Final

SITE-WIDE SAMPLING AND ANALYSIS PLAN
NEW WORLD MINING DISTRICT
RESPONSE AND RESTORATION PROJECT

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NEW WORLD MINING DISTRICT
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1.0INTRODUCTION

This Site-Wide Sampling and Analysis Plan (Site-Wide SAP) for the New World Mining District was developed by Maxim Technologies, Inc. (Maxim) for the United States Department of Agriculture Forest Service (USDA-FS). The USDA-FS is undertaking a non-time-critical response action in the New World Mining District to respond to and restore natural resources affected by historic gold, silver, copper, and lead mining. The historic New World Mining District is located a few miles north of Cooke City, Montana (Figure 1). This Site-Wide SAP covers data acquisition methods that will commonly be used during the life of the project, which is expected to carry through the year 2007.

The purpose of this Site-Wide SAP is threefold:

1. To standardize field methods that will be routinely used to collect environmental samples.

2. To identify routine physical and chemical parameters that will be analyzed.

3. To identify laboratory methods that will be used for sample analysis.

This Site-Wide SAP is comprised of two parts, a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP presents a detailed description of field investigation activities. It will be used by field personnel as a step-by-step guide to environmental sampling and will stipulate the laboratory analytical procedure that will be used for sample analysis. The QAPP will be used by field personnel to monitor and control data quality. The QAPP describes quality parameters and procedures to ensure that all data collection efforts produce data of known quality.

Actual sampling locations and number of samples are not identified in this Site-Wide SAP. This information, along with any specific methods or data collection needs that are not identified in the Site-Wide SAP, will be described in annual response action work plans that will be prepared in the fall of each year project activities occur.

The following sections present the FSP and QAPP. A brief background section precedes these two main sections as does a description of the data quality objectives (DQOs) for the project. The DQO provide the basis for sampling methods, analytical parameters, and quality assurance.

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Figure 1

Figure 1 - Back Page

2.0BACKGROUND

The New World Mining District (District) is located in Park County in south-central Montana. The District is bounded on the south by the Montana-Wyoming state line, on the west by Yellowstone National Park and on the north and east by the Absaroka-Beartooth Wilderness area boundary (Figure 2-1). The District is characteristic of high alpine regions of the northern Rocky Mountains with elevations that range from approximately 7,000 feet to over 10,000 feet. Accumulated snow pack in the higher elevations range from 10 feet to over 20 feet deep where drifting occurs. The ground is generally snow covered from late October through mid May at the lower elevations and from early October through late July at the higher elevations. Perennial and semi perennial snow fields occupy the north facing slopes of the highest mountain peaks.

Area streams are high energy, first and second order tributaries of the Yellowstone River system. These streams occupy glacially carved valleys and are fed largely by melting snow pack. Peak streamflow is characteristically reached by mid June or early July and may be several orders of magnitude higher than baseflow conditions, which typically occur in late winter or early spring. Three drainage basins have been identified as potentially being impacted by the proposed response and restoration actions: 1) Fisher Creek and the Clarks Fork of the Yellowstone River; 2) Daisy Creek and the Stillwater River drainage basin; and, 3) Miller Creek and Soda Butte Creek drainage basin.

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3.0DATA QUALITY OBJECTIVES

Determining DQOs is one of the first steps in determining the appropriate analytes, analytical methods, and detection limits needed for the sampling program. DQOs are qualitative and quantitative statements that specify the quality of data required to support project activities. The DQOs for the USDA-FS Response and Restoration Project were developed according to the process outlined in "Data Quality Objectives for Remedial Response Activities, Development Process" (EPA, 1987).

A list of typical data parameters and data uses needed to support response actions for the project was developed to initiate the DQO process (Table 3-1). The next step was to determine analytical support levels for the project. These levels are defined in EPA guidance (EPA, 1987) as analytical options available to support data collection activities. There are five general levels that are distinguished by the types of technology, documentation use, and degree of sophistication. These levels are:

- Level V - Nonstandard methods. Analyses that may require method modification and/or development. Analyses performed by the EPA CLP under a Special Analytical Service (SAS) request are considered Level V.

- Level IV - EPA CLP Routine Analytical Service (RAS). This level is characterized by rigorous QA protocols and documentation and provides qualitative and quantitative analytical data. Some commercial laboratories provide this level data.

- Level III - Laboratory analysis using methods other than EPA CLP RAS methods. This level is used primarily in support of engineering studies using standard EPA approved procedures. Some procedures may be equivalent to CLP RAS without the CLP requirements for documentation.

- Level II - Field analysis. This level is characterized by the use of portable analytical instruments or field kits that can be used on-site or in mobile laboratories stationed near the site.

- Level I - Field screening. This level is characterized by the use of portable instruments or field kits that can provide real-time data to assist in the optimization of sampling point locations and for health and safety support.

For this project, DQOs will be based on Level III for water quality monitoring of metals concentrations, mine waste, and soil sampling. Level IV may be appropriate for water quality monitoring metals analysis after a substantial level of remediation work is completed. When necessary, Level IV data will be specified in the annual work plan. Levels I and II will be used for field parameters. Table 3-2 presents DQOs for the project for each set of analytical parameters. Included in Table 3-2 is the measurement, measurement location, analytical method, sample media type, and analytical support level.

TABLE 3-1
Data Collection Type, Data Parameters, And Data Uses
Site-Wide Sampling and Analysis Plan
New World Mining District - Response and Restoration Project

Sample Type	Typical Data Parameters	Data Uses
Surface Water	Total recoverable metals, acidity, cations, anions, pH, conductivity, temperature, flow	Contaminant concentrations, loading, source areas, water pathways, water movement, exceedance of water quality standards
Groundwater	Dissolved metals, acidity, cations, anions, pH, conductivity, temperature, water level, aquifer characteristics	Contaminant concentrations, loading, source areas, water pathways, water movement, exceedance of water quality standards
Mine Waste	Total metals, acid base account, pH, conductivity, coarse fragment content, saturation percent	Contaminant identification, lime requirement, volume, compactability, moisture content
Sediment	Total metals	Contaminant identification, volume, exceedance of standards
Coversoil	Texture, pH, electrical conductivity, coarse fragment content, total metals, organic matter content, fertility	Suitability, volume, fertilizer prescription
Cover Materials	Sieve analysis, remolded hydraulic conductivity	Suitability for use in repository cover systems, volume, permeability
Vegetation (reclaimed areas)	Cover, species composition, species density, species frequency	Erosion resistance, maintenance needs (reseeding), species distribution
Macroinvertebrates	Species diversity, number, and density	Trends in abundance and diversity
GPS Survey	Feature location	Latitude and longitude
Engineering Survey	Elevation, topography, material volumes, location	Engineering evaluation/cost analysis, construction design

TABLE 3-2
SUMMARY OF DATA QUALITY OBJECTIVES
Site-Wide Sampling and Analysis Plan
New World Mining District - Response and Restoration Project

