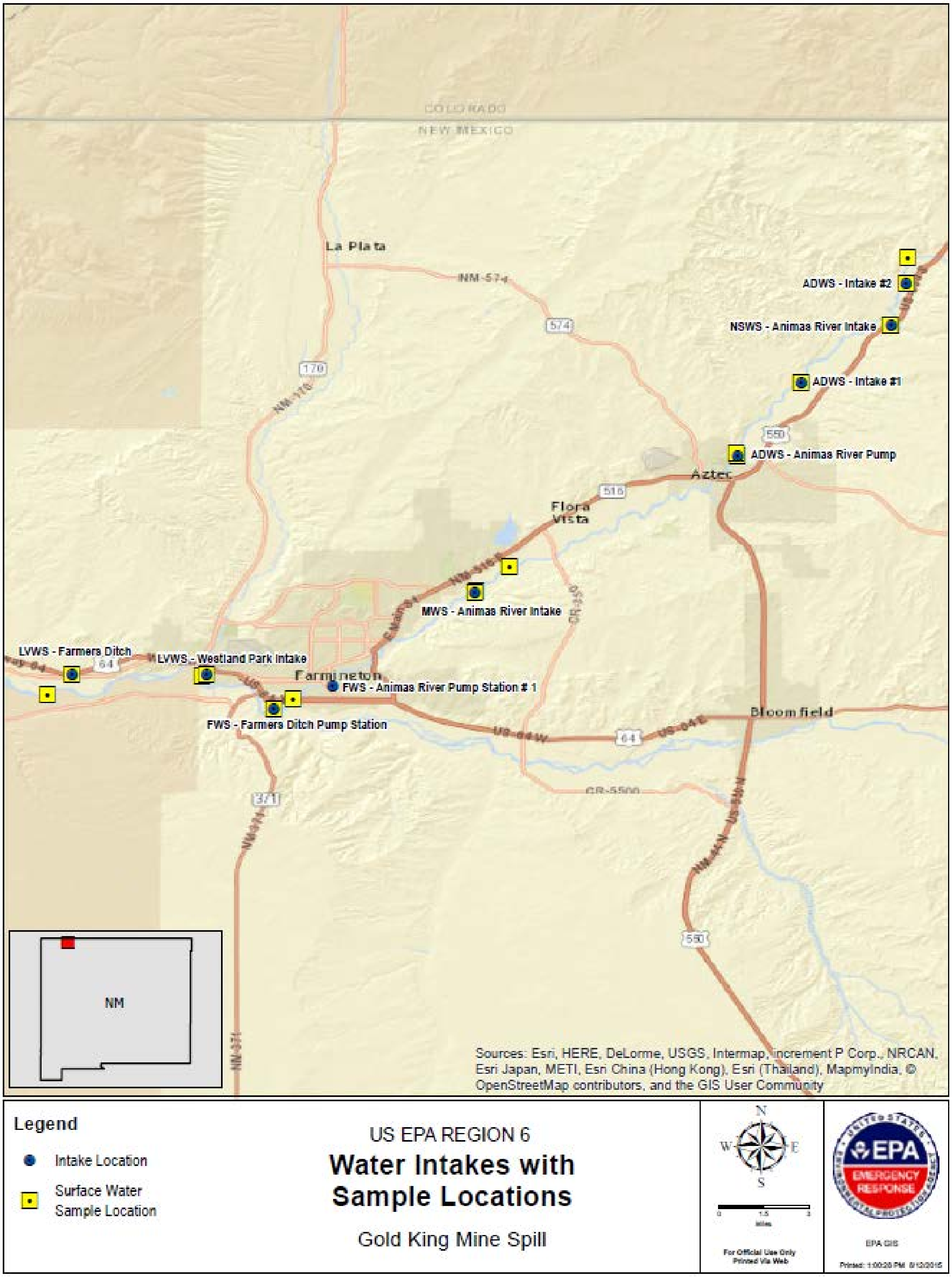
Sample data management will be completed utilizing SCRIBE including Chain-of-Custody (COC) and sample documentation needs.

## 4.5 SAMPLE PRESERVATION, CONTAINERS, AND HOLD TIMES

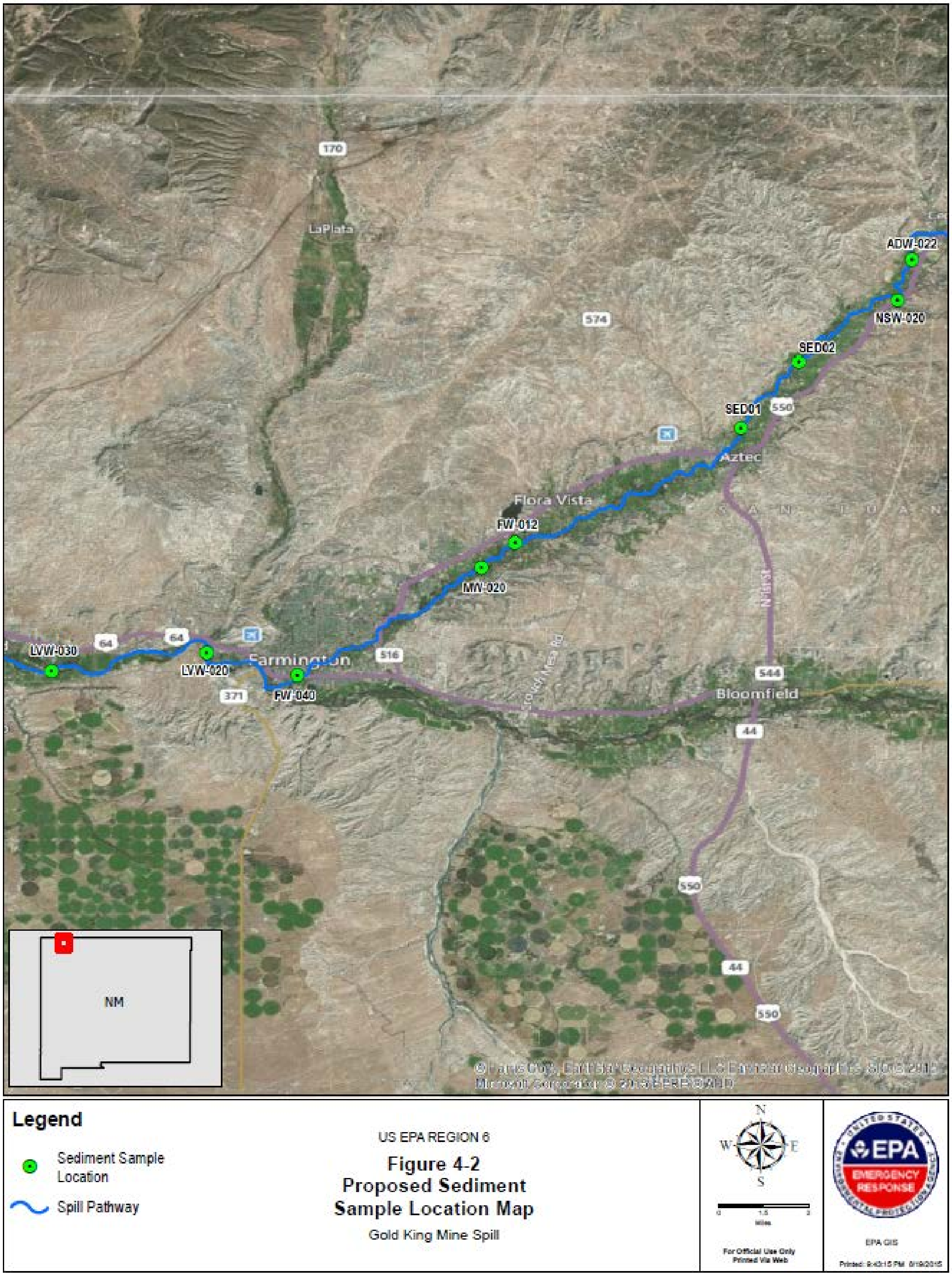
Water samples will be stored in coolers at 4 degrees centigrade (C), on-site until shipped for laboratory analysis. The samples will be shipped via common carrier to the laboratory or driven by START members to the designated laboratory.

Table 4-1 summarizes the presentation, containers, and hold times for each analytical method. The contractual analytical turnaround time (TAT) is initiated when the samples are collected in the field and continues until the analytical results are made available to START either verbally or by providing facsimile or email copies of the results for review. All samples that have been analyzed will be disposed by the designated laboratory in accordance with the laboratory SOPs provided in Appendix E.

## Figure 4-1
## Water Intake Sample Location Map



## Figure 4-2
## Proposed Sediment Sample Location Map



## Table 4-1
## Requirements for Containers, Preservation Techniques, Volumes, and Holding Times

| Name | Analytical Methods | Matrix | Container | Preservation | Minimum Volume or Weight | Maximum Holding Time |
|---|---|---|---|---|---|---|
| Total Metals and Mercury plus hardness by Calculation | Metals: EPA Methods 200.7, 200.8, and 245.1, 300.0<br>Hardness: SM2340B | Water | Polyethylene (water) | $HNO_3$ to pH<2 (water), 4°C | 1 x 250 mL | 28 days for mercury<br>180 days all other metals |
| Dissolved Metals and Mercury | EPA Methods 200.7, 200.8, and 245.1 | Water | Polyethylene (water) | Field Filtered: /$HNO_3$ to pH<2 (water), 4°C<br>*If not field filtered then no preservative* | 1 x 500- mL | 28 days for mercury<br>180 days all other metals |
| Anions* | EPA 300.0 | Water | Polyethylene (water) | 4°C | 1 x 250-mL (or may be included with pH and alkalinity since not preserved) | 48 hours for nitrate<br>28 days all other anions |
| Total Dissolved Solids | SM2540C | Water | Polyethylene (water) | 4°C | 1 x 250-mL (or may be included with Dissolved metals if not preserved) | 7 days |
| Total Suspended Solids | SM2540D | Water | Polyethylene (water) | 4°C | 1 x 1-L | 7 days |
| pH | SM4500H+B | Water | Polyethylene (water) | 4°C | 1 x 250-mL | ASAP |
| Alkalinity | SM2320B | | | | | 14 days |
| Total Metals and Mercury | EPA 6010C, 6020A, and 7471A | Soil/ Sediment | Glass wide-mouth jar | 4°C | 1 x 4 oz. | 28 days for mercury<br>180 days all other metals |
| Anions* | EPA 9056 | Soil/ Sediment | Glass wide-mouth jar | 4°C | 1 x 4 oz. | 48 hours for nitrate<br>28 days all other anions |

SM = Standard Methods for the Examination of Water and Wastewater

ASAP = As soon as possible

* Anions list includes chloride, fluoride, nitrate, and sulfate. Note that there is no published holding time for anions in solid matrices, the listed holding time is based on the holding time for the water leachate.

## Table 4-2
## Field Quality Control Sample Summary

| Matrix | Analyte/Analytical Group | No. of Field Samples[1] | No. of Field Duplicates | No. of MS/MSD | No. of Field Blanks | No. of Equip. Blanks | No. of Trip Blanks | No. of Other | Total No. of Samples to Laboratory |
|---|---|---|---|---|---|---|---|---|---|
| Surface Water | Total Metals | TBD | 1 per 10 | 1 per 20 or 1 per day | 1 per 20 or 1 per day | 1 per 20 if using non-disposable equipment | 0 | 0 | TBD |
| Surface Water | Dissolved Metals | TBS | 1 per 10 | 1 per 20 or 1 per day | 1 per 20 or 1 per day | 1 per 20 if using non-disposable equipment | 0 | 0 | TBD |
| Groundwater | Total Metals | TBD | 1 per 10 | 1 per 20 or 1 per day | 1 per 20 or 1 per day | 1 per 20 if using non-disposable equipment | 0 | 0 | TBD |
| Groundwater | Dissolved Metals | TBS | 1 per 10 | 1 per 20 or 1 per day | 1 per 20 or 1 per day | 1 per 20 if using non-disposable equipment | 0 | 0 | TBD |
| Sediment | Total Metals | TBD | 1 per 10 | 1 per 20 or 1 per day | 1 per 20 or 1 per day | 1 per 20 if using non-disposable equipment | 0 | 0 | TBD |

[1] Samples that are collected at different depths at the same location, and analyzed separately, will be counted as separate field samples. Even if they are taken from the same container as the parent field sample, MS/MSDs are counted separately, because they are analyzed separately. If composite samples or incremental samples are collected, only the sample that will be analyzed will be included; subsamples and increments will not be listed separately.

[2] Total number of samples to the laboratory does not include MS/MSD samples.

Note: If EPA requests that field samples be collected from treatment system water and analyzed for total and dissolved metals, the need for a duplicate will be determined based on the rationale for sampling. The number and types of QC samples will be based on project-specific DQOs and this table will be adapted, as necessary, to accommodate project-specific requirements.

# 5. ANALYTICAL APPROACH

## 5.1 LABORATORY ANALYSIS

The water and sediment samples will be submitted to a qualified subcontracted commercial laboratory for the following analyses with a turn-around-time of 24 hours for analytical results. Hall Environmental Laboratories in Albuquerque, NM and TestAmerica Laboratories in Savannah, GA are the selected laboratories for these analyses. Laboratory SOPs for chemical analyses are provided in Appendix E-*Laboratory Methods and Procedures*.

**Water**

- Total Metals, Molybdenum and Mercury by EPA Methods 200.7, 200.8, and 245.1
- Chloride, Sulfate, Fluoride, and Nitrate, EPA Method 300.0
- Hardness by SM2340B
- Dissolved Metals and Mercury by EPA Methods 200.7, 200.8, and 245.1
- Total Dissolved Solids by SM2540C
- Total Suspended Solids by SM2540D
- pH bySM4500H+B
- Alkalinity by SM2320B

**Sediment**

- TAL metals, molybdenum, and inorganic mercury (EPA Method 6010C, EPA Method 6020A, and EPA Method 7471A)
- Anions (EPA Method 300.0)
- Grain size will be analyzed for a representative number of sediment samples collected.

The START team will indicate on the Chain of Custody that a Level IV data package is required.

The laboratory shipping information is as follows:

TestAmerica Laboratories, Inc. - Savannah
5102 LaRoche Avenue
Savannah, GA 31404
(912) 354-7858

Deliverables will include preliminary data via email in portable document (pdf) format and an Electronic Data Deliverable (EDD) in excel format and an electronic deliverable. The final data deliverable will include a full Level IV "Contract Laboratory Program (CLP) like" data package in PDF format and a final EDD in excel format.

## 5.2 MEASUREMENT PERFORMANCE CRITERIA TABLES

Data Quality Objectives (DQOs) for Surface Water Sampling and Sediment Sampling have been developed and are presented in Appendix C - Site-Specific Data Quality Objectives of this QASP.

The following are measurement performance criteria for inorganic sample collection for all media.

**Matrix:** All
**Analytical Group or Method:** Inorganics
**Concentration Level:** All

| Data Quality Indicator | QC Sample or Measurement Performance Activity | MPC |
|---|---|---|
| Field Precision | Field Duplicate | 1 per 10 samples<br>RPD: 50% (soil) and 30% (water) |
| Field Representativeness/ Accuracy/Bias | Equipment Rinsate Blank | 1 per 20 samples/matrix or 1 per day<br><½ RL |
| Accuracy/Bias | MS/MSD | 1 per 20 samples per matrix<br>75-125%R for metals (NFG) and RPD <20%<br>%R and RPD within statistically-derived laboratory acceptance limits for non-metals methods |
| Laboratory Precision | Laboratory Duplicate[1] | 1 per 20 samples per matrix<br>RPD within statistically-derived laboratory acceptance limits for non-metals methods |
| Laboratory Representativeness/ Accuracy/Bias | Method Blank | 1 per batch per matrix or 1 per 20 samples, whichever is more frequent<br>No analyte ≥ RL |
| Laboratory Accuracy/ Sensitivity | LCS | 70-130%R for metals per the Inorganic NFG (2014)[2]<br>%R within statistically-derived laboratory acceptance limits for non-metals methods |

[1] Laboratory Duplicates performed for wet chemistry parameters that cannot be spiked (e.g., alkalinity, pH, TDS, TSS, etc.)

[2] NFG = USEPA National Functional Guidelines for Inorganic Superfund Data Review (2014)

## 5.3 SECONDARY DATA USES AND LIMITATIONS

Sources and types of secondary data include but are not limited to the following:

| **Data Type** | **Data Source** (originating organization, report title and date) | **Data Uses Relative to Current Project** | **Factors Affecting the Reliability of Data and Limitations on Data Use** |
|---|---|---|---|
| Soils | United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Web Soil Survey and Soil Data Mart | Identify soil types, composition, elevation, precipitation, setting, properties and qualities, profile, land capability and farmland classification | |
| Geology/Hydrology | United States Department of the Interior Geologic Survey (USGS) Topographic and Geologic Maps, State Agencies/EPA My WATERS Mapper | Identify area geology, topography, surface water bodies, hydrologic units/watersheds, water quality, etc. | |
| Streams/Drainages | EPA My WATERS Mapper and USGS Topographic Maps | Topography, surface water bodies, hydrologic units/watersheds, water quality, etc. | |
| Registered Wells | State Databases | Identify well locations, drinking water wells, and groundwater use | |
| Meteorological | National Weather Service | Seasonal fluctuations in storm-water runoff | |
| Property Boundaries | County Assessor and Plat Maps | Identify property boundaries to determine site requirements for assessment | |
| Environmentally Sensitive Areas | U.S. and State Fish & Wildlife Service Maps, Publications, and Databases | Identify sensitive and endangered species and environments potentially present on or in removal action/emergency response area | |
| Wetlands | USDA NRCS Web Soil Survey and Soil Data Mart (Hydric Soils List), and U.S. and State Fish & Wildlife Databases | Identify wetlands and associated sensitive and endangered species and environments potentially present on or in removal action/emergency response area | |
| Historical and Current Site Use and Investigations | Historical Records, Previous Investigations, Visual Site Reconnaissance, and Interviews | Supplemental background information on historical site use and current site conditions, and previous investigations | |

The project team will carefully evaluate the quality of secondary data (in terms of precision, bias, representativeness, comparability, and completeness) to ensure they are of the type and quality necessary to support their intended uses. When evaluating the reliability of secondary data and determining limitations on their uses, the project team will consider the source of the data, the time period during which they were collected, data collection methods, potential sources of uncertainty, the type of supporting documentation available, and the comparability of data collection methods to the currently proposed methods. With respect to secondary analytical data that will be utilized to support critical decisions, such as comparison of contaminant levels with applicable standards, a detailed review of the data will be necessary to determine the usability of the data. In addition to the qualitative rating of the data source, the project team should complete a data quality review and document the review in a data usability summary.

## 5.4 DATA VALIDATION

START will validate the analytical data at a Stage 2A level based on delivery of a Level II deliverable generated by the outside laboratories using EPA-approved validation procedures in accordance with the *USEPA National Functional Guidelines for Inorganic Superfund Data Review* (August 2014). A summary of the data validation findings will be presented in Data Validation Summary Reports as part of the final report. START will evaluate the following applicable parameters to verify that the analytical data is within acceptable QA/QC tolerances:

- The completeness of the laboratory reports, verifying that required components of the Level II report are present and that the samples indicated on the accompanying chain-of-custody are addressed in the report.
- Holding time and preservation
- The results of laboratory blank analyses.
- The results of laboratory control sample (LCS) analyses.
- The results of matrix spike/matrix spike duplicate (MS/MSD) analyses.
- The results of surrogate recovery analyses (for any organic analyses).
- Laboratory precision, by reviewing the results for laboratory duplicates.
- Field and laboratory precision, by reviewing the results for blind field duplicates.

Variances from the QA/QC objectives will be addressed as part of the Data Validation Summary Reports.

Validation will be performed on all laboratory analytical data unless a defined quantity or percentage of samples is identified by EPA in the Technical Direction Document (TDD) or during the project scoping meeting on a project-specific basis. WESTON-contracted laboratory data packages will be verified and validated using a Stage 2A validation, as described in the EPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (January 2009) unless otherwise specified by the EPA WAM/COR during the development of the DQOs. Validation Qualifiers will be applied using the following hierarchy: Region 6 UFP-QASP for Removal Actions and Emergency Responses; the site-specific SAP, and/or QASP; *EPA National Functional Guidelines for Organic Data Review*; *EPA National Functional Guidelines for Inorganic Data Review*; EPA Methods; and/or the laboratory-specific SOP. Methods for which no data validation guidelines exist will be validated following the guidance deemed most appropriate by the data validator.

The data validator will receive all laboratory packages and analytical results electronically. Additionally, the validator will be required to submit final validation reports via PDF format and must provide an annotated laboratory analytical result electronic data deliverable (EDD) with applicable data validation qualifiers identified in the site-specific SAP, and/or QASP, and/or result value modifications. The Delegated Quality Assurance (QA) Manager will use the EPA document *Using Qualified Data to Document an Observed Release and Observed Contamination* (July 1996) to aid in determining the use of qualified data to document all observed release and observed contamination by chemical analysis under EPA's Hazard Ranking System (HRS) Approved data will be released by the Delegated QA Manager for reporting.

## 5.5 DATA USABILITY ASSESSMENT

Personnel (organization and position/title) responsible for participating in the data usability assessment may include, but not be limited to:

- START PM;
- START Delegated QA Manager;

- START Risk Assessor;
- START Chemist; and
- START PTL.

Based on project-specific oversight responsibilities and analytical scopes, this data usability assessment outlines the approach that will be taken as the analytical scope expands on a project-specific basis. The following general steps will be followed to assure that the data usability assessment evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence:

- Step 1 – Review the project's objectives and sampling design.
- Step 2 – Review the data verification and data validation outputs.
- Step 3 – Verify the assumptions of the selected statistical method.
- Step 4 - Implement the statistical method.
- Step 5 – Document data usability and draw conclusions.

The data usability assessment is considered the final step in the data evaluation process; all data will be assessed for usability, regardless of the data evaluation/validation process implementation. Data usability goes beyond validation in that it evaluates the achievement of the Data Quality Objectives (Appendix C) based on the comparison of the project Data Quality Indicators (DQIs) and individual study-specific work plans, with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be reported in the data summary.

Primarily, the assessment of the usability will follow procedures described in appropriate EPA guidance documents, particularly Guidance for Data Usability in Risk Assessment (Publication No. 9285.7-05FS, September 1992), and will be conducted according to the process outlined below.

1. **Sampling and Analysis Activities Evaluation**: The first part of the data usability evaluation will include a review of the sampling and analysis activities in comparison to project-specific DQIs and study-specific work plans. Specific limitations to the data (i.e., results that are qualified as estimated [J/UJ], or rejected [R], will be determined and documented in the database).

2. **Achievement of DQIs**: The second part of data usability pertains to the achievement of the program-specific DQIs. Each investigator will compare the performance achieved for each data quality criterion against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from re-sampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. If corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

   In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (bias, imprecision, etc.) of the qualified results. Cumulative Quality Control (QC) exceedances from the DQIs may require technical judgment to determine the overall effect on the usability of the data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA document mentioned, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

3. **Achievement of DQOs**: The final part in the data usability process concerns achievement of the DQOs (Appendix C). Once the data set has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

   - Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were expected to migrate from potential hazardous substance source areas?
   - Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
   - Are the data statistically adequate to evaluate on a per chemical and per media basis?
   - Does the data collected allow assessment of hydrogeologic factors, which may influence contaminant migration/distribution?
   - Do laboratory reporting limits attain the applicable state and/or federal standards and/or screening levels?
   - Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
   - Have sufficient data been collected to evaluate how factors including physical characteristics of the site and climate and water table fluctuations affect contaminant fate and transport?

- Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances that which may remain as residual contamination at the source facility?

Principal investigators, in conjunction with the project team, will formulate solutions if data gaps are found as a result of problems, biases, trends, etc., in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO.

If the project scope changes, the DQOs will be expanded. The DQOs will address the specific action limits and measurable performance criteria in order to make appropriate decisions on the analytical data.

DQIs, such as precision, accuracy, completeness, representativeness, and comparability measurements, aid in the evaluation process and are discussed below.

## Precision

The most commonly used estimates of precision are the RPD for cases in which only two measurements are available, and the percent RSD (%RSD) when three or more measurements are available. This is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentration indigenous to samples.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows:

$$\text{RPD} = \frac{|C1-C2|}{\frac{C1+C2}{2}} \text{ x } 100$$

Where:

$C_1$ = First measurement value
$C_2$ = Second measurement value

For field measurements such as pH, where the absolute variation is more appropriate, precision is often reported as the absolute range (D) of duplicate measurements:

$$\%D = m1 - m2$$

Where:

$m1$ = First measurement value
$m2$ = Second measurement value

The % RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula:

$$\%\,\mathrm{RSD} = \frac{\sqrt{\sum_{I-1}^{N}\left(\frac{\mathrm{RFi}-\mathrm{RF}}{\mathrm{N}-1}\right)}}{\mathrm{RF}} \times 100$$

Where:

RF = Response factor
N = Number of measurements

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or LCS purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes (BS) for organic analyses. For multi-analyte methods, the LCS or BS may contain only a representative number of target analytes rather than the full list.

The RPD for duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrix.

## Accuracy/Bias

Accuracy control limits are established by the analysis of control samples, which are in water and/or solid/waste matrices. For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the blank spike. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis for soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The %R for spiked investigative sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the respective matrix. These values are used to assess a reported result within the context of the project DQOs. For results that are outside control limits provided as requirements in the QASP, corrective action appropriate to the project will be taken and the deviation will be noted in the case narrative accompanying the sample results. Percent recovery (%R) is defined as follows:

$$\% \text{ Recovery} = \frac{(AT - A0)}{AF} \text{ x } 100$$

Where:

$A_T$ = Total amount recovered in fortified sample
$A_0$ = Amount recovered in unfortified sample
$A_F$ = Amount added to sample

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This is measured as percent difference (%D) from the reference value and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration.

The %D is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. This method for precision measurement can be expressed by the formula:

$$\% D = \frac{C1 - C2}{C1} \text{ x } 100$$

Where:

$C_1$ = Concentration of analyte in the initial aliquot of the sample.
$C_2$ = Concentration of analyte in replicate.

The laboratory will review the QC samples and surrogate recoveries for each analysis to ensure that the %R lies within the control limits listed in the UFP-QASP. Otherwise, data will be flagged by the laboratory.

For field measurements such as pH, accuracy is often expressed in terms of bias (B) and is calculated as follows:

$$B = M - A$$

Where:

M = Measured value of Standard Reference Material (SRM)
A = Actual value of SRM

## Sensitivity

Sensitivity is the ability of the analytical test method and/or instrumentation to differentiate between detector responses to varying concentrations of the target constituent. Methodology to establish sensitivity for a given analytical method or instrument includes examination of standardized blanks, instrument detection limit studies, and calibration of the QL. The findings of the usability of the data relative to sensitivity will be included in the report, including any limitations on the data set and/or individual analytical results.

The Precision, Accuracy, Representativeness, Completeness, Comparability and Sensitivity MPC, as described in the following steps, will be performed:

- Evaluate if the project required quantitation limits were achieved for non-detected site contaminants. If no detectable results were reported and data are acceptable for the verification and validation steps, then the data are usable.
- If detectable concentrations are reported and the verification and validation steps are acceptable, the data are usable.
- If verification and validation are not acceptable, the data are qualified, estimated (J, UJ) for minor QC deviations that do not affect the data usability, or rejected for major QC deviations affecting data usability. The impact of rejected data will be evaluated and re-sampling may be necessary. Use of estimated data will be discussed in the project report.
- For statistical comparisons and mathematical manipulations, non-detect values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate will be used to represent the concentration at that sample location.

Statistical tests will be conducted to identify potential outliers. Potential outliers will be removed if a review of the field and laboratory documentation indicates that the results are true outliers.

Method sensitivity is typically evaluated in terms of the method detection limit (MDL) and is defined as follows for many measurements:

$$MDL = {}^{t}(n - 1, 1 - \alpha = 0.99)\,(s)$$

Where:

$s$ = Standard deviation of the replicate analyses
${}^{t}(n - 1, 1 - \alpha = 0.99)$ = Student's t-value for a one-sided 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom
$n$ = Number of measurements
$\alpha$ = Statistical significance level

**Representativeness**

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Data representativeness for this project is accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within the site-specific SAP, and/or QASP.

Field personnel will be responsible for collecting and handling samples according to the procedures in this QASP and the site-specific SAP and/or QASP so that samples are representative of field conditions. Errors in sample collection, packaging, preservation, or chain-of-custody procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

**Comparability**

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data. Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, use standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

## Completeness

Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample. The following calculation is used for determining the percent complete:

$$\text{Completeness} = \frac{A}{B} \text{ x}100$$

Where:

A = Actual number of measurements judged valid (the validity of a measurement result is determined by judging its suitability for its intended use)
B = Total number of measurements planned to achieve a specified level of confidence in decision making

The formula for sampling completeness is:

$$\text{Sampling Completeness} = \frac{\text{Number of locations sampled}}{\text{Number of planned sample locations}} \text{ x}100$$

An example formula for analytical completeness is:

$$\text{Metals Analytical Completeness} = \frac{\text{Number of Usable Data Points}}{\text{Expected Number of Usable Data Points}} \text{ x}100$$

The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis.

## Graphics

Graphic figures will be generated to depict sample locations, as needed. Also, if necessary, figures will be generated to represent contaminant concentrations at each sampling location. Each figure will contain a detailed legend.

## Reconciliation

PQOs will be examined to determine if the objective was met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the data verification and validation, DQIs, and MPC assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the Project Quality Objectives (PQO) was met and whether project action limits were exceeded. As part of the reconciliation of each objective, conclusions will be drawn, and any limitations on the usability of any of the data will be described.

# 6. QUALITY ASSURANCE

An EPA Region 6 Quality Control (QC) Officer will be assigned and will monitor work conducted throughout the entire project including reviewing interim report deliverables and field audits. The START PTL will be responsible for QA/QC of the field sampling and monitoring activities. The designated laboratory utilized during the investigation will be responsible for QA/QC related to the analytical work. START personnel will also collect samples to verify that laboratory QA/QC is consistent with the required standards and to validate the laboratory data received.

## 6.1 SAMPLE CUSTODY PROCEDURES

Because of the evidentiary nature of sample collection, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. After sample collection and identification, samples will be maintained under chain-of-custody (COC) procedures. If the sample collected is to be split (laboratory QC), the sample will be allocated into similar sample containers. Sample labels completed with the same information as that on the original sample container will be attached to each of the split samples. Personnel required to package and ship coolers containing potentially hazardous material will be trained accordingly.

START personnel will prepare and complete chain-of-custody forms using the Scribe Environmental Sampling Data Management System (SCRIBE) for all samples sent to a START designated off-site laboratory. The chain-of-custody procedures are documented and will be made available to all personnel involved with the sampling. A typical chain-of-custody (COC) record will be completed each time a sample or group of samples is prepared for shipment to the laboratory. The record will repeat the information on each sample label and will serve as documentation of handling during shipment. A copy of this record will remain with the shipped samples at all times, and another copy will be retained by the member of the sampling team who originally relinquished the samples. At the completion of the project, the data manager will export the SCRIBE COC documentation to the Analytical Service Tracking System (ANSETS) database.

Samples relinquished to the participating laboratories will be subject to the following procedures for transfer of custody and shipment:

- Samples will be accompanied by the COC record. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the sample transfer on the record. This custody records document transfer of sample custody from the sampler to another person or to the laboratory.
- Samples will be properly packed for shipment and dispatched to the appropriate laboratory for analysis with separate, signed custody records enclosed in each sample box or cooler. Sample shipping containers will be custody-sealed for shipment to the laboratory. The preferred procedure includes use of a custody seal wrapped across filament tape that is wrapped around the package at least twice. The custody seal will then be folded over and stuck to the seal to ensure that the only access to the package is by cutting the filament tape or breaking the seal to unwrap the tape.
- If sent by common carrier, a bill of lading or airbill will be used. Bill of lading and airbill receipts will be retained in the project file as part of the permanent documentation of sample shipping and transfer.