Measurement	Location	Analytical Method(1)	Support Level	Media(2)	Data Use(3)
Total Metals	Lab	SW-846; CAWW	IV; III	SE, SI, SW, SO	SC, RA, EA, ED
Dissolved Metals	Lab	CAWW	IV; III	GW	SC, RA, EA
Bicarbonate	Lab	Method 2320B ASTM	III	SW, GW	SC, EA, ED
Total Alkalinity	Lab	Method 2320B ASTM	III	SW, GW	SC, EA
Common Ions	Lab	CAWW	III	SW, GW	SC, RA, EA
Acid Base Accounting	Lab	Sobeck; ASTM	III	SI, SO	SC, EA, ED
Coversoil Parameters	Field/Lab	MSA; USDA; ASTM	III	SO	EA, ED
Engineering Parameters	Lab	ASTM	III	SI, SO	EA, ED
Specific Conductance	Field/Lab	Maxim SOP; CAWW	II	SW, GW, SI, SO	SC
Flow	Field	Maxim SOP	II	SW	SC, EA, ED
Water Level	Field	Maxim SOP	II	GW	SC, EA
Turbidity	Field	Maxim SOP	II	SW	SC, ED
Temperature	Field	Maxim SOP	II	SW, GW	SC
pH	Field/Lab	Maxim SOP; CAWW	II	SW, GW, SI, SO	SC

1) ASTM American Society for Testing Materials
CAWW Methods for Chemical Analysis of Water and Wastes (EPA, 1984)
MSA Methods of Soil Analysis, American Society of Agronomy, Parts I and II. Mono No. 9 (1982)
Sobeck - Field and Laboratory Methods Applicable to Overburdens and Minesoils (EPA, 1978)
SW-846 Test methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846 (EPA, 1986).
USDA Handbook 60 - Diagnosis and Improvement of Saline and Alkali Soils (USDA, 1954)
2) Media SW - surface water; GW - groundwater; SE - sediment; SI - mine waste; SO - native soil
3) Data use SC - site characterization; RA - risk assessment; EA - alternative evaluation; ED - engineering design

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4.0FIELD SAMPLING PLAN

The primary information covered in this section of the Site-Wide SAP is focused on six environmental media: mine waste, surface water, sediment, groundwater, aquatics, and soil. Standard field methods covered in the FSP include the following: measurement of field parameters (pH, conductivity, temperature, dissolved oxygen, oxidation-reduction potential); surface water sampling; flow measurements; gauge installation and maintenance; monitoring well installation; well development; groundwater sampling; aquifer testing; macroinvertebrate sampling; and, soil and mine waste sampling (manual, backhoe, and drilling). Detailed descriptions of sample designation, sampling methods, field note taking, completing field forms, sample packaging, and sample shipment are also described.

4.1 SAMPLE DESIGNATION AND LABELING

Sample designations will consist of a series of letters and numbers to indicate the site, sample type, media, and location. The site prefix will consist of the letters RR- for the project name (Response and Restoration). For established surface water, mine waste, and groundwater stations, the station number will follow the project designation (Figures 2, 3a, 3b, and 4).

For new surface water and groundwater stations, the project designation will be followed by a letter designation for the drainage basin where the station is located. The drainage basin letter designates are: 'DC-' for samples in the Daisy Creek drainage; 'FC-' for samples in the Fisher Creek drainage; 'MC' for samples in the Miller Creek drainage; and, 'SB-' for samples in the Soda Butte Creek drainage. For new sampling stations, if the sample is a surface water sample, the drainage basin code will be followed by the letters 'SW'. If the sample is a groundwater sample, the drainage basin code will be followed by the letters 'GW'. Finally, for new surface water and groundwater stations, a consecutive number beginning with the number 101 will be used. Examples of new and existing surface water and groundwater designation are shown below:

RR-DCSW-101 (new)
RR-DC-5 (existing) ← *Surface Water*

RR-FCGW-101 (new)
RR-EPA-1 (existing) ← *Groundwater*

For mine waste sampling, the established numbering system used by the USDA-FS will be adopted for all mine dumps (Figure 4). The numbering system for the known dumps with current designations will be augmented by adding an individual sample number at the end of the designation beginning with the number 01. Where several samples are collected from a single dump, a lower case letter will follow the sample number beginning with the letter 'a'.

For new mine waste sites, the same sample designation system as the existing system will be used. The sample ID will consist of a drainage basin code added to the project designation and followed by a number identifier. The drainage basin codes for mine wastes are the same as for surface water. The letter code 'SI' (mine waste sample) will follow the drainage basin code. Each new mine waste site will then be given an individual number beginning with the number 101. An individual sample number will follow the mine waste identifier as described in the preceding paragraph for existing samples. Examples of new and existing mine waste sample numbers are shown below:

RR-DCSI-101-01a (new)
RR-FCSI-96-6-01a (existing) ← *Mine Waste*

For sediment samples, the sediment identifier will consist of the surface water station identifier followed by the letters 'SE'. Examples of new and existing sediment sample designations are provided below.

RR-DCSW-101-SE (new)
RR-DC-5-SE (existing) ← *Sediment*

For natural soil samples, sample identification will consist of the project identifier, followed by the letter code 'SO' and then followed by a consecutive number beginning with the number 01.

Field quality control samples will be submitted blind to the laboratory. Field quality control samples will include deionized water blanks, rinsate blanks, and field duplicates. The sample designation for blind field duplicates will be the same number and letter designation as the station where the duplicate sample is taken. The quality control sample will be differentiated from the natural sample by adding the following codes at the end of the sample designation number:

Deionized Water Blank	'B'
Rinsate Blank	'R'
Field Duplicate	'X'

← *Quality Control*

Examples of quality control sample designations are provided below.

RR-DCGW-101B (new groundwater deionized water blank)
RR-FCSW-101R (new surface water rinsate blank)
RR-SBSI-105-01X (new mine waste duplicate sample)
RR-DC-5X (existing surface water field duplicate)

All samples will be labeled in the field along with the date and time of sample collection, the sample number, the sample depth if necessary, any preservatives used, and the sampler's initials. A permanent marker will be used for labeling.

4.2 FIELD NOTES

All field observations will be recorded in a project dedicated field notebook in accordance with SOP-12 (Sample Documentation). The standard project field books that will be used by all personnel will be the equivalent of the pocket-sized "Rite in the Rain"® All-weather Transit Notebook No. 301 (4 5/8 x 7" with numbered pages). Each field book will be labeled on the front cover with the project name, beginning entry date, final entry date, and general contents of notes (e.g. surface water sampling).