## 6.2 PROJECT DOCUMENTATION

Field observations will be recorded legibly and in ink and by entry into field logbooks, Response Manager, or SCRIBE. Response Manager is the Enterprise Data Collection System designed to provide near real-time access to non-analytical data normally collected in logbooks. Response Manager provides a standard data collection interface for modules of data normally collected by START field personnel while on-site. These modules fall into two basic categories for Response and Removal. The modules include Emergency Response, Reconnaissance, Facility Assessment, Shipping, Containers, Materials, Calls, HHW, and General/Site Specific data. The system provides users with a standard template for laptop/desktop/tablet PCs that will synchronize to the secure web interface using merge replication technology to provide access to field collected data via on the Regional Response Center Enterprise Data Management System (RRC-EDMS) EPA Web Hub. Response Manager also includes a PDA application that provides some of the standard data entry templates from Response Manager to users for field data entry. Response Manager also includes an integrated GPS unit with the secure PDA application, and the coordinates collected in Response Manager are automatically mapped on the RRC-EDMS interactive mapping site. GIS personnel can then access this data to provide comprehensive site maps for decision-making support.

Response Manager also includes an Analytical Module that is designed to give SCRIBE users the ability to synchronize the SCRIBE field data to the RRC-EDMS Web Hub. This allows analytical data managers and data validators access to data to perform reviews from anywhere with an Internet connection. The Analytical Module is designed to take the analytical data entered into EPA SCRIBE software and make it available for multiple users to access on one site. START personnel will utilize SCRIBE for data entry on-site and will upload to the Response Manager Analytical module.

### 6.2.1 Field Documentation

The following field documentation will be maintained as described below.

**Field Logbook.** The field logbook is a descriptive notebook detailing site activities and observations so that an accurate, factual account of field procedures may be reconstructed. Logbook entries will be signed by the individuals making them. Entries should include, at a minimum, the following:

- Site name and project number.
- Names of personnel on-site.
- Dates and times of all entries.
- Description of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.
- Site observations.
- Identification and description of samples and locations, including Latitudes and Longitudes.
- Subcontractor information and names of on-site personnel.
- Dates and times of sample collections and chain-of-custody information.
- Records of photographs.
- Site sketches of sample location including identification of nearest roads and surrounding developments.
- Calibration results.
- Changes from the sampling plan.

**Sample Labels.** Sample labels will be securely affixed to the sample container. The labels will clearly identify the particular sample and include the following information:

- Site name and project number.
- Date and time the sample was collected.
- Sample preservation method.
- Analysis requested.
- Sampling location.

**Chain-of-Custody Record (COC).** A COC will be maintained from the time of sample collection until final deposition. Every transfer of custody will be noted and signed for and a copy of the record will be kept by each individual who has signed it.

**Custody Seal.** Custody seals demonstrate that a sample container has not been tampered with or opened. The individual who has custody of the samples will sign and date the seal and affix it to the container in such a manner that it cannot be opened without breaking the seal.

**Photographic Documentation.** START will take photographs to document site conditions and activities. Photographs should be taken with either a film camera or digital camera capable of recording the date on the image. Each photograph will be recorded in the logbook and within Response Manager with the location of the photographer, direction the photograph was taken, the subject of the photograph, and its significance (i.e., why the picture was taken). Where appropriate, the photograph location, direction, and subject will also be shown on a site sketch and recorded within Response Manager.

### 6.2.2 Report Preparation

At the completion of the project, START will review and validate laboratory data and prepare a draft report of field activities and analytical results for EPA OSC review. Draft deliverable documents will be uploaded to the EPA TeamLink website for EPA OSC review and comment.

### 6.2.3 Response Manager

START will use the Response Manager module located on the EPA Web Hub to collect and organize the data collected from project activities. The information to be included encompasses some or all of the following depending on the specific project needs:

- General Module – Site specific data including location and type of site. It also includes an area for key site locations including geo-spatial data associated with the key site locations.
- Emergency Response Module – includes the following sub-modules: Basic Info, HAZMAT, Release, Time Line Log, Incident Zones, Photos, Sensitive Receptors, Evacuations, Source, Cause, and Weather.
- Reconnaissance Module – provides standard templates with the flexibility of adding any additional questions of values to the drop-down lists for targeted reconnaissance efforts. Typically the data in this module is associated with ESF-10 deployments and the clean-up of orphaned containers and hazardous debris, but the module can be utilized for any and all reconnaissance activities.
- Facility Assessment Module – provides standard templates with the flexibility of adding any additional questions of values to the drop-down lists for assessments of structures. This is typically utilized for EPA-regulated program facilities during an ESF-10 deployment of resources. This module can be utilized to track the assessment of any facilities including multiple assessments of the fixed facilities.
- Shipping Module – provides standard templates for creating a cradle-to-grave record of waste shipments from the site until they are recycled or destroyed. This includes the ability to capture manifests and manifest line items and to upload photos/original documents to support the records.
- Container Module – provides standard templates for cataloging containers including HAZCAT and Layer information in each container. The module also allows for the tracking of which containers are bulked.
- Properties Module – provides standard templates with the flexibility of adding any additional questions of values to the drop-down lists for collection of property data including access agreements and assessments of the property and current status of property regarding the site removal action.
- Materials Module – provides standard templates for tracking materials that are brought on-site or that are removed from the site.
- Daily Reports – provides standard templates for tracking daily site activities, daily site personnel, and daily site notes for reporting back to the EPA OSC in a POLREP or SITREP.
- Household Hazardous Waste Module (HHW) – provides standard templates with the flexibility of adding any additional questions of values to the drop-down lists for tracking the amount of HHW collected at individual collection stations by HHW type.

- Data Files – data files can be uploaded in the photo-module section and be associated with individual records or with the site in general. The metadata associated with that data file can be filled in using the photo log fields.

The data stored in the Response Manager database can be viewed and edited by any individual with access rights to those functions. At any time deemed necessary, Pollution Reports (POLREPs) and/or Situation Reports (SITREPs) can be generated by exporting the data out of Response Manager into Microsoft Excel/Word. The database is stored on a secure server and backed up regularly.

# Appendix A

# Data Management Plan

# Appendix A
# R6 Gold King Mine ER Data Management Plan

## Table A-1

| | | | | | |
|---|---|---|---|---|---|
| | This data management plan (DMP) is intended to provide guidance for data collection by field personnel and subsequent data management activities. The data collection and management practices presented in this plan are designed to ensure data integrity and consistency for all data collection personnel and from operational period to the next. This document is intended to be used in conjunction with the Region 8 Data Management Plan and only includes the details specific to the site. | **Site-Specific Data Management Plan** | | | |
| | | **Project Name:** | Gold King Mine ER | **TDD Number/Site ID:** | |
| | | **Author:** | Janine Latham | **Company:** | Weston Solutions |
| | | **Date Initiated :** | 8/8/2015 | **Last Updated:** | |
| **Reviewed by:** | | | **Date:** | | |

## Site Specific Data Elements and Valid Values

**Data Processing**

The following table outlines the specific requirements for various data types being collected during the project.

| Data Stream[1] | Site Specific Procedure (Y/N)[2] | Required Information[3] | Data Source[4] | Site Specific Data Elements (Y/N) | QA Process[5] | Data Repository[6] | Reporting Task |
|---|---|---|---|---|---|---|---|
| Water Sampling Data | Y | *Location, sample number, sample matrix, water quality parameters* | iPad (if available), Field logbook, Water quality meter | Y | Reviewed by field personnel prior to import into scribe | Scribe.net | Results Report, Geospatial Viewer |
| Sediment Sampling Data | Y | *Location, sample number, sample matrix* | iPad (if available), Field logbook, Water quality meter | Y | Reviewed by field personnel prior to import into scribe | Scribe.net | Results Report, Geospatial Viewer |
| Photographic Data | N | *Location, date, time, description* | GPS Field Camera | N | | EPAOSC.org and Response Manager | Site photo-log, Geospatial Viewer |

# Appendix A
# R6 Gold King Mine ER Data Management Plan

| **Data Stream**[1] | **Site Specific Procedure (Y/N)**[2] | **Required Information**[3] | **Data Source**[4] | **Site Specific Data Elements (Y/N)** | **QA Process**[5] | **Data Repository**[6] | **Reporting Task** |
|---|---|---|---|---|---|---|---|
| Site Documents | N | *SAP, HASP, Customized data presentations* | START PTL | N | PTL and OSC Reviews | EPAOSC.org | NA |
| `Analytical Data | N | *Chain of Custody, Laboratory Data from ESAT mobile lab* | Scribe, Laboratory EDD (in Tech Law LIMS format) | N | Review by field personnel prior to import to ensure all required fields are present and data maps accurately into scribe database (using ESAT data map) | Scribe.net | Results Report, Geospatial Viewer |
| Project Costs | N | *Field Costs, Personnel Hours* | Weston time track reports, ODC reports, burn sheets | N | PTL Review | RCMS database | Weekly 1900 - 1955 Forms, Email to OSC |

1: Category of data generated for projects (i.e. monitoring data, water sampling data, locational data, photographs, analytical data, costs, etc). Create one line per category.
2: Y – indicates a site specific procedure is employed, N – indicates data management follows procedures outlined in the R8 DMP
3: Information necessary to provide a complete data record
4: Equipment or source that generates data (i.e. TVA 1000, camera, iPad, Trimble GPS, laboratory EDD)
5: QA process related to data, do not include analytical data validation here
6: Location of data storage (i.e. epaosc.org, scribe.net, geospatial viewer)

# Appendix A
# R6 Gold King Mine ER Data Management Plan

## Table A-2
## Site Specific Data Elements and Valid Values

**Ref. Project:** **Gold King Mine ER** **TDD:** **Date:** **8/7/15**

| Data Element | Required | Description | Format | Scribe Table. Field | Valid Values* |
|---|---|---|---|---|---|
| **Location** | Yes | Identifier for a geographic point where samples or monitoring results are collected. Must be unique within a Site. | Text (30) | Location.Location | GKMSW##<br>GKMSD##<br>(See Reference Table below for Location ID reference table) |
| LocationDescription | Yes | Brief description of a geographic point where samples or monitoring results are collected. Includes previously sampled nomenclature | Text (100) | Location.Location Description | Example: Toe of Gold King Mine Waste Dump, CC01C, CC19, etc. |
| **SampleID** | Yes | Identifier for a sample that is collected. Must be unique within a Site | Text (25) | Samples.Sample No. | LocationID –MMDDYY - Collection Type + QC Type<br>(See Reference table below for Collection Type and QC Type Codes) |
| **Matrix** | Yes | Matrix that is sampled. | Valid Values | Samples.Matrix | Water, Soil, Sediment |
| **SampleCollection** | Yes | The category of sample that is collected. | Valid Values | Samples.SampleCollection | Grab, Composite |
| SampleType | Yes | The category of Quality Control sample that is collected in the field (if appropriate). | Valid Values | Samples.SampleType | Field Sample, Blank, Duplicate |
| **SampleDate** | Yes | Date when a sample is collected. If a sampling duration is involved, enter the beginning date for this activity. | Date (MM/DD/YY) | Samples.SampleStartDate | |
| **SampleTime** | Conditional | Time when a sample is collected. If a sampling duration is involved, enter the beginning time for this activity. Required if | Time (24HH:MM:SS) | Samples.SampleStartTime | |

# Appendix A
# R6 Gold King Mine ER Data Management Plan

| Data Element | Required | Description | Format | Scribe Table. Field | Valid Values* |
|---|---|---|---|---|---|
| | | Sample End Time is provided. | | | |
| **Sample Media** | | Specification of sample matrix | Valid Values | Samples.SampleMedia | Potable Water, Surface Water, Groundwater, Surface Soil, Subsurface Soil |

*Fill in additional site specific data elements/ valid values if identified in the field

NOTE: This table is meant to provide detailed guidance for the collection of field data to be housed in the site scribe database. This table ensures site data is collected consistently across field teams and field events.

**Collection Type:** A one-digit code used to designate what type of sample was collected:

| | |
|---|---|
| 1 | Surface Water |
| 2 | Ground Water |
| 3 | Leachate |
| 4 | Field QC/water sample |
| 5 | Soil/Sediment |

| | |
|---|---|
| 6 | Oil |
| 7 | Waste |
| 8 | Other |
| 9 | Drinking Water |
| | |

**QC Type:** A one-digit code used to designate the QC type of the sample:

| | |
|---|---|
| 1 | Normal |
| 2 | Duplicate |
| 3 | Rinsate Blank |
| 4 | Trip Blank |
| 5 | Field Blank |
| 6 | Confirmation, Normal |
| 7 | Confirmation, Duplicate |

# Appendix A
# R6 Gold King Mine ER Data Management Plan

## Table A-3
## Location ID

| PWSID | System | Facility | Location ID |
|---|---|---|---|
| NM3509824 | Aztec domestic water system | Animas River pump | ADWS-ARP |
| NM3509824 | Aztec domestic water system | intake #1 | ADWS-IT1 |
| NM3509824 | Aztec domestic water system | intake #2 | ADWS-IT2 |
| NM3510224 | Farmington water system | Animas River pump station # 1 | FWS-ARP1 |
| NM3510224 | Farmington water system | Animas River pump station # 2 | FWS-ARP2 |
| NM3510324 | Lower valley water users association | Farmers ditch | LVW-FD |
| NM3510324 | Lower valley water users association | Westland Park intake | LVW-WPI |
| NM3510524 | Morningstar water supply system | Animas River intake | MWSS-ARI |
| NM3520024 | North Star water users association | Animas River intake | NSW-ARI |
| NM3509824 | Aztec domestic water system | intake #1 | ADWS-IT1 |
| NM3509824 | Aztec domestic water system | intake #2 | ADWS-IT2 |
| NM3510224 | Farmington water system | Animas River pump station # 2 | FWS-ARP2 |
| NM3510324 | Lower Valley water users association | farmers ditch | LVW-FD |
| NM3510224 | Farmington water system | farmers ditch pump station | FWS-FDPS |

# Appendix B

# Surface Water and Sediment Sample Analyte List and Benchmarks

## Table B-1
## Metals Analytes, Methods of Analysis, and RLs for Surface Water

| Analyte | RLs (µg/L) | | SITE-SPECIFIC ACTION LEVEL (µg/L) | | | | | Basis for Site-Specific Action Level | Analytical Method | RL Exceeds Site-Specific Action Level |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | **RL** | **MDL** | **Surface Water Recreational Use** | **Agriculture (30-day Colorado)** | **Recreational Use** | **Aquatic Acute** | **Aquatic Chronic** | | | |
| Aluminum | 200 | 24 | 170000 | | | 8358 | 3348 | Ecological | EPA 200.8 | No |
| Antimony | 20 | 5.3 | | | 129 | | | Human Health | EPA 200.8 | No |
| Arsenic | 20 | 6.2 | 50 | 100 | 2.15 | | | Human Health | EPA 200.8 | Yes |
| Barium | 10 | 1.7 | 33000 | | 34900 | | | Human Health | EPA 200.8 | No |
| Beryllium | 4 | 0.100 | 330 | 100 | 100 | 340 | 150 | Human Health | EPA 200.8 | No |
| Cadmium | 0.1 | 0.043 | 83 | 10 | 65 | 2.88 | 0.72 | Ecological | EPA 200.8 | No |
| Calcium | 500 | 25 | | | | | | | EPA 200.7 | No |
| Chromium | 10 | 1.6 | 210000 | 100 | | 972 | 126 | Human Health | EPA 200.8 | No |
| Cobalt | 0.4 | 0.12 | 50 | | 3130 | | | Human Health | EPA 200.8 | No |
| Copper | 20 | 1.8 | 6700 | 200 | 8580 | 25 | 16 | Ecological | EPA 200.8 | Yes |
| Iron | 50 | 17 | 120000 | | 601000 | | | Human Health | EPA 200.7 | No |
| Lead | 10 | 3.9 | 200 | 100 | | 130 | 5 | Ecological | EPA 200.8 | Yes |
| Magnesium | 500 | 33 | | | | | | | EPA 200.7 | No |
| Manganese | 10 | 1 | 7800 | 200 | 2550 | 3710 | 2050 | Human Health | EPA 200.8 | No |
| Mercury | 0.2 | 0.08 | | | | 104 | 0.77 | Ecological | EPA 245.1 | No |
| Molybdenum | 10 | 1.1 | | | | | | | EPA 200.8 | No |
| Nickel | 40 | 2.1 | 3300 | 200 | 7870 | 813 | 90 | Ecological | EPA 200.8 | No |
| Potassium | 1000 | 17 | | | | | | | EPA 200.7 | No |
| Selenium | 20 | 9.9 | | 20 | 4290 | 20 | 5 | Ecological | EPA 200.8 | Yes |
| Silver | 10 | 0.6 | | | 837 | 9.9 | | Ecological | EPA 200.8 | No |
| Sodium | 1000 | 480 | | | | | | | EPA 200.7 | No |
| Thallium | 25 | 6 | 1.7 | | 34.3 | | | Human Health | EPA 200.8 | No |
| Vanadium | 10 | 1 | 830 | | 712 | | | Human Health | EPA 200.8 | No |
| Zinc | 20 | 7 | 50000 | 2,000 | 292000 | 290 | 219 | Ecological | EPA 200.8 | No |
| Total Dissolved Solids | 5,000 | | | | | | | | 2540C | NA |
| Total Suspended Solids | 1,000 | | | | | | | | 2540D | NA |

Notes:

µg/L = micrograms per liter

CRQL = Contract Required Quantitation Limit

Source for CRQLs:

Organics: The US EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, SOM01.2. October 5, 2006, Updated February 12, 2007, amended April 11, 2007.

## Table B-2
## Metals Analytes, Methods of Analysis, and RLs for Sediment

| Analyte | RLs (mg/kg) | | SITE-SPECIFIC ACTION LEVEL (µg/L) | | | | Basis for Site-Specific Action Level | Analytical Method | RL Exceeds Site-Specific Action Level |
|---|---|---|---|---|---|---|---|---|---|
| **Metals** | **RL** | **MDL** | **TSCA RES** | **Freshwater Screening Benchmark (mg/kg)** | **Reference Dose Screening Level (mg/kg)** | **Cancer Rick Screening Level (mg/kg)** | | | |
| Aluminum | 20 | 3.1 | | 14000 | 1000 | | Human Health | 6010C | No |
| Antimony | 1 | 0.1 | | 2 | 0.5 | | Human Health | 6020A | No |
| Arsenic | 0.3 | 0.1 | | 9.8 | 0.4 | .0021 | Human Health | 6020A | No |
| Barium | 0.5 | 0.06 | | 20 | 200 | | Ecological | 6020A | No |
| Beryllium | 0.05 | 0.015 | | NA | 200 | | Human Health | 6020A | No |
| Cadmium | 0.05 | 0.015 | | 0.99 | 0.6 | | Human Health | 6020A | No |
| Calcium | 50 | 5.2 | | NA | NA | | | 6010C | No |
| Chromium | 1 | 0.11 | | 43.4 | 4 | | Human Health | 6020A | No |
| Cobalt | 0.05 | 0.1 | | 50 | 0.4 | | Human Health | 6020A | No |
| Copper | 0.5 | 0.13 | | 31.6 | 50 | | Ecological | 6020A | No |
| Iron | 20 | 5.3 | | 2000 | 900 | | Human Health | 6010C | No |
| Lead | 0.2 | 0.05 | | 35.8 | NA | | Ecological | 6020A | No |
| Magnesium | 50 | 8.9 | | NA | NA | | | 6010C | No |
| Manganese | 1 | 0.12 | | 460 | 1800 | | Ecological | 6020A | No |
| Mercury | 0.02 | 0.008 | | 0.18 | 0.4 | | Ecological | 7471A | No |
| Molybdenum | 1 | 0.08 | | NA | NA | | | 6020A | No |
| Nickel | 1 | 0.26 | | 22.7 | 20 | | Human Health | 6020A | No |
| Potassium | 100 | 2.5 | | NA | NA | | | 6010C | No |
| Selenium | 0.5 | 0.1 | | 2 | 6 | | Ecological | 6020A | No |
| Silver | 0.1 | 0.01 | | 1 | 6 | | Ecological | 6020A | No |
| Sodium | 200 | 48 | | NA | NA | | | 6010C | No |
| Thallium | 0.1 | 0.05 | | NA | .001 | | Human Health | 6020A | No |
| Vanadium | 0.5 | 0.27 | | NA | 10 | | Human Health | 6020A | No |
| Zinc | 2 | 1 | | 121 | 400 | | Ecological | 6020A | No |

# Appendix C

# Site-specific Data Quality Objective (DQOs)

# Appendix C
# Data Quality Objective – Sediment Sampling
# Gold King Mine Spill

| | |
|---|---|
| **STEP 1. STATE THE PROBLEM** | |
| Sediment samples will be collected at various locations within the Animas River to assess the potential health and ecological risks associated with the Gold King Mine release and determine the need for remedial action. To assess these potential risks, EPA Region 6 will assess the water and sediment quality of the Animas River as it flows from the Colorado border south into northwestern New Mexico. Surface water and sediment samples will be collected for metal analysis at a variety of locations to obtain comprehensive spatial coverage. In addition, these locations will be sampled on a routine basis to provide an understanding of the temporal trend of the metals concentrations over time. | |
| **STEP 2. IDENTIFY THE DECISION** | |
| **Are the concentrations of constituents of concern in sediments, represented by a sample, above specified action levels?** | |
| IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS. | If the constituents of concern (COCs) exceed the specified action level in sediments, the sediment represented by that sample will be considered contaminated and will require additional attention.<br>If no COC concentrations exceed the specified action levels in sediments, the sediments represented by that sample will not require additional attention. |
| **STEP 3. IDENTIFY INPUTS TO THE DECISION** | |
| IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION. | COC concentrations in sediment samples collected during sampling. |
| IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS. | Sediment sample locations will be determined in the field in conjunction with the EPA OSC and START team. Analytical results obtained from the subcontracted laboratory following the analytical methods listed in Table 4-1. |
| BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS. | TBD at the direction of EPA Environmental Unit. |
| IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS. | Sediment sampling techniques are described in Appendix C. |

# Appendix C
# Data Quality Objective – Sediment Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 4. DEFINE THE BOUNDARIES OF THE STUDY** | |
|---|---|
| DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY. | Portions of the Animas River and San Juan River as shown on Figure 1-1. |
| SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST. | COC concentrations in sediments for the analytes listed on Table 4-1 and 4-2. |
| DEFINE THE SCALE OF DECISION MAKING. | The scale of decision will be for sediment represented by each sample collected from the selected locations. |
| DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY. | The data will apply until the sediment represented by the sample receives appropriate response actions. |
| DETERMINE WHEN TO COLLECT DATA. | Samples will be collected during the Gold King Mine Emergency Response activities. |
| IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION. | Inclement weather.<br>Site access not attainable.<br>Debris in sediment. |
| **STEP 5. DEVELOP A DECISION RULE** | |
| SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST. | The sample concentrations at each sample location will be compared to the site-specific action levels based on sediment benchmarks listed in Appendix B. |
| SPECIFY THE ACTION LEVEL FOR THE DECISION. | Sediment benchmarks intended to be protective of benthic biota, and are not necessarily protective of mammalian and avian receptors that may be exposed to PCBs through the food chain or via incidental ingestion of sediment. |
| DEVELOP A DECISION RULE. | If any result in a sediment sample is above the contaminant-specific action level, then the sediment represented by that sample will require additional attention; otherwise, the sediment does not require additional attention. |

# Appendix C
# Data Quality Objective – Sediment Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 6. SPECIFY LIMITS ON DECISION ERRORS** | |
|---|---|
| DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST. | Concentrations may range from non-detected to more than the contaminant- specific action level. |
| DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH. | Type I Error: Deciding that the specified area represented by the sediment sample does not exceed the specified action level when, in truth, the sediment concentration of the contaminant exceeds its specified action level. The consequence of this decision error is that contaminated sediment will remain in the river, possibly endangering human health and the environment. There may also be potential future liability associated with cleanup costs of leaving contaminated sediment in the adjacent off-site drainage ditch. This decision error is more severe.<br>Type II Error: Deciding that the specified area represented by the sediment sample does exceed the specified action level when, in truth, it does not. The consequences of this decision error are that remediation of the specified area will continue and unnecessary costs will be incurred. |
| ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE. | The true state of nature when the sediment is decided to be below the specified action levels when in fact, it is not below the specified action levels, is that the area may need remedial action.<br>The true state of nature when the sediment is decided to be above the specified action levels when in fact, it is not above the specified action levels, is that the area may not need remedial action. |
| DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS ($H_o$) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS ($H_a$). | $H_o$: The sediment represented by the sediment sample of the specified area is above the specified action level.<br>$H_a$: The sediment represented by the sediment sample of the specified area is below the specified action level. |
| ASSIGN THE TERMS “FALSE POSITIVE” AND “FALSE NEGATIVE” TO THE PROPER DECISION ERRORS. | False Positive Error = Type I<br>False Negative Error = Type II |
| ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS. | To be assigned based on discussions with EPA Environmental Unit. |

# Appendix C
# Data Quality Objective – Sediment Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 7. OPTIMIZE THE DESIGN** | |
|---|---|
| ***REVIEW THE DQOs*** | Due to insufficient historical data, determination of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered. |
| **DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.**<br>Sediment samples (including QA/QC samples) will be collected utilizing sampling procedures described in this QASP – Section 4 and Appendix D. The samples will be analyzed for the analytes listed in Table 4-1 and 4-2. The sample locations will be included on Figure 4-2 (TBD). Sample depths (approximately 0 to 3 cm) will be at the direction of the EPA Environmental Unit. Any changes to sample locations will be discussed with the EU prior to relocation. | |

# Appendix C
# Data Quality Objective – Surface Water Sampling
# Gold King Mine Spill

| | |
|---|---|
| **STEP 1. STATE THE PROBLEM** | |
| Surface water samples will be collected at various locations within the Animas River to assess the potential health and ecological risks associated with the Gold King Mine release and determine the need for remedial action. To assess these potential risks, EPA Region 6 will assess the water and sediment quality of the Animas River as it flows from the Colorado border south into northwestern New Mexico. Surface water and sediment samples will be collected for metal analysis at a variety of locations to obtain comprehensive spatial coverage. In addition, these locations will be sampled on a routine basis to provide an understanding of the temporal trend of the metals concentrations over time. | |
| **STEP 2. IDENTIFY THE DECISION** | |
| **Are the concentrations of constituents of concern in surface water, represented by a sample, above specified action levels?** | |
| IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS. | If the constituents of concern (COCs) exceed the specified action level in surface waters, the surface water represented by that sample will be considered contaminated and will require additional attention.<br>If no COC concentrations exceed the specified action levels in surface waters, the surface waters represented by that sample will not require additional attention. |
| **STEP 3. IDENTIFY INPUTS TO THE DECISION** | |
| IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION. | COC concentrations in surface water samples collected during sampling. |
| IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS. | Surface water sample locations will be determined in the field in conjunction with the EPA OSC and START team. Analytical results obtained from the subcontracted laboratory following the analytical methods listed in Table 4-1. |
| BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS. | TBD at the direction of EPA Environmental Unit. |
| IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS. | Surface water sampling techniques are described in Appendix D. |

# Appendix C
# Data Quality Objective – Surface Water Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 4. DEFINE THE BOUNDARIES OF THE STUDY** | |
|---|---|
| DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY. | Portions of the Animas River and San Juan River as shown on Figures 1-1, 2-1 and 4-1. |
| SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST. | COC concentrations in surface waters for the analytes listed on Table 4-1 and Appendix B. |
| DEFINE THE SCALE OF DECISION MAKING. | The scale of decision will be for surface water represented by each sample collected from the selected locations. |
| DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY. | The data will apply until the surface water represented by the sample receives appropriate response actions. |
| DETERMINE WHEN TO COLLECT DATA. | Samples will be collected during the Gold King Mine Emergency Response activities planned during early 2009. |
| IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION. | Inclement weather.<br>Site access not attainable.<br>Rate of water flow. |
| **STEP 5. DEVELOP A DECISION RULE** | |
| SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST. | The sample concentrations at each sample location will be compared to the site-specific action levels based on surface water benchmarks listed in Appendix B. |
| SPECIFY THE ACTION LEVEL FOR THE DECISION. | Surface water benchmarks and action levels are included in Appendix B. Additional Action Levels may be determined applicable at the direction of the EPA Environmental Unit. |
| DEVELOP A DECISION RULE. | If any result in a surface water sample is above the contaminant- specific action level, then the surface water represented by that sample will require additional attention; otherwise, the surface water does not require additional attention. |

# Appendix C
# Data Quality Objective – Surface Water Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 6. SPECIFY LIMITS ON DECISION ERRORS** | |
|---|---|
| DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST. | Concentrations may range from non-detected to more than the contaminant-specific action level. |
| DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH. | Type I Error: Deciding that the specified area represented by the surface water sample does not exceed the specified action level when, in truth, the surface water concentration of the contaminant exceeds its specified action level. The consequence of this decision error is that contaminated surface water will remain in the drainage pathway, possibly endangering human health and the environment. There may also be potential future liability associated with cleanup costs of allowing contaminated surface water to flow down gradient in the drainage pathway. This decision error is more severe.<br>Type II Error: Deciding that the specified area represented by the surface water sample does exceed the specified action level when, in truth, it does not. The consequences of this decision error are that remediation of the specified area will continue and unnecessary costs will be incurred. |
| ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE. | The true state of nature when the surface water is decided to be below the specified action levels when in fact, it is not below the specified action levels, is that the area may need remedial action.<br>The true state of nature when the surface water is decided to be above the specified action levels when in fact, it is not above the specified action levels, is that the area may not need remedial action. |
| DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS ($H_o$) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS ($H_a$). | $H_o$: The surface water represented by the surface water sample of the specified area is above the specified action level.<br>$H_a$: The surface water represented by the surface water sample of the specified area is below the specified action level. |
| ASSIGN THE TERMS “FALSE POSITIVE” AND “FALSE NEGATIVE” TO THE PROPER DECISION ERRORS. | False Positive Error = Type I<br>False Negative Error = Type II |
| ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS. | To be assigned based on discussions with EPA Environmental Unit. |

# Appendix C
# Data Quality Objective – Surface Water Sampling
# Gold King Mine Spill
# (Continued)

| **STEP 7. OPTIMIZE THE DESIGN** | |
|---|---|
| ***REVIEW THE DQOs*** | Due to insufficient historical data, determination of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered. |
| **DEVELOP *GENERAL SAMPLING AND ANALYSIS DESIGN.***<br>Surface water samples (including QA/QC samples) will be collected utilizing sampling procedures described in this QASP – Section 4 and Appendix D. The samples will be analyzed for the analytes listed in Table 4-1 and Appendix B. Some sample locations are included on Figure 4-1 and additional locations will be identified by the EPA Environmental Unit. Any changes to sample locations will be discussed with the EU prior to relocation. | |

# Appendix D

## START (SOPs)

***May Contain Confidential Business Information***

***Contact EPA Region 6 for more information***

# U. S. EPA ENVIRONMENTAL RESPONSE TEAM

## STANDARD OPERATING PROCEDURES

SOP: 2012
PAGE: 1 of 13
REV: 0.0
DATE: 02/18/00

## SOIL SAMPLING

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CONTENTS

SUPERCEDES: SOP #2012; Revision 0.0; 11/16/94; U.S. EPA Contract 68-C4-0022.