The field team leader is responsible for recording information such as weather conditions, field crew members, visitors to the site, samples collected, the date and time of sample collection, procedures used, any field data collected, and any deviations from this SAP. The field notebook will be the master log of all field activities. As such, in addition to standard field notations (e.g. field conditions, date, time, weather, field personnel, sample station number, etc.), information entered into the field notebook will also include the number and type of measurements taken, the location and types of data

Figure 2a - Existing Surface water sampling stations with water quality data

Figure 2a - back page

Figure 2b - Existing Surface water sampling stations with water quality data

Figure 2b - back page

Figure 3a - Mine Waste Sources (North Half)

Figure 3a - back page

Figure 3b - Mine Waste Sources (South Half)

Figure 3b - back page

Figure 4 - Existing Groundwater Monitoring Stations

Figure 4 - back page

recorded by another means (i.e. field forms, data recorder, or portable computer), the number of samples collected each day, sample packaging and shipping summaries (i.e. number and type of shipping containers, shipping carrier, date and time of shipment, etc.), and any other information relevant to the field event.

4.3 SURFACE WATER

Surface water sampling consists of measuring flow, measuring field parameters, and collecting samples. The following subsections describe each of these elements.

4.3.1 FLOW MEASUREMENTS

Flow measurements will be taken in accordance with SOP-01 (Streamflow Measurement; Wading Technique) and will consist of one or more of the following methods: 1) Area-velocity method; 2) Portable flume method; or 3) Timed volumetric method. At high flow periods some downstream sites may be unsafe to wade. In such cases, flows will be estimated by measuring stream stage. If not already in place, stream stage gauges will be installed at appropriate sample sites in accordance with the manufacturer's recommendations and SOP-40. Stream gauges will be operated in accordance with SOP-21 (Gauging Station Operation). A field form for calculating flow is included in Appendix B.

4.3.2 SURFACE WATER FIELD PARAMETERS

Several types of field parameters will be measured during individual sampling events. Table 4-1 lists the standard field parameters that will be collected for all sampling events. Field parameters will be measured according to the referenced Maxim SOPs. For construction monitoring, additional surface water field parameters will be measured. These construction monitoring field parameters and methods are also shown in Table 4-1. Appropriate field forms will be filled out in accordance with SOP-10 (Field Forms). Field forms for recording surface water field parameters is included in Appendix B.

4.3.3 SURFACE WATER SAMPLING

Surface water samples will be collected according to SOP-03 (Surface Water Quality Sampling). Samples will be collected in clean laboratory supplied bottles in accordance with those shown in Table 4-2. Table 4-2 also lists preservation requirements for surface water constituents. If dissolved constituents are requested, samples will be filtered through a 0.45 micron disposable filter. Non-disposable sampling equipment will be decontaminated between sampling stations according to SOP-11 (Equipment Decontamination).

4.3.4 SURFACE WATER ANALYTICAL METHODS

Constituents exceeding Montana water quality standards for a class B-1 stream have been identified in the Implementation Plan as the basis for the analytical parameters list. Montana water quality standards for metals are defined as total recoverable metals. Dissolved metals may be analyzed on selected samples. Table 4-3 summarizes laboratory analytical parameters, holding times, EPA Analytical Method Number, required detection limits, and sample preservation.

TABLE 4-1
SURFACE WATER FIELD PARAMETERS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	SOP Number[1]	SOP Title	Event
Specific Conductance	SOP-05	Field Measurement of Specific Conductance	All
pH	SOP-06	Field Measurement of pH	All
Water Temperature	SOP-07	Field Measurement of Water Temperature	All
Flow	SOP-01	Streamflow Measurement; Wading Technique	All
Turbidity	SOP-35	Field Measurement of Turbidity	Construction
Iron	Hach[2]	NA	Construction
Copper	Hach[2]	NA	Construction
Sulfate	Hach[2]	NA	Construction

1. Maxim Standard Operating Procedures (Appendix A)
2. Field analysis will be conducted using a Hach DR 2000 Spectrophotometer following the procedures in Hach, 1992. Water Analysis Handbook

TABLE 4-2
SURFACE WATER SAMPLING REQUIREMENTS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	Preservation[1]	Bottle Size/Type
Total Recoverable Metals	HNO_3 to pH < 2; Iced to 4°C	1 liter polyethylene
Dissolved Metals	Filtered through 0.45 micron filter; HNO_3 to pH < 2; Iced to 4°C	1 liter polyethylene
Common Ions	Iced to 4°C	1 liter polyethylene
Dye Tracer	Keep in dark; Iced to 4°C	10 milliliter Pyrex glass

1. HNO_3 = nitric acid; H2SO4 = sulfuric acid

TABLE 4-3
SUMMARY OF SURFACE WATER ANALYTICAL REQUIREMENTS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	PQL (mg/l)[1]	EPA Method No.	Max. Holding Time
Physicochemical			
Specific Conductivity	None	120.1	7 days
pH	None	150.1	Upon arrival at lab
Total Dissolved Solids	None	160.1	7 days
Total Suspended Solids	None	160.2	7 days
Hardness	None	200.7	14 days
Acidity	None	305.1	14 days
Dye Tracer	None	Not Applicable	Not Applicable
Metals[2]			
Aluminum	0.1	200.7/202.1	6 months
Cadmium	0.0001	200.7/213.2	6 months
Copper	0.001	200.7/220.2	6 months
Iron	0.01	200.7/236.1	6 months
Lead	0.001	200.7/239.2	6 months
Manganese	0.003	200.7/243.1	6 months
Zinc	0.01	200.7/289.1	6 months
Common Cations[2]			
Calcium	1.0	200.7/215.1	6 months
Magnesium	1.0	200.7/242.1	6 months
Potassium	1.0	200.7/258.1	6 months
Sodium	1.0	200.7	6 months
Common Anions[2]			
Sulfate	None	300.0/375.0	28 Days
Bicarbonate	None	310.1	14 Days
Carbonate	None	310.1	14 Days
Chloride	None	325/300.0	28 Days

1. PQL = Practical Quantitation Limit in milligrams per liter (mg/L)
2. Surface water parameters will be analyzed as total recoverable (unfiltered) unless otherwise specified; dissolved metals (filtered) may be done on an as specified basis.

4.4 GROUNDWATER

Groundwater sampling involves measuring field parameters and collecting water samples. The following subsections describe these elements.

4.4.1 GROUNDWATER FIELD PARAMETERS

Table 4-4 lists standard field parameters that will be measured during all groundwater sampling events. Field parameters will be measured according to the referenced Maxim SOPs. Appropriate field forms will be filled out in accordance with SOP-10 (Field Forms). A groundwater field parameter form is included in Appendix B.