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of representative soil samples. Sampling depths are assumed to be those that can be reached without the use of a drill rig, direct-push, or other mechanized equipment (except for a back-hoe). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the actual procedures used should be documented and described in an appropriate site report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a trier, a split-spoon, or, if required, a backhoe.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Samples should, however, be cooled and protected from sunlight to minimize any potential reaction. The amount of sample to be collected and proper sample container type are discussed in ERT/REAC SOP #2003 Rev. 0.0 08/11/94, *Sample Storage, Preservation and Handling.*

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling - cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

## 5.0 EQUIPMENT

Soil sampling equipment includes the following:

- Maps/plot plan
- Safety equipment, as specified in the site-specific Health and Safety Plan
- Survey equipment or global positioning system (GPS) to locate sampling points
- Tape measure
- Survey stakes or flags
- Camera and film
- Stainless steel, plastic or other appropriate homogenization bucket, bowl or pan
- Appropriate size sample containers
- Ziplock plastic bags
- Logbook
- Labels
- Chain of Custody records and custody seals
- Field data sheets and sample labels
- Cooler(s)
- Ice
- Vermiculite
- Decontamination supplies/equipment
- Canvas or plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel(s)
- Continuous flight (screw) auger
- Bucket auger
- Post-hole auger
- Extension rods
- T-handle
- Sampling trier
- Thin wall tube sampler
- Split spoons
- Vehimeyer soil sampler outfit
    - Tubes
    - Points
    - Drive head
    - Drop hammer
    - Puller jack and grip
- Backhoe

## 6.0 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in ERT/REAC SOP #2006 Rev. 0.0 08/11/94, *Sampling Equipment Decontamination*, and the site specific work plan.

## 7.0 PROCEDURES

### 7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations should be utility-cleared by the property owner or the On-Scene-Coordinator (OSC) prior to soil sampling; and utility clearance should always be confirmed before beginning work.

### 7.2 Sample Collection

#### 7.2.1 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample.

This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required. Tools plated with chrome or other materials should not be used. Plating is particularly common with garden implements such as potting trowels.

The following procedure is used to collect surface soil samples:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.

2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.

3. If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

### 7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet.

The following procedure is used for collecting soil samples with the auger:

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.

2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole and proceed to Step 10.

5. Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.

6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.

7. Remove the tube sampler, and unscrew the drill rods.

8. Remove the cutting tip and the core from the device.

9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.

10. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly.

    When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.

12. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

### 7.2.3 Sampling with a Trier

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth.

The following procedure is used to collect soil samples with a sampling trier:

1. Insert the trier (Figure 2, Appendix A) into the material to be sampled at a $0^o$ to $45^o$ angle from horizontal. This orientation minimizes the spillage of sample.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

### 7.2.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".

The following procedures are used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.

2. Place the sampler in a perpendicular position on the sample material.

3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.

4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.

5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume.

6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

### 7.2.5 Test Pit/Trench Excavation

A backhoe can be used to remove sections of soil, when detailed examination of soil characteristics are required. This is probably the most expensive sampling method because of the relatively high cost of backhoe operation.

The following procedures are used for collecting soil samples from test pits or trenches:

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities.

2. Review the site specific Health & Safety plan and ensure that all safety precautions including appropriate monitoring equipment are installed as required.

3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.

4. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.

5. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.

6. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

## 8.0 CALCULATIONS

This section is not applicable to this SOP.

## 9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration

activities must occur prior to sampling/operation, and they must be documented.

## 10.0 DATA VALIDATION

This section is not applicable to this SOP.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OHSA and corporate health and safety procedures, in addition to the procedures specified in the site specific Health & Safety Plan..

## 12.0 REFERENCES

Mason, B.J. 1983. Preparation of Soil Sampling Protocol: Technique and Strategies. EPA-600/4-83-020.

Barth, D.S. and B.J. Mason. 1984. Soil Sampling Quality Assurance User's Guide. EPA-600/4-84-043.

U.S. Environmental Protection Agency. 1984 Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA-600/4-84-076.

de Vera, E.R., B.P. Simmons, R.D. Stephen, and D.L. Storm. 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA-600/2-80-018.

ASTM D 1586-98, ASTM Committee on Standards, Philadelphia, PA.

APPENDIX A
Figures
SOP #2012
February 2000

FIGURE 1. Sampling Augers

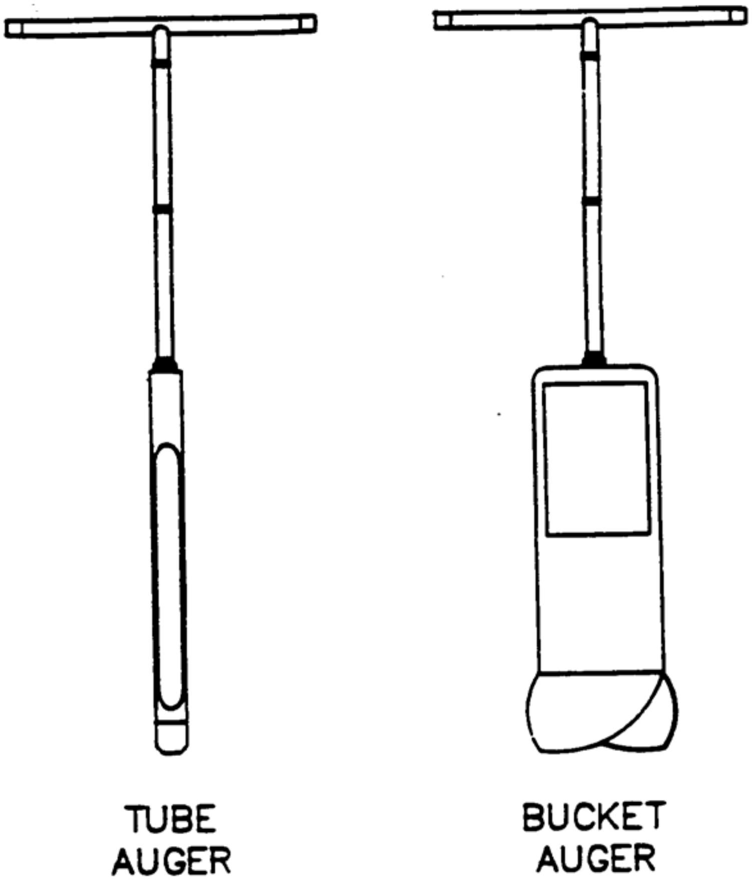
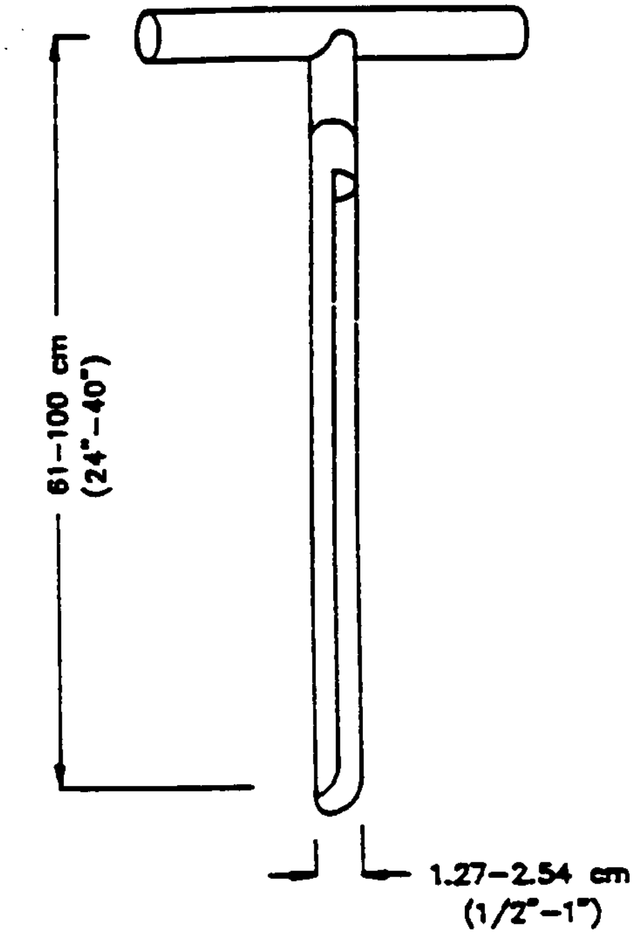


FIGURE 2. Sampling Trier



# SURFACE WATER SAMPLING

SOP#: 2013
DATE: 11/17/94
REV. #: 0.0

## 1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative liquid samples, both aqueous and non-aqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Sampling situations vary widely, therefore, no universal sampling procedure can be recommended. However, sampling of both aqueous and non-aqueous liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- Bacon bomb sampler
- Dip sampler
- Direct method

These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, the following procedure should be followed:

1. Transfer the sample(s) into suitable, labeled sample containers.
2. Preserve the sample if appropriate, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.
3. Cap the container, place in a ziploc plastic bag and cool to 4°C.
4. Record all pertinent data in the site logbook and on field data sheets.
5. Complete the Chain of Custody record.
6. Attach custody seals to cooler prior to shipment.
7. Decontaminate all sampling equipment prior to the collection of additional samples with that sampling device.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems with surface water sampling. These include cross contamination of samples and improper sample collection.

1. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to the Sampling Equipment Decontamination SOP.

2. Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed area.

Following proper decontamination procedures and minimizing disturbance of the sample site will eliminate these problems.

## 5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- Kemmerer bottles
- Bacon bomb sampler
- Dip sampler
- Line and messengers
- Sample bottles/preservatives
- Ziploc bags
- Ice
- Coolers
- Chain of Custody records, custody seals
- Field data sheets
- Decontamination equipment
- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Logbook/waterproof pen
- Sample bottle labels

## 6.0 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed.

## 7.0 PROCEDURES

### 7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain the necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry, in accordance with the site specific Health and Safety Plan.

6. Use stakes, flagging, or buoys to identify and mark all sampling locations. If required the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. If collecting sediment samples, this procedure may disturb the bottom.

### 7.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and morphometrics of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons, or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected in impoundments, and to determine if stratification is present. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist which would effect analytical results. Measurements should be collected at one-meter intervals from the substrate to the surface using the appropriate instrument (i.e., a Hydrolab or equivalent).

Water quality measurements such as dissolved oxygen, pH, temperature, conductivity, and oxidation-reduction potential can assist in the interpretation of analytical data and the selection of sampling sites and depths when surface water samples are collected.

Generally, the deciding factors in the selection of a sampling device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

1. Will the sample be collected from shore or from a boat?
2. What is the desired depth at which you wish to collect the sample?
3. What is the overall depth and flow direction of river or stream?
4. What type of sample will be collected (i.e., water or lagoon liquids)?

### 7.2.1 Sampler Composition

The appropriate sampling device must be of a proper composition. Selection of samplers constructed of glass, stainless steel, PVC or PFTE (Teflon) should be based upon the analyses to be performed.

## 7.3 Sample Collection

### 7.3.1 Kemmerer Bottle

A Kemmerer bottle (Figure 1, Appendix A) may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the sampling end pieces (upper and lower stoppers) are pulled away from the sampling tube (body), allowing the substance to be sampled to pass through this tube.
2. Lower the pre-set sampling device to the predetermined depth. Avoid bottom disturbance.
3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.
4. Retrieve the sampler and discharge from the bottom drain the first 10-20 mL to clear any potential contamination of the valve. Transfer the sample to the appropriate sample container.

### 7.3.2 Bacon Bomb Sampler

A bacon bomb sampler (Figure 2, Appendix A) may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill.
2. Release the trigger line and retrieve the sampler.
3. Transfer the sample to the appropriate sample container by pulling up on the trigger.

### 7.3.3 Dip Sampler

A dip sampler (Figure 3, Appendix A) is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample by dipping the sampler into the substance.
3. Retrieve the sampler and transfer the sample to the appropriate sample container.

### 7.3.4 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface directly into the sample bottle. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants is a concern.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

## 8.0 CALCULATIONS

This section is not applicable to this SOP.

## 9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

## 10.0 DATA VALIDATION

This section is not applicable to this SOP.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

More specifically, when sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate precautions must be taken to ensure the safety of sampling personnel. The sampling team member collecting the sample should not get too close to the edge of the impoundment, where bank failure may cause him/her to lose his/her balance. The person performing the sampling should be on a lifeline and be wearing adequate protective equipment. When conducting sampling from a boat in an impoundment or flowing waters, appropriate boating safety procedures should be followed.

## 12.0 REFERENCES

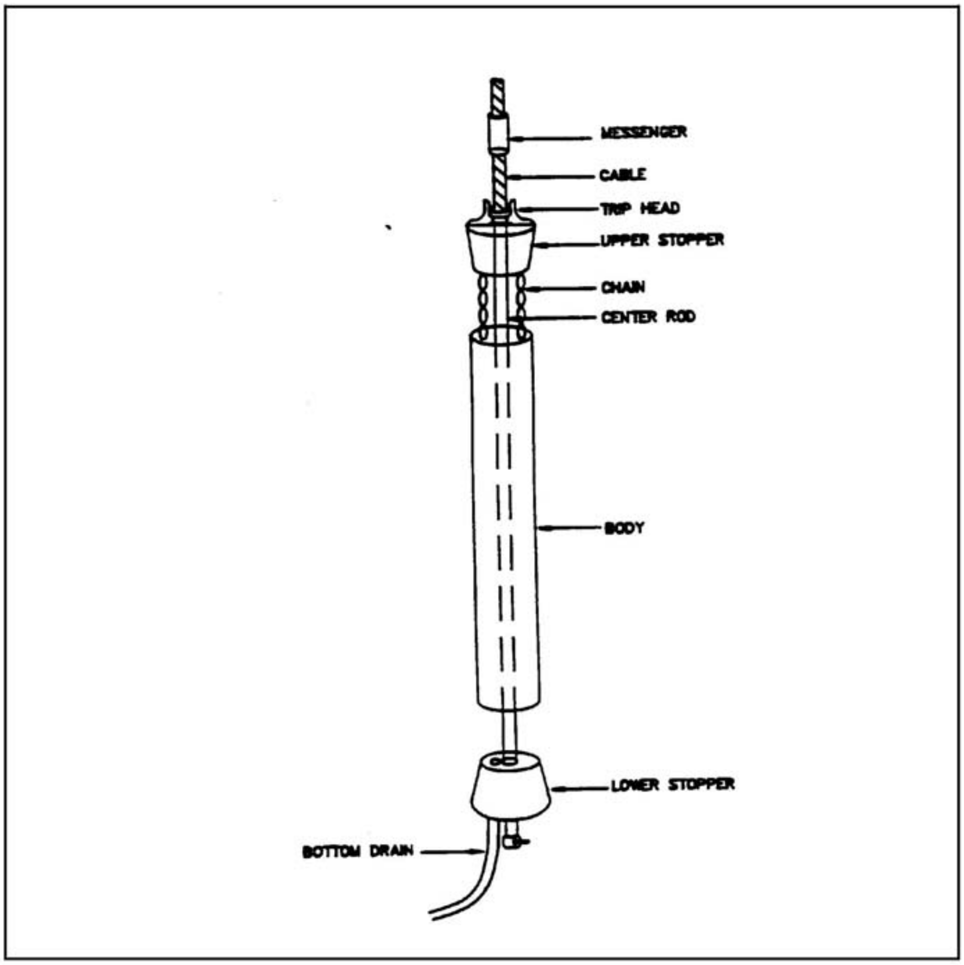
U.S. Geological Survey. 1977. National Handbook or Recommended Methods for Water Data Acquisition. Office of Water Data Coordination Reston, Virginia. (Chapter Updates available).