TABLE 4-4
GROUNDWATER FIELD PARAMETERS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	SOP Number(1)	SOP Title	Event
Specific Conductance	SOP-05	Field Measurement of Specific Conductance	All
pH	SOP-06	Field Measurement of pH	All
Water Temperature	SOP-07	Field Measurement of Water Temperature	All
Oxidation-Reduction	SOP-28	Field Measurement of Redox Potential (Eh)	All
Dissolved Oxygen	SOP-08	Field Measurement of Dissolved Oxygen	All
Depth to Water	SOP-20	Field Measurement of Groundwater Level	All

4.4.2 GROUNDWATER SAMPLING

A number of methods will be used to collect groundwater samples including hand bailing, hand pumping, and submersible pumping. The method used for groundwater sampling will depend on well depth and well completion details and may vary from well to well. All groundwater samples will be collected according to SOP-18 (Groundwater Sampling). Samples for metals analysis will be filtered through a 0.45 micron disposable filter and collected in clean laboratory supplied bottles in accordance with those shown in Table 4-5. Table 4-5 also lists preservation requirements for groundwater constituents. Non-disposable sampling equipment will be decontaminated between monitoring wells according to SOP-11 (Equipment Decontamination).

4.4.3 GROUNDWATER ANALYTICAL METHODS

Table 4-6 summarizes laboratory analytical parameters, holding times, EPA Analytical Method Number, required detection limits, and sample preservation.

TABLE 4-5
GROUNDWATER SAMPLING REQUIREMENTS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	Preservation(1)	Bottle Size/Type
Dissolved Metals	Filtered through 0.45 micron filter; HNO_3 to pH < 2; Iced to 4°C	1 liter polyethylene
Common Ions	Iced to 4°C	1 liter polyethylene
Physicochemical	Iced to 4°C	1 liter polyethylene
Dye Tracer	Keep in dark; Iced to 4°C	10 milliliter Pyrex glass

1. HNO_3 = nitric acid

4.4.4 Monitoring Well Installation

Monitoring wells may be installed at certain locations to fill identified data gaps. Standard monitoring wells will be installed according to Maxim SOP-16. Other monitoring wells may need to be designed to fill special needs and may depart from the standard design. If so, special well designs will be developed in the annual work plan. Monitoring wells will be developed according to Maxim SOP-17.

4.4.5 Aquifer Testing

Aquifer tests may be conducted at certain wells to fill identified data gaps or to support engineering design. For standard aquifer tests, Maxim SOP--26 will be used to guide test activities. For specialized tests, or for tests in non-standard well completions, a procedure will be developed and presented in the annual work plan.

4.5 MINE WASTE

Mine waste samples will be collected from waste rock dumps, mill tailings, or other identified mine wastes in the District following Maxim SOP-22. At each identified mine waste site, approximately one sample will be collected for each 1,000 cubic yards of mine waste present. Each sample will consist of three to five composite samples collected at an evenly spaced distance along a transect. The transect will be located by crossing the 1,000 cubic yard portion of the mine waste in a longitudinal direction from the head to the toe of the waste pile. Samples will be collected primarily from hand dug test pits using a shovel or hand auger. For hand dug pits, subsample test pits will be dug to a depth of about 18 inches. Where warranted, samples may be collected from deeper depths using a backhoe or drill rig. Methods to collect samples from depth are described in SOP 22.

Waste rock and soil samples will be placed in one gallon, heavy-duty, polyethylene bags and labeled with the date, sampler, and sample ID according to sample designation and labeling procedures. Mine waste samples collected for mercury analysis will be placed in wide-mouth, 8-ounce plastic jars with plastic lids. Mine waste samples will not need to be chilled prior to shipping to the laboratory or before being put into storage except for samples analyzed for mercury. Samples collected for mercury

TABLE 4-6
SUMMARY OF GROUNDWATER ANALYTICAL REQUIREMENTS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	PQL (mg/l)[1]	EPA Method No.	Max. Holding Time
Physicochemical			
Specific Conductivity	None	120.1	7 days
pH	None	150.1	Upon arrival at lab
Total Dissolved Solids	None	160.1	7 days
Hardness	None	200.7	14 days
Acidity	None	305.1	14 days
Dye Tracer	None	Not Applicable	Not Applicable
Metals[2]			
Aluminum	0.1	200.7/202.1	6 months
Cadmium	0.0001	200.7/213.2	6 months
Copper	0.001	200.7/220.2	6 months
Iron	0.01	200.7/236.1	6 months
Lead	0.001	200.7/239.2	6 months
Manganese	0.005	200.7/243.1	6 months
Zinc	0.01	200.7/289.1	6 months
Common Cations[2]			
Calcium	1.0	200.7/215.1	6 months
Magnesium	1.0	200.7/242.1	6 months
Potassium	1.0	200.7/258.1	6 months
Sodium	1.0	200.7	6 months
Common Anions[2]			
Sulfate	None	300.0/375.0	28 Days
Bicarbonate	None	310.1	14 Days
Carbonate	None	310.1	14 Days
Chloride	None	325/300.0	28 Days

1. PQL = Practical Quantitation Limit in milligrams per liter (mg/L)
2. Groundwater parameters will be analyzed as dissolved constituents as filtered through a 0.45 micron filter

analyses should be chilled to 4°C. There are no holding times or preservatives for mine waste samples except mercury (28 day holding time). Mine waste samples will be analyzed for parameters shown in Table 4-7.

TABLE 4-7
MINE WASTE ANALYTICAL METHODS AND DETECTION LIMITS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	Method(1)	PQL(2)
Saturated Paste pH (s.u.) and Electrical Conductivity (mmhos/cm)	USDA Handbook 60 - 2, 3a, 21a	--
Sulfur Fractionation (%)	Modified Sobeck	0.1
Neutralization Potential (tons/1,000 tons)	Modified Sobeck	1
SMP Lime Requirement (tons/1,000 tons)	Methods of Soil Analysis	--
Total Arsenic (mg/Kg)	SW-846 - 7062	2
Total Cadmium (mg/Kg)	SW-846 - 6010	2
Total Chromium (mg/Kg)	SW-846 - 6010	5
Total Copper (mg/Kg)	SW-846 - 6010	10
Total Lead (mg/Kg)	SW-846 - 6010	20
Total Mercury (mg/Kg)	SW-846 - 7471	0.5
Total Silver (mg/Kg)	SW-846 - 6010	20
Total Zinc (mg/Kg)	SW-846 - 6010	10

1. USDA Handbook 60 - Diagnosis and Improvement of Saline and Alkali Soils (USDA, 1954)
   Sobeck - Field and Laboratory Methods Applicable to Overburdens and Minesoils (EPA, 1978)
   Methods of Soil Analysis - American Society of Agronomy, Parts I and II. Monograph No. 9 (1982)
   SW-846 - Test Methods for Evaluating Solid Waste-Physical Chemical Methods (EPA, 1986)
2. PQL = Practical quantitation limit

Field observations will be noted in accordance with Section 3.2 of this plan. In addition to standard field observations at each subsample test pit, field observations will be noted for general mine waste mineralogy, color, grain size, and the presence of any unique features.

4.6 STREAMBED SEDIMENT

Sediment samples will be collected from identified locations that generally coincide with a surface water sampling station. Streambed sediment samples will be collected as grab samples using a stainless steel spade according to Maxim SOP-22. Samples will be collected from the 0 to 2-inch interval at the surface of the streambed. Samples will be placed in 8-ounce polyethylene jars and the water decanted so that the jar is filled with as much sediment as possible. Streambed sediment samples will be analyzed for parameters listed in Table 4-8.

TABLE 4-8
STREAMBED SEDIMENT ANALYTICAL METHODS AND DETECTION LIMITS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	Method(1)	PQL(2)
Total Arsenic (mg/Kg)	SW-846 - 7062	2
Total Cadmium (mg/Kg)	SW-846 - 6010	2
Total Chromium (mg/Kg)	SW-846 - 6010	5
Total Copper (mg/Kg)	SW-846 - 6010	10
Total Lead (mg/Kg)	SW-846 - 6010	20
Total Mercury (mg/Kg)	SW-846 - 7471	0.5
Total Silver (mg/Kg)	SW-846 - 6010	20
Total Zinc (mg/Kg)	SW-846 - 6010	10

1. SW-846 - Test Methods for Evaluating Solid Waste-Physical Chemical Methods (EPA, 1986)
2. PQL = Practical quantitation limit

4.7 NATIVE SOIL

Native soil materials will be sampled for two purposes: 1) To determine if certain locations have been contaminated by mine wastes; and, 2) To determine if soils are suitable as coversoil for revegetation purposes or as capping materials for repository cover systems.

4.7.1 CONTAMINATED SOIL

Native soil materials that will be sampled to determine if the soil has been impacted by mine wastes will be analyzed for total metals listed in Table 4-7. These samples will be collected from the 0 to 2-inch depth interval with a decontaminated stainless steel spade in accordance with Maxim SOP-22. Sample locations will be selected in the field as biased grab samples and numbered according to Section 4.1 of this SAP. Field observations will be noted in accordance with Section 4.2 of this plan. In addition to standard field observations at each sample location, field observations will be noted for soil texture, color, grain size, and the presence of any unique features.

4.7.2 COVERSOIL OR CAPPING MATERIAL

For native soil that has the potential for use as coversoil or capping materials, samples will be collected using both hand test pit methods or backhoe methods. Test pits will be excavated in multiple locations in each potential area investigated. As a rule of thumb, about one test pit will be excavated for every one to two acres of area represented. Test pit locations will be opportunistically sited. Maxim SOP-22 will be used to guide all field activities for coversoil sampling.

Coversoil test pits will be excavated to a depth determined in the field and based on types of soil materials encountered. The exposed soil profiles will be logged in accordance with the Soil Survey Manual (USDA, 1993) by field-identified soil horizons. A field form is included in Appendix B. Samples will be collected from each soil horizon that has the potential to meet suitability requirements for either coversoil or for capping materials. Suitability criteria (fair category) for soil reconstruction material for drastically disturbed areas, according to the National Soils Handbook, are the following:

- pH — greater than 4.0 and less than 8.5 standard units
- Electrical Conductivity — less than 16.0 mmhos/cm
- Texture — not sand, silty clay, sandy clay, or clay
- Coarse Fragments — less than 50% by weight
- Organic Matter — greater than 0.5%

For capping materials, suitability will depend on hydraulic conductivity requirements for the cover system. Suitability criteria will be set for these materials in the annual engineering evaluation/cost analysis (EE/CA) report.

Analytical parameters and methods for coversoil and capping materials are listed in Table 4-9. Soil samples will not need to be chilled prior to shipping to the laboratory or before being put into storage. There are no holding times or preservatives for soil samples.

TABLE 4-9
COVERSOIL AND CAPPING ANALYTICAL METHODS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

Parameter	Method(1)	Data Use
Sieve Analysis	ASTM C136 (granular) or D1140 (clays) and C117	Coarse fragments
Hydrometer	ASTM D422	Soil texture
Saturated Paste pH (s.u.) and Electrical Conductivity (mmhos/cm)	USDA Handbook 60 - 2, 3a, 21a	Acidity and salinity
Macronutrients (nitrate-nitrogen, phosphorus, and potassium)	Methods of Soil Analysis	Soil Fertility
Organic Matter (%)	MSA - Walkley-Black	Organic matter
Remolded Hydraulic Conductivity (cm/sec)	ASTM D2084 (granular) or D5084 (cohesive)	Capping material suitability

1. ASTM - American Society for Testing Materials (1998); sieve and hydrometer analysis will be calibrated to USDA Soil Survey textural classes when used for coversoil samples.
   USDA Handbook 60 - Diagnosis and Improvement of Saline and Alkali Soils (USDA, 1954)
   EPA - Field and Laboratory Methods Applicable to Overburdens and Minesoils (EPA, 1978)
   MSA - Methods of Soil Analysis - American Society of Agronomy, Parts I and II. Monograph No. 9 (1982)

4.7.3 Soil Sample Containers

All soil samples submitted for chemical analytical testing will be placed in one gallon, heavy-duty, polyethylene bags and labeled with the date, sampler, and sample ID according to sample designation and labeling procedures. Those samples collected for sieve analysis, hydrometer, and hydraulic conductivity may be placed in 5-gallon buckets, canvas bags, or other container of suitable size.

4.7.4 Equipment Decontamination

Sampling equipment will be washed with tap water, soapy water, and then a tap water rinse. Shovels and backhoe equipment will not need to be decontaminated except for removing large soil debris.

4.8 VEGETATION

Long-term revegetation monitoring of reclaimed areas will be done annually over the 8-year life of the project to ensure revegetation is meeting project specific performance standards. Monitoring will initially be conducted on about 26 acres of reclaimed disturbed areas and about 9.8 miles of reclaimed roads that have been located in the District as of May 1999 (Figure 2). Through review of reclamation history, additional reclamation areas will be identified. Long-term monitoring will commence on these areas as they are verified. Additional disturbed areas are expected to be reclaimed during each year of the project life. Long-term monitoring will commence on these newly reclaimed areas following the first growing season after seeding has been completed.

Revegetation monitoring will include both cover sampling and area-wide observations. Cover sampling will use the following methods described in Chambers and Brown (1983): Point-Quadrat Method, 35mm Slide Method, and Bitterlich's Variable Radius Method. Data collected in cover sampling will be used to report cover, species composition, species diversity, species density, and species frequency. Area-wide monitoring will be conducted on the major reclaimed areas to: 1) record the number, size, and location of revegetated areas bare of vegetation; 2) record the presence, size and extent of erosional features such as rills and gullies; and 3) assess the cause for the lack of vegetation.

Reclaimed areas will be stratified to accommodate statistical analysis with respect to ecological factors such as slope, aspect, moisture regime, soil types, and elevation. By stratifying, variability can be reduced, thus allowing less uncertainty in the statistical analysis and providing more meaningful results. Revegetation monitoring will be conducted annually timed to coincide with the mature phenological stages of the majority of species under investigation. In most years, this time period begins at the end of July and persists for about one month.