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

# APPENDIX A

## Figures

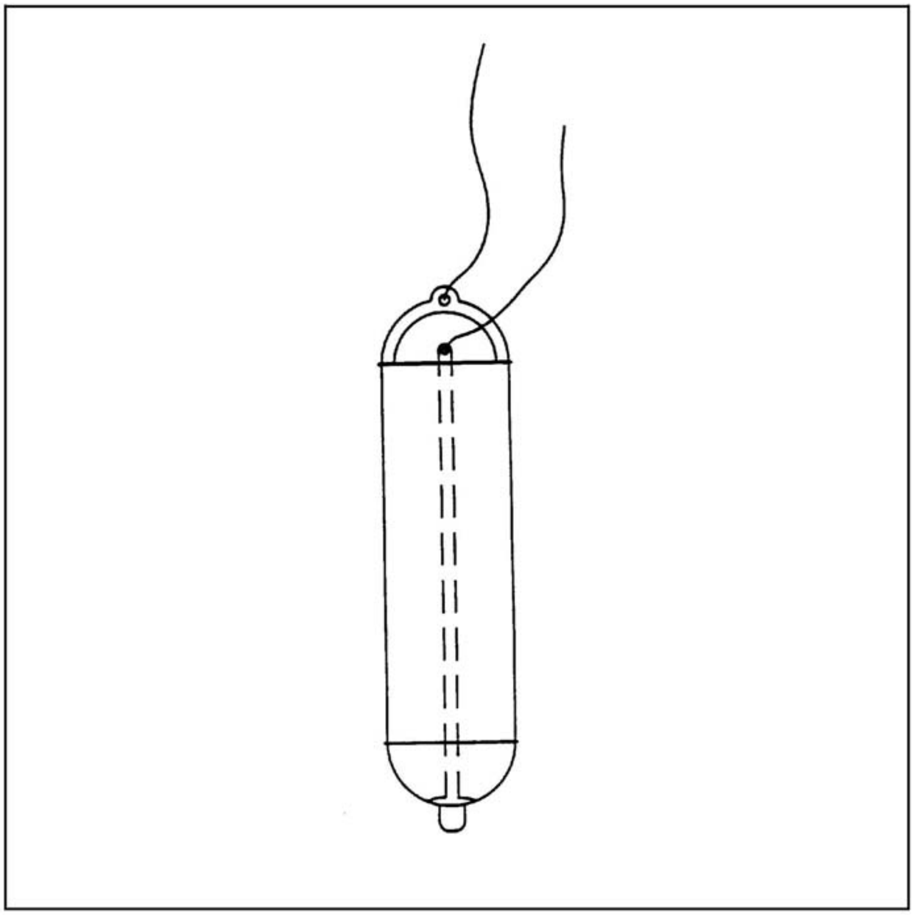
FIGURE 1. Kemmerer Bottle



## APPENDIX A (Cont'd)

Figures

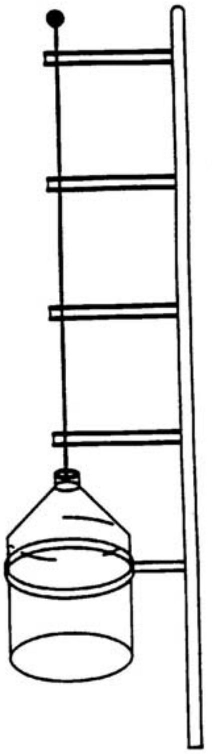
FIGURE 2. Bacon Bomb Sampler



## APPENDIX A (Cont'd)

### Figures

FIGURE 3. Dip Sampler



# SEDIMENT SAMPLING

SOP#: 2016
DATE: 11/17/94
REV. #: 0.0

## 1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- toxicity;
- biological availability and effects of contaminants;
- benthic biota;
- extent and magnitude of contamination;
- contaminant migration pathways and source;
- fate of contaminants;
- grain size distribution.

The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications occur, they should be documented in a site or personal logbook and discussed in reports summarizing field activities and analytical results.

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested. The homogenization procedure should not be used if sample analysis includes volatile organics; in this case, sediment, or multiple grabs of sediment, should be transferred directly from the sample collection device or homogenization container to the sample container.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

1. Chemical preservation of solids is generally not recommended. Cooling to 4°C is usually the best approach, supplemented by the appropriate holding time for the analyses requested.

2. Wide mouth glass containers with Teflon lined caps are utilized for sediment samples. The sample volume is a function of the analytical requirements and will be specified in the Work Plan.

3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses

requested. Transfer is accomplished with a stainless steel or plastic lab spoon or equivalent.

4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location are deposited into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) containers. The sediment is homogenized thoroughly to obtain a composite representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analyses requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for volatile organic analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize loss of contaminant due to volatilization during homogenization.

5. All sampling devices should be decontaminated, then wrapped in aluminum foil. The sampling device should remain in this wrapping until it is needed. Each sampling device should be used for only one sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required. Sampling devices should be cleaned in the field using the decontamination procedure described in the Sampling Equipment Decontamination SOP.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a waterbody. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic matter content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate pollutants and are generally found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results and should be justified and specified in the Work Plan.

## 5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of sediment samples may include:

- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- "T" handle
- Sediment coring device (tube, drive head, eggshell check value, nosecone, acetate tube, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

## 6.0 REAGENTS

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP.

## 7.0 PROCEDURES

### 7.1 Preparation

1. Determine the objective(s) and extent of the sampling effort. The sampling methods to be employed, and the types and amounts of equipment and supplies required will be a function of site characteristics and objectives of the study.
2. Obtain the necessary sampling and monitoring equipment.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
4. Decontaminate or preclean equipment, and ensure that it is in working order.
5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, contaminant source, and extent and nature of contamination should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### 7.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

#### 7.2.1 Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range from 0 to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated/consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A stainless steel or plastic sampling implement will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials; plating is particularly common with garden trowels.

The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
3. Surface water should be decanted from the sample or homogenization container prior to sealing or transfer; care should be taken to retain the fine sediment fraction during this procedure.

#### 7.2.2 Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle (Figure 1, Appendix A). The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a subsample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a bucket auger or tube auger:

1. An acetate core may be inserted into the bucket auger or tube auger prior to sampling if characteristics of the sediments or waterbody warrant. By using this technique, an intact core can be extracted.
2. Attach the auger head to the required length of extensions, then attach the "T" handle to the upper extension.
3. Clear the area to be sampled of any surface debris.
4. Insert the bucket auger or tube auger into the sediment at a 0° to 20° angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.
5. Rotate the auger to cut a core of sediment.
6. Slowly withdraw the auger; if using a tube auger, make sure that the slot is facing upward.
7. Transfer the sample or a specified aliquot of sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

### 7.2.3 Sampling Deep Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, deep sediment is considered to range from six to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches. Collection of deep sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a "T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to five feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling operation. In addition, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole, and driven into the sediment to the lower range of the desired sampling depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, but is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect deep sediment samples with a bucket auger and a tube auger:

1. Attach the bucket auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
2. Clear the area to be sampled of any surface debris.
3. Begin augering, periodically removing any accumulated sediment (i.e., cuttings) from the auger bucket. Cuttings should be disposed of far enough from the sampling area to minimize cross contamination of various depths.
4. After reaching the upper range of the desired depth, slowly and carefully remove bucket auger from the boring.
5. Attach the tube auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
6. Carefully lower tube auger down borehole using care to avoid making contact with the borehole sides and, thus, cross contaminating the sample. Gradually force tube auger into sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls

to collapse.

7. Remove tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.

8. Discard the top of core (approximately 1 inch); as this represents material collected by the tube auger before penetration to the layer of concern.

9. Transfer sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

### 7.2.4 Sampling Surface Sediment with an Ekman or Ponar Dredge from Beneath a Shallow or Deep Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring loaded or lever operated jaws.

An Ekman dredge is a lightweight sediment sampling device with spring activated jaws. It is used to collect moderately consolidated, fine textured sediment. The following procedure will be used for collecting sediment with an Ekman dredge (Figure 2, Appendix A):

1. Attach a sturdy nylon rope or stainless steel cable through the hole on the top of the bracket, or secure the extension handle to the bracket with machine bolts.

2. Attach springs to both sides of the jaws. Fix the jaws so that they are in open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.

3. Lower the sampler to a point 4 to 6 inches above the sediment surface.

4. Drop the sampler to the sediment.

5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extension handle.

6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Care should be taken to retain the fine sediment fraction during this procedure.

7. Open the dredge jaws and transfer the sample into a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment grabs until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A Ponar dredge is a heavyweight sediment sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used for collecting sediment with a Ponar dredge (Figure 3, Appendix A):

1. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.

2. Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring loaded pin into the aligned holes in the trip bar.

3. Slowly lower the sampler to a point approximately two inches above the sediment.

4. Drop the sampler to the sediment. Slack on

the line will release the trip bar or spring loaded pin; pull up sharply on the line closing the dredge.

5. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.

6. Open the dredge and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenized and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

### 7.2.5 Sampling Subsurface Sediment with a Coring Device from Beneath a Shallow Aqueous Layer

For purposes of this method, subsurface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, extensions, and "T" handle, or drivehead. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure describes the use of a sample coring device (Figure 4, Appendix A) used to collect subsurface sediments.

1. Assemble the coring device by inserting the acetate core into the sampling tube.

2. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate core.

3. Screw the nosecone onto the lower end of the sampling tube, securing the acetate tube and eggshell check valve.

4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.

5. Place the sampler in a perpendicular position on the sediment to be sampled.

6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Slowly withdraw the sampler from the sediment and proceed to Step 15.

7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.

8. Drive the sampler into the sediment to the desired depth.

9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.

10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

11. Rotate the sampler to shear off the core at the bottom.

12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.

13. Slowly withdraw the sampler from the sediment. If the drivehead was used, pull the hammer upwards and dislodge the sampler from the sediment.

14. Carefully remove the coring device from the water.

15. Unscrew the nosecone and remove the eggshell check valve.

16. Slide the acetate core out of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. If head space is present in the upper end, a hacksaw may be used to shear the acetate tube off at the sediment surface. The acetate core may then be capped at both ends. Indicate on the acetate tube the appropriate orientation of the sediment core using a waterproof marker. The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.

17. Open the acetate tube and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

## 8.0 CALCULATIONS

This section is not applicable to this SOP.

## 9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

## 10.0 DATA VALIDATION

This section is not applicable to this SOP.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA/OSHA and Corporate health and safety procedures.

More specifically, when sampling sediment from waterbodies, physical hazards must be identified and adequate precautions must be taken to ensure the safety of the sampling team. The team member collecting the sample should not get too close to the edge of the waterbody, where bank failure may cause loss of balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is determined to be necessary, appropriate protective measures must be implemented.

## 12.0 REFERENCES

Mason, B.J., Preparation of Soil Sampling Protocol: Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason, Soil Sampling Quality Assurance User's Guide. 1984 EPA-600/4-84-043.

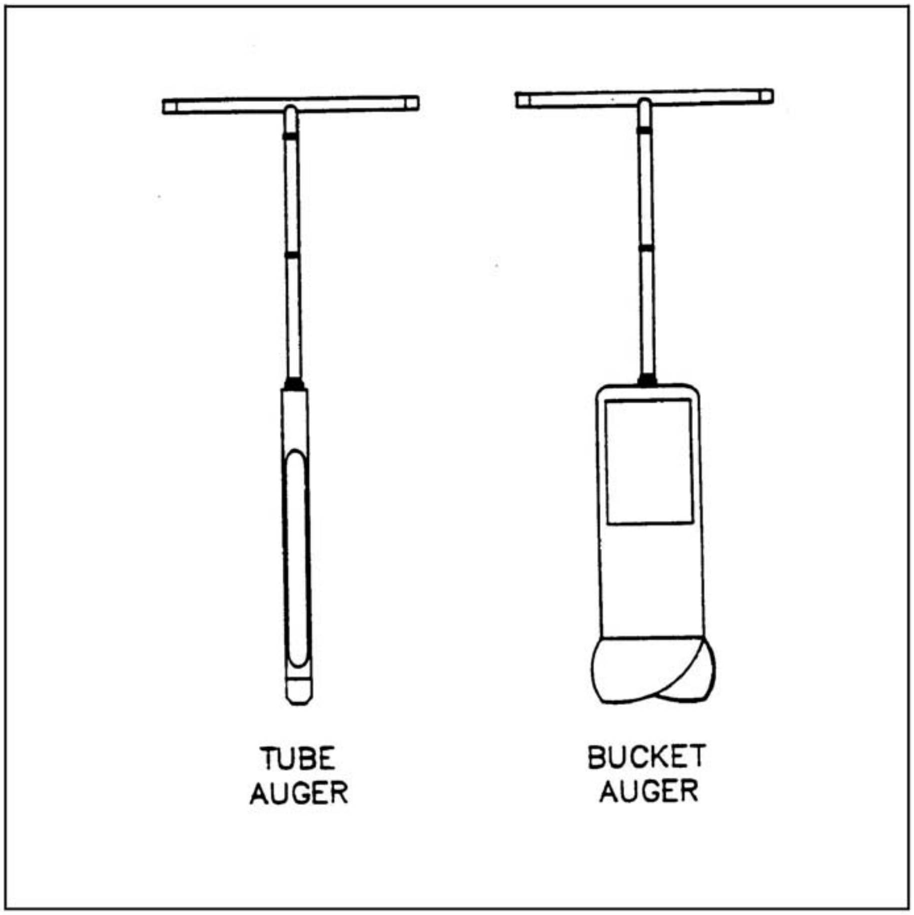
U.S. EPA. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA-600/4-84-076.

de Vera, E.R., B.P. Simmons, R.D. Stephen, and D.L. Storm. Samplers and Sampling Procedures for Hazardous Waste Streams. 1980 EPA-600/2-80-018.