4.8.1 Cover Sampling

Cover sampling will use the following methods described in Chambers and Brown (1983): Point-Quadrat Method, 35mm Slide Method, and Bitterlich's Variable Radius Method. Each method will use transects that will be established in reclaimed and undisturbed areas. In reclaimed areas other than roads, samples transects and sample locations will be located to represent a one-dimensional "square grid" pattern as described in Cochran (1977). Measurements of plant parameters will be taken along these transects.

Transects will be sited randomly within each monitoring strata. Transects will be located in reclaimed areas using random starts and will be randomly oriented. Sample locations along these transects that fall within research plots will not be sampled. Reclaimed road transects will be sited by dividing roads within each strata into segments, assigning a numerical value to each segment, and randomly selecting segments to monitor. Transects will be established in a similar manner within reference areas. Reference (native) areas will be selected according to criteria noted in Chambers and Brown (1983).

The Point-Quadrat Method will be used to report cover, species composition, species diversity, species density, and species frequency in herbaceous and shrubby vegetation. Cover and density will be recorded in the field on a species basis. Species diversity and frequency will be calculated from these data. The 35mm Slide Method will be used to document transect location and provide a reference for cover in herbaceous and shrubby vegetation. Individual sample quadrats will be photographed in the field. Cover will be determined from the developed slide. Bitterlich's Variable Radius Method will be used to report tree cover, species composition, and species density in strata where trees have measurable diameter at breast height (DBH). These conditions are anticipated at lower elevations. Trees will be tallied in the field on a species basis using point angle gages. Species cover, composition, and density will be calculated from these data.

4.8.2 AREA-WIDE MONITORING

The purpose of area-wide observational monitoring of reclaimed areas is to identify areas that require maintenance. Area-wide observational monitoring will be conducted on the entire major reclaimed areas to record the number, size, and location of revegetated areas bare of vegetation and, the presence, size and extent of erosional features such as rills and gullies. Area-wide surveys will also be done on reclaimed roads to the extent feasible in consideration of site conditions and level of effort. A minimum of at least half the total miles of reclaimed roads will be monitored in this manner.

Criteria used to determine if an area is barren will be: 1) areas that are approximately 10 percent or more of the monitoring strata; and, 2) areas where reclamation treatment has clearly failed. These criteria would be applied in the McLaren Pit, Como Basin or other historic or newly reclaimed areas added to the monitoring program. For roads, criteria used will be: 1) areas that are 10 percent or more of the reclaimed segment; and, 2) areas where significant erosion or slope stability concerns are associated with lack of vegetation. For recording erosional features, a minimum size criterion will not apply; rather, the criterion for noting erosional features will be determined by field personnel if erosional features dominate the character of the reclaimed areas. Areas that appear to be bare will be generally located using a GPS instrument.

Observations of barren reclaimed areas will include an assessment of the cause for the lack of vegetation and recorded on a field sheets. Factors to note may be the appearance of salts, steepness of slope, pooling of water, seeding failure, or other soil inhibiting factors. Reclamation practices (e.g., road re-contouring, erosion mats) that may be affecting performance will also be noted. Field assessment will include photo documentation and a site map. Soil samples will be collected in areas without vegetation according to methods presented in the Site-Wide SAP.

4.9 AQUATICS

Aquatic data collection will be conducted to monitor the effects of surface water quality, flow, and streambed sediment on fish and macroinvertebrate populations. Annual aquatic monitoring needs will be reviewed yearly in conjunction with annual work plan development. Generally, data will be collected from existing baseline sampling locations and/or locations that coincide with long-term surface water quality monitoring stations (Figure 2). Stream reaches potentially affected by remedial activities may also be considered for aquatic monitoring if needed. Baseline data collection will be necessary only for stations where none exists. Otherwise, sampling at identified sites will commence after reclamation work is completed and water quality response is detected. Sampling will occur once per year and continue until credible statements regarding response indicators can be made from the data.

The intent of fish population surveys will be to obtain a representative estimate of the species present and their relative abundance. Fish community data will be analyzed using biological metrics to assess integrity based on the fish community's taxonomic and trophic composition and the abundance and condition of fish. Macroinvertebrate sampling will be performed as a means to evaluate effects among stations and to provide a basis for monitoring trends in benthic community structure that might be attributable to improvement of conditions over time. Community level metrics will be calculated to assess biotic integrity and other metrics will be calculated as sensitive indicators of heavy metal biotic stressors. Habitat condition will be recorded in all surveys as a means of characterizing physical response factors as well as potential limiting factors. This section describes each of these surveys and parameters.

4.9.1 FISH POPULATION

Fish populations will be monitored in July or August at selected baseline sampling locations and/or long-term surface water quality stations within the surface water monitoring network. Fish will be sampled by electrofishing when possible. Up to 1000 feet of representative stream reach will be sampled at each station. Sampling reaches will be permanently marked and flagged, photo documented, and surveyed using resource-grade GPS instruments. Block nets will also be set at the upper and lower limits to prevent fish movement into or out of the sample reach during sampling. Guidelines set by the Montana Department of Fish, Wildlife, and Parks concerning pulse width and frequency will be adhered to at all times. Gear selection will vary depending on stream width, flow, and conductivity conditions.

Fish habitat condition will be measured to evaluate substrate and instream cover, channel morphology, and riparian and bank structure. Sampling reaches will be stratified into fast and slow water groups and will be further grouped by gradient and pool types, respectively. At a minimum, fish habitat conditions will be monitored in reaches that are likely to improve with decreased sediment load. Critical response variables would include maximum pool depth, residual pool depth, and embeddedness. These sites will be permanently marked and flagged, photo documented, and surveyed using resource-grade GPS instruments. Measurements made within each habitat type will include: habitat type dimensions, pool dimensions, width/depth ratios, pocket pools, surface fines, substrate composition, large woody debris, and bank condition. Measurements will be entered on the field form included in Appendix B.

Fish sampling procedures will vary depending on population levels. Where fish populations are anticipated to be very low, presence/absence surveys will be considered adequate. Otherwise, fish sampling procedures will generally use multiple pass depletion methods to collect fish data for estimating population densities. Capture efficiency is anticipated to be low and a minimum of three passes will be considered adequate. Sampled fish will be identified to species, counted, inspected for condition, measured for total length, weighed, and released. If large numbers of some species and size classes are encountered, fish will be counted, weighed, subsampled for condition inspection, and released. In the event a specimen cannot be identified, the specimen will be preserved for vouchering. Sample data from multiple pass surveys will be used to calculate species richness and composition metrics, trophic composition metrics, and fish abundance and condition metrics. Data will be entered on the field form included in Appendix B.

4.9.2 Macroinvertebrates

Macroinvertebrate populations will be monitored in July or August at selected baseline sampling locations and/or long-term surface water quality stations within the surface water monitoring network. Because of high summer flows, sampling at selected stations may need to be deferred until stream conditions are wadable. Sampling sites will be chosen to be of similar substrate, gradient, depth, and cover and sites near bridges and road crossings will be avoided. Shallow (0.5 to 1.5 feet), low velocity (less than 1.5 feet per second) conditions will be selected, where possible. Sampling sites will be permanently marked and flagged, photo documented, and surveyed using resource-grade GPS instruments. Habitat condition will be measured at each site, using the protocols outlined above, to evaluate substrate and instream cover, channel morphology, and riparian and bank structure.

Sampling will focus on benthic macroinvertebrates supplemented by periphyton observations. Macroinvertebrate collections will follow Rapid Bioassessment Protocols described by Bukantis (1998) and sample collection protocols described by Bahls (1993) will be used to sample algae and diatoms. These protocols are included in Appendix A. Data will be collected on field forms included in Appendix B.

Macroinvertebrates will be sampled at each site using the high-gradient kick-net method. Mesh nets (280 micron) will be used to effectively sample the variety of habitat for approximately 60 seconds. Periphyton will be sampled by scraping and brushing a composite of algae and diatoms from a variety of natural substrates lifted from the streambed. Samples will be collected in plastic bottles as described in Appendix A. Samples will be preserved in the field and shipped to a qualified laboratory for processing. Laboratory processing will involve identification to the lowest possible taxonomic level and enumerating by taxon. If large numbers of some taxa are encountered, taxon will be subsampled. All samples will be counted and a reference collection will be preserved. These data will provide a list of species, relative abundance, number of taxa, dominant taxa, and percent dominant taxa. Further analysis will be performed to calculate biotic integrity indices, ratios of scraper, shredder and filtering taxa, ratios of EPT and Chironomidae taxa, tolerance quotients, tolerance values, and community similarity indices.

4.10 SAMPLE SHIPPING

All samples will be shipped to Northern Analytical Laboratories, 602 South 25th Street, Billings, Montana 59107 for analysis except for dye tracer samples and macroinvertebrate samples. Dye tracer samples will be shipped to the following address:

Cambrian Groundwater Company
109 Dixie Lane
Oak Ridge, Tennessee 37830
(423) 483-1148

Macroinvertebrate samples will be shipped to an appropriate laboratory for periphyton taxon identification. The specific laboratory that will be used for this analysis will be identified in the associated annual work plan.

Samples will be stored and shipped, in accordance with SOP-09 (Sample Packaging and Shipping). Samples will be chilled to 4^o C. in ice filled coolers and secured with a chain of custody seal. Samples will be shipped at the end of the sampling event, or sooner if required to meet seven day holding time requirements, for overnight delivery to the analytical laboratory. Chain-of-custody forms will accompany each cooler to the laboratory. Chain-of-custody forms will be filled out to include the project name, samplers name, sample number, date and time of sampling, number and type of bottles, and analytical parameter and method list. The chain-of-custody form that will be used for the project is included in Appendix B.

4.11 GLOBAL POSITION SYSTEM DATA COLLECTION

Site features and all sample locations will be surveyed using a resource-grade global positioning system (GPS) instrument. This GPS instrument has a horizontal resolution of plus or minus several meters. Data collection with the GPS will be accomplished using Maxim SOP-41. Mission planning and data menus will be developed for specific data needs.

4.12 ENGINEERING SURVEY

Standard engineering survey data will be collected on certain mine features to support engineering design. These surveys will be performed to verify the perimeter of mine waste disturbances and surface topography. Standard surveying instruments such as a theodolite or total station with data recorder will be used for the engineering surveys. Surveys will be tied to permanently monumented control points. These control points will have positions determined from North American Datum 1983 (NAD-83).

For volume determinations, surveying data will be imported into Eagle Point Civil Engineering software. Using the computer software program, triangulated irregular networks (TINs) will be created for the surface of the mine waste disturbance and an estimated surface of the underlying original topography. The configuration of the original topographic surface will be based on the configuration of the surrounding natural topography. The TINs created for each of the two surfaces will be overlaid and the in-place volume of material calculated between the TINs.

Some relative vertical elevations may be surveyed using a level survey instrument to obtain information on dump heights for volume estimation purposes, slope and stream gradients, and road grades. All vertical elevations will be measured to the nearest tenth of a foot. Maxim Standard Operating Procedure (SOP) 29 will be followed for level survey activities.

4.13 FIELD QUALITY CONTROL SAMPLES

Quality control (QC) samples will be collected during each sampling event and for each media sampled according to Maxim SOP-13 (QC Samples). The following QC samples will be collected for surface water and groundwater:

- *Blanks (DI water)* - 1 per sampling event or 5% of the total number of samples.
- *Equipment rinsate blanks* - 1 per day for each procedure requiring equipment decontamination (disposable equipment will be used where possible).
- *Field duplicates* - 1 per sampling event or 5% of total # of samples.

Quality control samples will be analyzed for the same constituents as field samples. Rinsate blanks will only be collected when pre-cleaned, disposable equipment is not available and reusable equipment requires decontamination.

For solid media (sediment, mine waste, and soil), QC samples will include only field duplicates at the same frequency as shown for surface water and groundwater. Rinsate blanks will not be collected for solid material samples due to the negligible amounts of contamination associated with this type of sampling.

4.14 LABORATORY QUALITY CONTROL SAMPLES

Laboratory quality control samples will consist of calibration standards, laboratory control samples, method blanks, laboratory duplicates and matrix spikes. Laboratory QC samples will be prepared and analyzed at a frequency that is in accordance with the specified analytical method.

4.15 EQUIPMENT DECONTAMINATION

All water, soil, and sediment sampling equipment will be decontaminated according to Maxim SOP-11 before sampling. Equipment decontamination consists of a tap water rinse, a soap and tap water wash, a dilute nitric acid (HNO_3) rinse (for samples designated for metals analysis), and a deionized water rinse followed by air drying. Equipment and instrumentation will be decontaminated between samples in the same manner. Shovels and hand augers will be decontaminated with soap and tap water only.

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5.0 QUALITY ASSURANCE PROJECT PLAN

This QAPP has been written to ensure the reliability of monitoring and measurement data. The QA program requires the generation of a site or project specific Quality Assurance Project Plan (QAPP). The QAPP will identify instrument calibration procedures, preventative maintenance procedures, data reduction and validation procedures, and corrective actions. Guidance in the QAPP will enable field personnel to address quality issues in the field so that the majority of data collected meet the established data quality objectives

5.1 QUALITY ASSURANCE OBJECTIVES

The ability of data to meet DQOs is evaluated with a precision, accuracy, representativeness, completeness, and comparability (PARC) statement. A PARC statement is generated during data evaluation (after data has been validated). The following sections define the terms used in the PARC statement.

5.1.1 Precision

Precision is the amount of scatter or variance that occurs in repeated measurements of a particular analyte. Precision acceptance and rejection for this project will be based on the relative percent difference (RPD) of the laboratory duplicates. Only metals analyses will be assessed for precision. To determine precision, the RPD for each duplicate/natural pair will be compared to the range of acceptable precision for the specific analytical method. Natural results associated with RPDs outside acceptable precision limits will be considered estimated. An overall assessment of precision will be made upon completion of the project. Because of the small number of laboratory duplicate samples anticipated, overall precision will be stated as a pooled standard deviation, as recommended by Taylor (1990). The range of acceptable RPDs for precision is presented in Table 5-1.