# APPENDIX A

## Figures

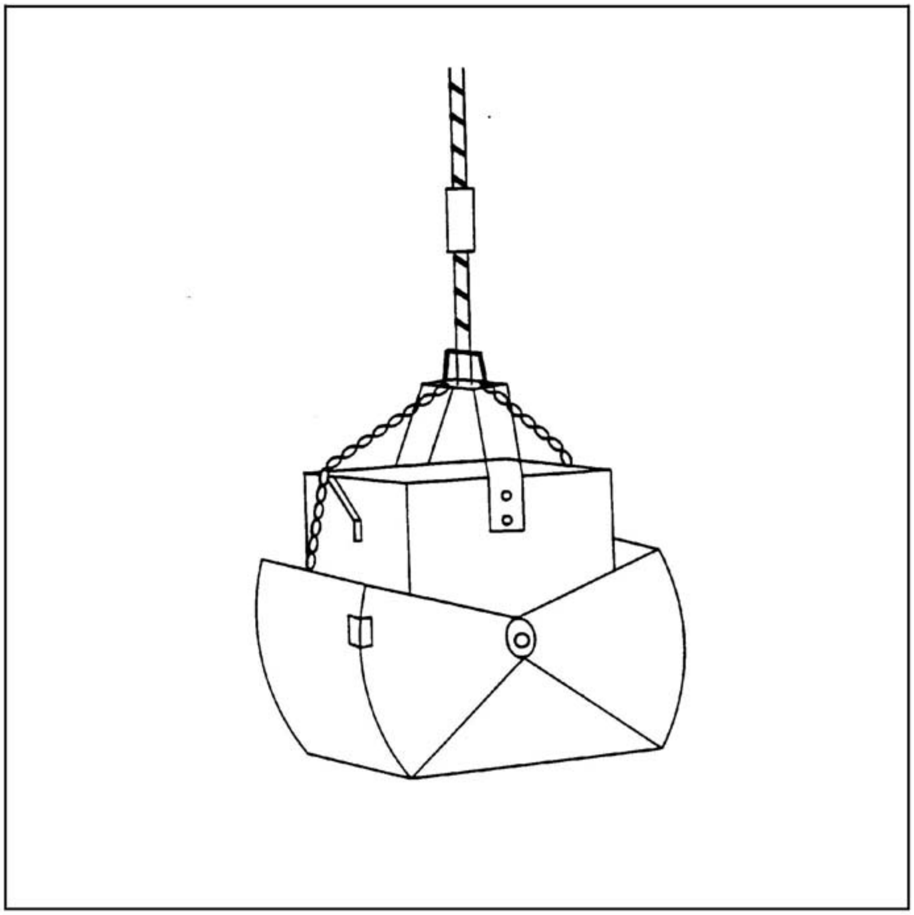
FIGURE 1. Sampling Auger



## APPENDIX A (Cont'd)

### Figures

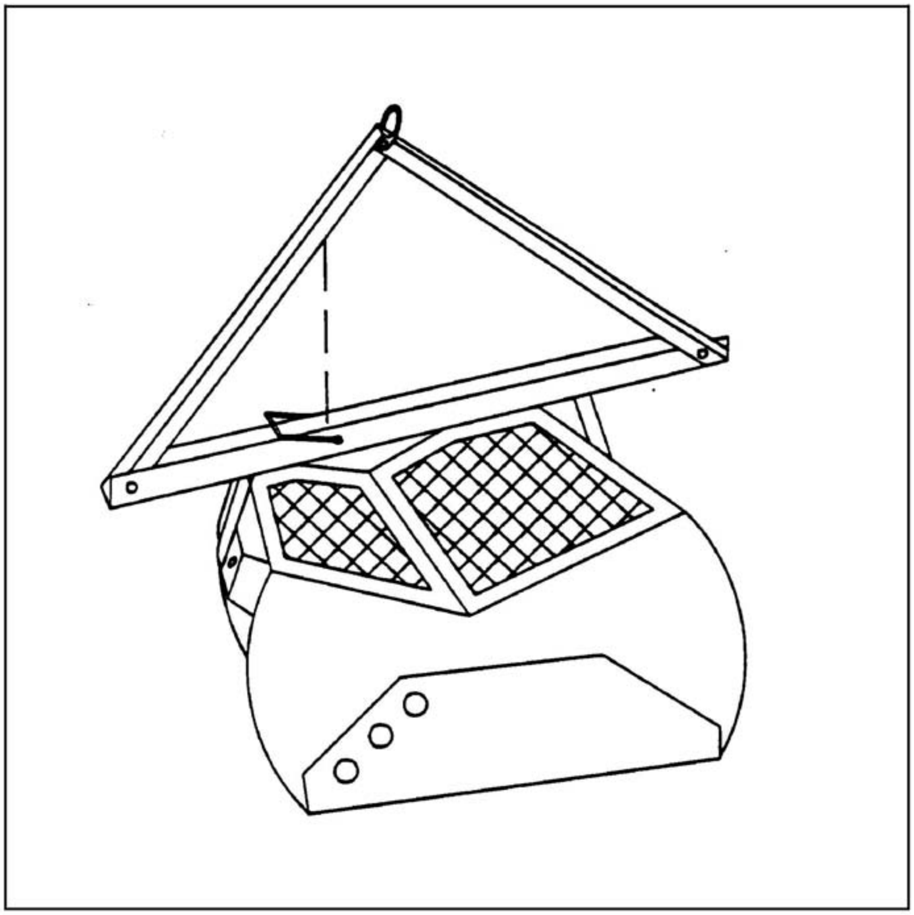
FIGURE 2. Ekman Dredge



## APPENDIX A (Cont'd)

Figures

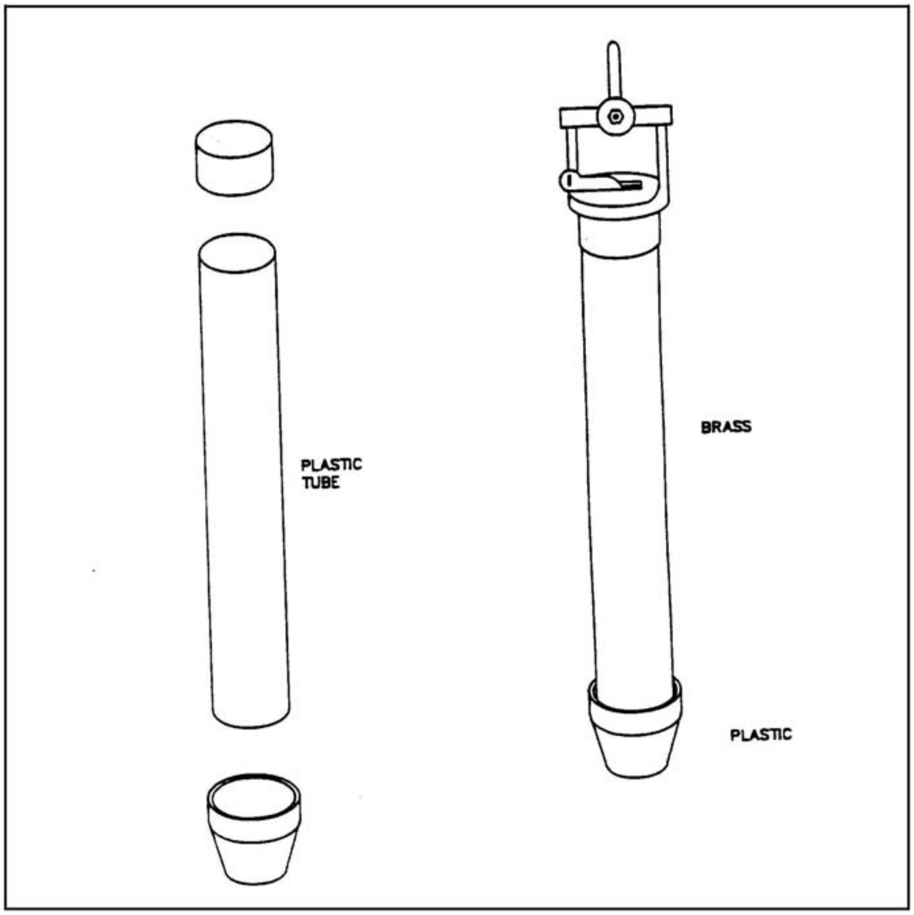
FIGURE 3. Ponar Dredge



## APPENDIX A (Cont'd)

Figures

FIGURE 4. Sample Coring Device



# GENERAL FIELD SAMPLING GUIDELINES

SOP#: 2001
DATE: 08/11/94
REV. #: 0.0

## 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide general field sampling guidelines that will assist REAC personnel in choosing sampling strategies, location, and frequency for proper assessment of site characteristics. This SOP is applicable to all field activities that involve sampling.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Sampling is the selection of a representative portion of a larger population, universe, or body. Through examination of a sample, the characteristics of the larger body from which the sample was drawn can be inferred. In this manner, sampling can be a valuable tool for determining the presence, type, and extent of contamination by hazardous substances in the environment.

The primary objective of all sampling activities is to characterize a hazardous waste site accurately so that its impact on human health and the environment can be properly evaluated. It is only through sampling and analysis that site hazards can be measured and the job of cleanup and restoration can be accomplished effectively with minimal risk. The sampling itself must be conducted so that every sample collected retains its original physical form and chemical composition. In this way, sample integrity is insured, quality assurance standards are maintained, and the sample can accurately represent the larger body of material under investigation.

The extent to which valid inferences can be drawn from a sample depends on the degree to which the sampling effort conforms to the project's objectives. For example, as few as one sample may produce adequate, technically valid data to address the project's objectives. Meeting the project's objectives requires thorough planning of sampling activities, and implementation of the most appropriate sampling and analytical procedures. These issues will be discussed in this procedure.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected, and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. Sample preservation, containers, handling, and storage for air and waste samples are discussed in the specific SOPs for air and waste sampling techniques.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The nature of the object or materials being sampled may be a potential problem to the sampler. If a material is homogeneous, it will generally have a uniform composition throughout. In this case, any sample increment can be considered representative of the material. On the other hand, heterogeneous samples present problems to the sampler because of changes in the material over distance, both laterally and vertically.

Samples of hazardous materials may pose a safety threat to both field and laboratory personnel. Proper health and safety precautions should be implemented when handling this type of sample.

Environmental conditions, weather conditions, or non-target chemicals may cause problems and/or interferences when performing sampling activities or when sampling for a specific parameter. Refer to the specific SOPs for sampling techniques.

## 5.0 EQUIPMENT/APPARATUS

The equipment/apparatus required to collect samples must be determined on a site specific basis. Due to the wide variety of sampling equipment available, refer to the specific SOPs for sampling techniques which include lists of the equipment/apparatus required for sampling.

## 6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 7.0 PROCEDURE

### 7.1 Types of Samples

In relation to the media to be sampled, two basic types of samples can be considered: the environmental sample and the hazardous sample.

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard; however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree.

The importance of making the distinction between environmental and hazardous samples is two-fold:

(1) Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel.

(2) Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or Department of Transportation (DOT) regulations and U.S. EPA guidelines.

### 7.2 Sample Collection Techniques

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples.

Grab Samples

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

Composite Samples

Composites are nondiscrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can in certain instances be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems by diluting isolated concentrations of some hazardous compounds below detection limits.

Compositing is often used for environmental samples and may be used for hazardous samples under certain conditions. For example, compositing of hazardous waste is often performed after compatibility tests have been completed to determine an average value over a number of different locations (group of drums). This procedure generates data that can be useful by providing an average concentration within a number of units, can serve to keep analytical costs down, and can provide information useful to transporters and waste disposal operations.

For sampling situations involving hazardous wastes, grab sampling techniques are generally preferred because grab sampling minimizes the amount of time sampling personnel must be in contact with the wastes, reduces risks associated with compositing unknowns, and eliminates chemical changes that might occur due to compositing.

## 7.3 Types of Sampling Strategies

The number of samples that should be collected and analyzed depends on the objective of the investigation. There are three basic sampling strategies: random, systematic, and judgmental sampling.

Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of a site. Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established. When judgmental sampling is performed, samples are collected only from the portion(s) of the site most likely to be contaminated. Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

## 7.4 QA Work Plans (QAWP)

A QAWP is required when it becomes evident that a field investigation is necessary. It should be initiated in conjunction with, or immediately following, notification of the field investigation. This plan should be clear and concise and should detail the following basic components, with regard to sampling activities:

- Objective and purpose of the investigation.
- Basis upon which data will be evaluated.
- Information known about the site including location, type and size of the facility, and length of operations/abandonment.
- Type and volume of contaminated material, contaminants of concern (including concentration), and basis of the information/data.
- Technical approach including media/matrix to be sampled, sampling equipment to be used, sample equipment decontamination (if necessary), sampling design and rationale, and SOPs or description of the procedure to be implemented.
- Project management and reporting, schedule, project organization and responsibilities, manpower and cost projections, and required deliverables.
- QA objectives and protocols including tables summarizing field sampling and QA/QC analysis and objectives.

Note that this list of QAWP components is not all-inclusive and that additional elements may be added or altered depending on the specific requirements of the field investigation. It should also be recognized that although a detailed QAWP is quite important, it may be impractical in some instances. Emergency responses and accidental spills are prime examples of such instances where time might prohibit the development of site-specific QAWPs prior to field activities. In such cases, investigators would have to rely on general guidelines and personal judgment, and the sampling or response plans might simply be a strategy based on preliminary information and finalized on site. In any event, a plan of action should be developed, no matter how concise or informal, to aid investigators in maintaining a logical and consistent order to the implementation of their task.

## 7.5 Legal Implications

The data derived from sampling activities are often introduced as critical evidence during litigation of a hazardous waste site cleanup. Legal issues in which sampling data are important may include cleanup cost recovery, identification of pollution sources and responsible parties, and technical validation of remedial design methodologies. Because of the potential for involvement in legal actions, strict adherence to technical and administrative SOPs is essential during both the development and implementation of sampling activities.

Technically valid sampling begins with thorough planning and continues through the sample collection and analytical procedures. Administrative requirements involve thorough, accurate documentation of all sampling activities. Documentation requirements include maintenance of a chain of custody, as well as accurate records of field activities and analytical instructions. Failure to observe these procedures fully and consistently may result in data that are questionable, invalid and non-defensible in court, and the consequent loss of enforcement proceedings.

## 8.0 CALCULATIONS

Refer to the specific SOPs for any calculations which are associated with sampling techniques.

## 9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Refer to the specific SOPs for the type and frequency of QA/QC samples to be analyzed, the acceptance criteria for the QA/QC samples, and any other QA/QC activities which are associated with sampling techniques.

## 10.0 DATA VALIDATION

Refer to the specific SOPs for data validation activities that are associated with sampling techniques.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures.

# Appendix E

# Laboratory Methods and Procedures

***May Contain Confidential Business Information***

***Contact EPA Region 6 for more information***

# QUALITY ASSURANCE SAMPLING PLAN ADDENDUM 1 – RESIDENTIAL GROUNDWATER SAMPLING AND MONITORING

## FOR

## GOLD KING MINE SPILL

# QUALITY ASSURANCE SAMPLING PLAN ADDENDUM 1 – RESIDENTIAL GROUNDWATER SAMPLING AND MONITORING

## FOR

## GOLD KING MINE SPILL

Prepared for

**U.S. Environmental Protection Agency Region 6**
Emergency Response Branch
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202

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Revision 1

# 1. PROJECT OBJECTIVES

The objective of this addendum to the quality assurance sampling plan is to include residential water well sampling and monitoring associated with the Gold King Mine Blowout into the upper portions of Cement Creek in San Juan County, Colorado. The information contained in this document describes procedures to be utilized in the completion of water sampling from water wells located near the Animas River in northwestern New Mexico. The purpose of water sampling is to document groundwater quality conditions in the area and assess if the groundwater has been impacted by the Gold King Mine Blowout.

This document summarizes the methods that will be used for the sampling, and analysis of groundwater samples and should be used in conjunction with the Quality Assurance Sampling Plan Water and Sediment Sampling and Monitoring for the Gold King Mine Blowout.

# 2. SAMPLING APPROACH AND PROCEDURES

The EPA team will coordinate contacting property owners and residents in the surrounding areas. Property owners will request EPA personnel to collect samples from their water well.

Sampling methods, quality assurance (QA) procedures, and the analytical approach and method that will be used are discussed in the following sections.

## 2.1 GROUNDWATER SAMPLING CONDUCTED BY EPA (START)

Once access has been granted by a property owner and/or resident to sample their water wells, the EPA personnel will coordinate with the property owner to determine a sample date and time. Samples will only be collected after a signed access agreement has been received. Efforts will be made to coordinate multiple sampling locations during one field event.

Once sampling dates are scheduled, these dates will be relayed to the analytical laboratory to coordinate delivery of sample containers and sample couriers. Laboratory contact personnel will schedule the sampling event at the laboratory and will ship pre-cleaned, properly preserved sample containers to the Sampling Team. The Sampling Team may choose to maintain a stock of a limited number of sampling containers. It is recommended that no more than a one (1) month supply of containers be kept in stock at any given time. It is very important that any changes in the sampling schedule be communicated to the appropriate laboratory contact personnel.

### 2.1.1 Sample Collection

Samples will be collected in accordance with the attached SOP. The Sampling Teams will consist of two STARTs that have received training in environmental sample collection techniques, environmental sample collection and chain-of-custody documentation, environmental sample preservation, sample packaging, and sample shipment.

The Sampling Team will check the shipping container upon arrival to make sure there was no breakage or leakage of preservatives during transit. If problems are evident, the laboratory contact personnel will be notified as soon as possible so replacement containers can be shipped. Sufficient ice shall be taken to the sample collection locations so that filled containers can be placed on ice immediately following sample collection.

Upon arrival at the sampling location, the sampling team will collect the required information about the well from the landowner. This information will be documented on the Sampling Form. GPS coordinates of the water well will also be collected with a handheld GPS unit. After collecting the coordinates, the field team will verify the coordinates on the GPS unit by viewing the overview map on the unit and making sure the coordinate is in the correct location.

The sampling team will review the water system set up to determine the closest water tap to the water source. Note the presence of treatment systems, such as a water softener, and make sure the selected sample location is **BEFORE** any such system. If the sample cannot be collected before the treatment system, then it should be documented on the Sampling Form. Note the presence of an aerator. If an aerator is present, it must be removed if possible prior to sample collection. Sampling personnel will **NOT** remove tubing or pumps from wells.

Photographs of the wellhead (if applicable) and sampling point (spigot, tap, etc.) shall be taken. GPS coordinates will be taken at the sample location. The sample location should best represent the groundwater source. The sampling team should avoid collecting samples from poor water sources such as hot and cold mixing faucets (single lever faucets), slop sinks, janitorial sinks, frost free hose bibs, etc.

Note: The Sampling Team will **NOT** alter an existing water system in order to collect samples. If existing pumping equipment is not functional, then the Sampling Team should note the equipment problems and inability to collect a sample on the Sampling Form.

### 2.1.2 Sampling the Line from Water Well

Purge the tap for a minimum of 10 minutes prior to collecting water quality readings. If samples are being collected in an area of limited water resources, try to purge a minimum of 5-10 gallons before collecting water quality readings. Attempts will be made to purge water in a manner that does not cause erosion or damage to the landowner's property. As needed, purge water will be collected and/or beneficially re-used (watering plants, etc.) depending on landowner preference. The purge volume shall be estimated by bucket fill and noted on the Sampling Form. After the well has been purged, properly calibrated water quality meters will be used to collect the following water quality parameters:

- Temperature
- pH
- Dissolved Oxygen
- Oxidation/Reduction Potential
- Specific Conductance
- Turbidity

Water quality instruments shall be calibrated daily prior to use and the calibration results documented in the field logbook. Water quality parameters shall be collected on 2-minute intervals until they have stabilized (pH should be within 0.1 units and specific conductance within 10%).