TABLE 5-1
PRECISION, ACCURACY, AND COMPLETENESS REQUIREMENTS
Site-Wide Sampling and Analysis Plan
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PRECISION		ACCURACY		COMPLETENESS
SOLID	WATER	SOLID	WATER	90%
35%	20%	75%-125%	75%-125%	

5.1.2 Accuracy

Accuracy is measured as the ability of the analytical procedure to determine the actual or known quantity of a particular substance in a sample. Accuracy acceptance or rejection will be based on the percent recovery (%R) of the laboratory matrix spike for water samples, and will be based on the percent recovery of the laboratory control sample (LCS) for solid samples. To determine accuracy, the %R for each matrix spike or LCS will be compared to the acceptable range as specified in the applicable laboratory method. Natural results associated with percent recoveries outside acceptable limits will be considered estimated.

Natural results associated with percent recoveries of less than 50% will be considered rejected, as recommended by EPA (1988). An overall assessment of accuracy will be made upon completion of the project. Overall accuracy will be stated as the mean %R. Because of the small number of matrix spike and laboratory control samples anticipated, no confidence interval will be calculated. The procedures for calculating accuracy are presented in Appendix C. The range of acceptable accuracy is presented in Table 5-1.

5.1.3 REPRESENTATIVENESS

The objective in addressing representativeness is to assess whether information obtained during the investigation accurately represents site conditions. Laboratory water blanks, field water equipment rinsate samples, and field water blanks are used to assess representativeness. No solid matrix blanks will be collected or assessed. Natural results associated with contaminated blanks will be considered estimated, with a high bias, when the natural result is greater than the practical quantitation limit but less than five times the contaminant concentration, as recommended in EPA (1988).

5.1.4 COMPLETENESS

The objective in addressing completeness is to assess whether enough data have been collected and enough data are valid to meet the investigation needs. Completeness is assessed by comparing the number of valid sample results to the number of samples collected. The completeness targets for this investigation are presented in Table 5-1.

5.1.5 COMPARABILITY

The objective in addressing comparability is to assess whether one set of data can be compared to another set of data. Comparability is assessed by determining if an EPA approved analytical method was used, if values and units are sufficient for the database, if specific sampling points can be established and documented, and if field collection methods were similar.

5.2 EQUIPMENT OPERATION, CALIBRATION, AND STANDARDIZATION

All field and laboratory equipment will be operated, maintained, calibrated, and standardized in accordance with EPA and manufacturer's recommended procedures. Applicable Maxim SOPs contain the field equipment operation, maintenance, calibration, and standardization procedures. Analytical methods contain laboratory equipment operation, maintenance, calibration, and standardization procedures.

5.3 DATA REDUCTION, VALIDATION, DATA EVALUATION, AND REPORTING

5.3.1 DATA REDUCTION

Data reduction is performed on the laboratory data while still in the laboratory; it is the result of grouping similar QC samples and calculating and reporting their recoveries. Maxim will work directly with the laboratory’s data quality assurance coordinator who will review all analytical data associated with each sample. The types of laboratory quality control data reviewed will include calibration standards, calibration verification, laboratory controls, laboratory duplicates, and laboratory spikes. When EPA methods are used, the applicable data reduction procedures called for in the EPA method will be used.

5.3.2 DATA VALIDATION

Data validation is performed on laboratory data in the laboratory and in the office after data reduction is complete. The objective of data validation is to identify any unreliable or invalid laboratory measurements and qualify that data for interpretive use. Data validation will be performed according to EPA guidelines for inorganics (EPA, 1994; 1988). Laboratory data validation is reported by qualifying concentrations with result and data qualifiers. These qualifiers are shown in Table 5-2.

TABLE 5-2
RESULT AND DATA QUALIFIERS
Site-Wide Sampling and Analysis Plan
New World Mining District – Response and Restoration Project

<	-	The analyte was analyzed for but not detected at the practical quantitation limit used for the method.
H	-	The required holding time was exceeded.
F%	-	Field duplicate analysis exceed acceptable limits - relative % difference determination.
F	-	Field duplicate results exceed acceptable limits - PQL determination.
M%	-	Matrix spike recoveries exceed acceptable limits.
B		Method blank shows evidence of contamination
U	-	The material was analyzed for, but was not detected above the level of the associated value. The associated value is the practical quantitation limit (PQL).
J	-	The associated value is an estimated quantity.
R	-	The data are unusable.

Knowing the limitations of the data assists the data user when making interpretations. Data with limitations are usable for evaluation as long as the limitations are considered.

Data validation of other field data (pH meter and SC meter) is not possible because these data have very limited statistical control limits. Professional judgement is required to assess the impact of field QC on the overall quality and usability of the field data. Field blanks are the most straight forward QC checks to assess. Evidence of cross contamination can be ascertained without much subjective judgement and the options for corrective action are clear.

5.3.3 DATA EVALUATION

Data evaluation is performed in the office after data validation is complete. Data evaluation is the generation of the PARC statement that assesses the data meeting the DQOs.

5.3.4 DATA REPORTING

Data reporting begins with transferring the analytical results and field measurements to a computerized database. For this project, data will be entered into the project database. Data reporting continues with a printout of the analytical results and field measurements database and the interpretation of the analytical results and field measurements. The QC Summary Results, validation summaries, and computerized database will be documented in various project reports.

5.4 CORRECTIVE ACTION PROCEDURES

Field equipment malfunctions are identified immediately and will be corrected by the field team leaders. Field QC samples outside of the control limits presented in Table 5-1 will be handled in the data validation process by assigning data or result qualifiers. Laboratory equipment malfunctions are handled by the chemist according to EPA analytical method specifications. Laboratory QC samples (calibration samples, method blanks, matrix spike samples, laboratory control samples, and laboratory duplicates) will be handled according to EPA analytical method specifications.

5.5 AUDIT PROCEDURES

An internal audit of all field procedures will be performed by the Quality Assurance Manager prior to any field work. The internal audit will include a review of procedures selected for the sampling program, a review of the QA/QC samples required, and a review of training requirements. The laboratory is required to have written procedures addressing internal QA/QC.

An external audit of all field procedures will be performed at the discretion of the USDA Forest Service Contracting Officer. External audit reports with recommended corrective action will be submitted by the USDA Forest Service Contracting Officer to the Quality Assurance Manager and the Field Project Officer.

5.6 PREVENTATIVE MAINTENANCE

Preventative maintenance of equipment is essential if project resources are to be used in a cost effective manner. Critical spare parts will be available in the field. These spare parts include pH buffer solutions, batteries, extra meter probes, film, field standards, among others.

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