After stabilization, sampling personnel shall reduce the flow of water, let the tap run for another minute, and then collect the sample. Personnel collecting samples shall use proper environmental sample collection techniques and appropriate personal protective equipment (PPE) to ensure samples are safely collected and are representative of the source water. PPE for sample collection will include, at a minimum, safety glasses and clean nitrile gloves as described in the site specific health and safety plan.

The water quality instruments shall be properly decontaminated prior to measuring the next well. This shall be accomplished by wiping the instrument probe dry with a paper towel, rinsing with de-ionized water, then drying again. Meters should always be stored and transported with the caps on and away from potential sources of contamination.

All samples collected for laboratory analysis will be placed directly into pre-cleaned, unused glass or plastic containers as appropriate based on the particular analytical method. Intermediate collection containers should not be used. Sampling personnel will change gloves between each sample collection/handling. All samples will be assembled and catalogued prior to delivery to the designated laboratory. Samples will be sent for analysis to a qualified subcontracted commercial laboratory for parameters listed in Table 2-1.

## Table 2-3
## Groundwater/Drinking Water Sampling Parameters

| Analysis | Matrix | Container | Preservation | Minimum Sample Volume or Weight | Maximum Holding Time | Analytical Methods |
|---|---|---|---|---|---|---|
| Metals [1, 2, 3] | Groundwater | 1 – 250 mL Poly | pH <2 ($HNO_3$)<br>4°C | Fill to capacity | 28 days for mercury, 180 days for all other metals | EPA Methods 200.7, 200.8, and 245.1 |
| Hardness as $CaCO_3$ [1] | Groundwater | | | | 180 calendar days | |
| Dissolved Metals [1,2,3] | Groundwater | 1- 250 mL Poly | Field Filtered: /$HNO_3$ to pH<2 (water), 4°C<br>*If not field filtered then no preservative* | Fill to capacity | 28 days for mercury, 180 days for all other metals | EPA Methods 200.7, 200.8, and 245.1 |
| Major anions and cations [3] | Groundwater | 2-250 mL Poly | None | Fill to capacity | 48 hours (nitrate),<br>28 days for all other 300.0<br>14 days Alkalinity | EPA Method 300.0 and SM2320B |

1. Metals and hardness sample to be collected in the same 250 mL poly container
2. TAL Metals + Mo
    200.7: Al, Ca, Co, Fe, K, Mg, Mo, Na, V
    200.8: Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Se, Tl, Zn
    245.1: Hg
    300.0: Chloride, Sulfate, Fluoride, Nitrate
3. Major cations (dissolved): Potassium, Sodium, Magnesium, (from 200.7/200.8) Fluoride (300.0)
   Major anions (dissolved): Chlorides, Sulfates, Carbonate and Bicarbonate (alkalinity)

# 3. QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field quality assurance/quality control (QA/QC) samples will be collected according to the following:

- One field duplicate will be collected for every 20 normal samples, or once per week whichever comes first (provides the higher number of duplicates) for all analyses listed in Table 2-1. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results.
- Additional QA/QC samples may be collected once the analytical parameters are finalized.

All data will be validated as outlined in the Gold King Mine Region 6 Water and Sediment QASP.

# 4. DATA QUALITY OBJECTIVES

Table 4-1 provides a summary of laboratory reporting and detection limits with a comparison to applicable medium-specific screening levels identified to be applicable to evaluating results to be obtained from the pending residential water well sampling.

## Table 4-1
## Metals Analytes, Test Methods, Reporting Limits and Methods Detection Limits for Residential Well Water Samples

| Analyte | RLs (µg/L)[1] | MDL (µg/L)[1] | RLs (µg/L)[2] | MDL (µg/L)[2] | EPA Tapwater RSL[3] | Irrigation | Livestock | State of New Mexico Tapwater[4] | EPA MCL | Site-Specific Action Level[5] | Analytical Method | RL Exceeds Site-Specific Action Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 20 | 5.3 | 50 | 25 | 20000 | 5000 | N/A | 19900 | N/A | 19900 | EPA 200.7 | No |
| Alkalinity, Bicarbonate | 20 | 0.94 | | | N/A | N/A | N/A | N/A | N/A | N/A | SM2320B | No |
| Alkalinity, Carbonate | 2 | 2 | | | N/A | N/A | N/A | N/A | N/A | N/A | SM2320B | No |
| Alkalinity, Total | 10 | 3.9 | 4 | 4 | N/A | N/A | N/A | N/A | N/A | N/A | SM2320B | No |
| Antimony | 1.0 | 0.43 | 2 | 0.5 | 7.8 | N | N/A | 7.26 | 6 | 6 | EPA 200.8 | No |
| Arsenic | 1.0 | 0.29 | 1 | 0.5 | 0.052 | 100 | 200 | 0.513 | 10 | 10 | EPA 200.8 | No |
| Barium | 2.0 | 1.1 | 1 | 0.5 | 3800 | N | N/A | 3280 | 2000 | 2000 | EPA 200.7 | No |
| Beryllium | 2.0 | 0.31 | 0.5 | 0.25 | 25 | 100 | 100 | 12.4 | 4 | 4 | EPA 200.7 | No |
| Cadmium | 0.50 | 0.0079 | 1 | 0.25 | 9.2 | 10 | 50 | 6.24 | 5 | 5 | EPA 200.8 | No |
| Calcium | 1000 | 84 | 100 | 50 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 200.7 | N/A |
| Chloride | 0.5 | 0.135 | 0.5 | 0.25 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 300.0 | N/A |
| Chromium | 6.0 | 2.2 | 2 | 0.5 | 0.035[3] | 100 | 1000 | 0.252[5] | 100 | 100 | EPA 200.7 | No |
| Cobalt | 6.0 | 1.3 | 1 | 0.5 | 6.0 | 50 | 1000 | N/A | N/A | 6.0 | EPA 200.7 | No |
| Copper | 1.0 | 0.26 | 2 | 0.5 | 800 | 200 | 500 | 790 | 1300 | 1300 | EPA 200.8 | No |
| Fluoride | 0.1 | 0.029 | 0.5 | 0.25 | 800 | N/A | N/A | 1180 | N/A | 1180 | EPA 300.0 | No |
| Iron | 20 | 7.2 | 40 | 10 | 14000 | N/A | N/A | 13800 | N/A | 14000 | EPA 200.7 | No |
| Lead | 0.50 | 0.047 | 1 | 0.5 | 15 | 5000 | 100 | N/A | 15 | 15 | EPA 200.8 | No |
| Magnesium | 1000 | 75 | 20 | 10 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 200.7 | N/A |
| Manganese | 2.0 | 1.5 | 1 | 0.5 | 430 | 200 | N/A | 2020 | N/A | 2020 | EPA 200.7 | No |
| Mercury | 0.20 | 0.15 | 0.2 | 0.1 | 0.63 | N/A | 10 | 0.626 | 2 | 2 | EPA 245.1 | No |
| Molybdenum | 8.0 | 2.7 | 2 | 0.5 | 100 | N/A | N/A | 98.7 | N/A | 100 | EPA 200.7 | N/A |
| Nickel | 10 | 2.3 | 2 | 0.5 | 390 | 200 | 1000 | 372 | N/A | 372 | EPA 200.7 | N/A |
| Nitrate | 0.1 | 0.32 | 0.11 | 0.055 | 32000 | N/A | N/A | 31600 | 10000 | 31600 | EPA 300.0 | No |
| Potassium | 1000 | 220 | 500 | 250 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 200.7 | N/A |
| Selenium | 1.0 | 0.19 | 2 | 0.5 | 100 | 130 | 250 | 98.7 | 50 | 50 | EPA 200.8 | No |
| Silver | 0.50 | 0.044 | 1 | 0.5 | 94 | N/A | N/A | 81.2 | N/A | 81.2 | EPA 200.8 | No |
| Sodium | 1000 | 102 | 500 | 250 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 200.7 | N/A |
| Sulfate | 0.5 | 0.115 | 0.5 | 0.25 | N/A | N/A | N/A | N/A | N/A | N/A | EPA 300.0 | N/A |
| Thallium | 0.50 | 0.0053 | 1 | 0.5 | 0.20 | N/A | N/A | 0.197 | 2 | 2 | EPA 200.8 | No |
| Vanadium | 50 | 1.5 | 2 | 1 | 86 | 100 | 100 | 63.1 | N/A | 63.1 | EPA 200.7 | No |
| Zinc | 10 | 3.9 | 20 | 0.5 | 6000 | 2000 | 25000 | 5960 | N/A | 5960 | EPA 200.7 | No |

Notes:

[1] – RLs/MDLs from Hall Environmental

[2] – RLs/MDLs from TestAmerica

[3] – Tapwater RSL from EPA Regional Screening Level tables dated June 2015, excess lifetime cancer risk of $10^{-06}$, HQ = 1

[4] – New Mexico Environmental Department of tapwater values from Table A-1 update, December 2014

[5] – Value for hexavalent chrome.

[6] – Action levels are based on MCLs when available. If no MCL, the action level was selected as the NMED tapwater value, of if no NMED tapwater value, the lowest of the EPA tapwater RSL, Irrigation and Livestock values.

# 5. SAMPLE MANAGEMENT

## 5.1 SAMPLE NOMENCLATURE

Specific nomenclature, as determined by the EPA, will be used to provide a consistent means of facilitating the sampling and overall data management for the project. The PTL must approve any deviations from the sample nomenclature proposed below.

Sample nomenclature will follow a general format regardless of the type or location of the sample collected. The general nomenclature consists of the following components:

WELL– YYMMDD - Collection Type + QC Type

Where:

Well or Station: For Wells and boreholes always assume there will be 10 or more so Monitoring Well 1 becomes designated MW01 or MW-01. If it is anticipated that there will be over 100 wells designate Monitoring Well 1 as MW001 or MW-001.

YYYYMMDD: A four-digit year + two-digit month + two-digit day

Collection Type: A one-digit code used to designate what type of sample was collected

| | |
|---|---|
| 1 | Surface Water |
| 2 | Ground Water |
| 3 | Leachate |
| 4 | Field QC/water sample |
| 5 | Soil/Sediment |

| | |
|---|---|
| 6 | Oil |
| 7 | Waste |
| 8 | Other |
| 9 | Drinking Water |
| | |

QC Type: A one-digit code used to designate the QC type of the sample

| | |
|---|---|
| 1 | Normal |
| 2 | Duplicate |
| 3 | Rinsate Blank |
| 4 | Trip Blank |
| 5 | Field Blank |
| 6 | Confirmation, Normal |
| 7 | Confirmation, Duplicate |

Sample data management will be completed utilizing SCRIBE including Chain-of-Custody (COC) and sample documentation needs.

## 5.2 SAMPLE PRESERVATION, CONTAINERS, AND HOLD TIMES

Water samples will be stored in coolers at 4 degrees centigrade (C), on-site until shipped for laboratory analysis. The samples will be shipped via common carrier to the laboratory or driven by START members. Table 2-1 lists the container requirements, preservation techniques, volumes and hold times.

The remaining requirements of the QASP are still in effect.

# Addendum No. 1
# Data Quality Objective –Groundwater Sampling
# Gold King Mine Spill

| | |
|---|---|
| **STEP 1. STATE THE PROBLEM** | |
| Groundwater samples will be collected from private groundwater wells at various locations along the Animas River to assess the potential health and ecological risk associated with the Gold King Mine release. To assess these potential risks, EPA Region 6 will assess the water quality of the wells sampled. The groundwater samples will be collected for metal analysis to determine if there is a threat to human health and the environment. | |
| **STEP 2. IDENTIFY THE DECISION** | |
| **Are the concentrations of constituents of concern in groundwater, represented by a sample, above specified action levels?** | |
| IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS. | If the constituents of concern (COCs) exceed the specified action level in groundwater, the groundwater represented by that sample will be considered contaminated and will require additional attention.<br>If no COC concentrations exceed the specified action levels in groundwater, the groundwater represented by that sample will not require additional attention. |
| **STEP 3. IDENTIFY INPUTS TO THE DECISION** | |
| IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION. | Groundwater information obtained from analytical results from groundwater samples collected during sampling. |
| IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS. | Groundwater sample locations will be determined in the field in conjunction with the EPA Environmental Unit, EPA OSC and START team.<br>Analytical results obtained from the subcontracted laboratory following the analytical methods listed in Table 4-1. |
| BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS. | The screening and benchmark levels shown on Table 4-1 and at the direction of EPA Environmental Unit. |
| IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS. | Groundwater sampling techniques are described in the attached SOP. |

## Addendum No. 1
## Data Quality Objective –Groundwater Sampling
## (Continued)

| | |
|---|---|
| **STEP 4. DEFINE THE BOUNDARIES OF THE STUDY** | |
| DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY. | The groundwater sampling area includes wells within 500 ft of the Animas River. |
| SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST. | COC concentrations in groundwater for the analytes listed on the attached table. |
| DEFINE THE SCALE OF DECISION MAKING. | The scale of decision will be for groundwater represented by each sample collected from the selected locations. |
| DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY. | The data will apply until the response actions are complete. |
| DETERMINE WHEN TO COLLECT DATA. | Samples will be collected during the Gold King Mine Emergency Response activities. |
| IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION. | Inclement weather.<br>Site access not attainable. |
| **STEP 5. DEVELOP A DECISION RULE** | |
| SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST. | The sample concentrations at each sample location will be compared to the site-specific action levels based on groundwater benchmarks listed in Table 4-1. |
| SPECIFY THE ACTION LEVEL FOR THE DECISION. | Groundwater benchmarks and action levels are included in Table 4-1. Additional Action Levels may be determined applicable at the direction of the EPA Environmental Unit. |
| DEVELOP A DECISION RULE. | If any result in a groundwater sample is above the contaminant specific action level, then the groundwater represented by that sample will require additional attention; otherwise, the groundwater does not require additional attention. |

# Addendum No. 1
# Data Quality Objective –Groundwater Sampling
# (Continued)

| STEP 6. SPECIFY LIMITS ON DECISION ERRORS | |
|---|---|
| DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST. | Concentrations may range from 0 mg/L to greater than the contaminant specific action level. |
| DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH. | Type I Error: Deciding that the water represented by the groundwater sample does not exceed the specified action level when, in truth, the groundwater concentration of the contaminant exceeds its specified action level. The consequence of this decision error is that contaminated groundwater will remain in the groundwater pathway, possibly endangering human health and the environment. There may also be potential future liability associated with cleanup costs of leaving contaminated groundwater in the groundwater pathway. This decision error is more severe.<br>Type II Error: Deciding that the water represented by the groundwater sample does exceed the specified action level when, in truth, it does not. The consequences of this decision error are that remediation of the groundwater may continue and unnecessary costs will be incurred. |
| ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE. | The true state of nature when the groundwater is decided to be below the specified action levels when in fact, it is not below the specified action levels, is that the water may need remedial action.<br>The true state of nature when the groundwater is decided to be above the specified action levels when in fact, it is not above the specified action levels, is that the water may not need remedial action. |
| DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS ($H_o$) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS ($H_a$). | $H_o$: The groundwater represented by the groundwater sample is above the specified action level.<br>$H_a$: The groundwater represented by the groundwater sample is below the specified action level. |
| ASSIGN THE TERMS “FALSE POSITIVE” AND “FALSE NEGATIVE” TO THE PROPER DECISION ERRORS. | False Positive Error = Type I<br>False Negative Error = Type II |
| ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS. | To be assigned based on discussions with EPA Environmental Unit. |

# Addendum No. 1
# Data Quality Objective –Groundwater Sampling
# (Continued)

| **STEP 7. OPTIMIZE THE DESIGN** | |
|---|---|
| ***REVIEW THE DQOs*** | Due to insufficient historical data, determination of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered. |
| ***DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.***<br>*Groundwater samples (including QA/QC samples) will be collected utilizing sampling procedures described in the attached SOP. The samples will be analyzed for the analytes listed in Table 2-1 and 4-1. The sample locations will be at the direction of the EPA Environmental Unit. Any changes to sample locations will be discussed with the EU prior to relocation.* | |