NORTH FORK OF CLEAR CREEK PROJECT
RESTORATION OF ABANDONED MINE SITES

FINAL REPORT

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ACRONYMS AND ABBREVIATIONS

ASTM	American Standard Testing Materials
^{o}C	Degrees Celsius
CDMG	Colorado Division of Minerals and Geology
CDQAR	Chemical Data Quality Assessment Report
CENWO	Corps of Engineers, Omaha District
COC	Chain-of-Custody
DQOs	Data Quality Objectives
DUP	Duplicate
ECB	Environmental Chemistry Branch
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
Ft	Foot/Feet
GPS	Global Positioning System
IDW	Investigative Derived Waste
Kg	Kilogram
L	Liter
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
MRL	Method Reporting Limit
µg/L	Micrograms per Liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
mg	Milligram
Min	Minute
mL	Milliliters
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Applicable
ND	non-detect
ppb	Parts per Billion (measured in water as µg/L)
QA	Quality Assurance
QC	Quality Control
RAMS	Restoration of Abandoned Mine Sites
RPD	Relative Percent Difference
SSHP	Site Safety Health Plan
SOP	Standard Operating Procedure
SSA	Site-Specific Addendum
U.S.	United States
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFS	U.S. Forest Service
WRDA	Water Resource Development Act

1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) has been provided authority for Restoration of Abandoned Mine Sites (RAMS) through the Water Resource Development Act (WRDA) 1999 Section 560. The RAMS program is a regionally focused and stakeholder responsive program for the restoration of abandoned and inactive non-coal mines where water resources (ecosystem/habitat) have been degraded by past mining practices. This authority is intended to allow the USACE to provide support to agencies that manage lands impacted by past mining. The USACE coordinated in advance to obtain stakeholder buy-in on all work proposed to be performed by Corps Districts to ensure that the proposed work is supportive of the stakeholders' efforts in the area.

The USACE Omaha District is working in coordination with the Colorado Division of Minerals and Geology (CDMG) and the Bureau of Reclamation (USBR) on the North Fork of Clear Creek RAMS Project. The CDMG and USBR identified the data needs for this drainage. The USACE obtained the necessary right-of-entry (ROE) to the identified locations. Individuals from the USACE Omaha District and USACE Albuquerque District performed the fieldwork from September 9 through September13, 2002.

The purpose of this report is to submit documentation of the field activities and analytical results to the CDMG, the primary data user. This report includes the methods and procedures used for collecting surface soil and sediment samples, data quality review, the field forms, and site photos. This report does not include any interpretations or conclusions based on this data.

2 PROJECT INFORMATION

2.1 Site Description

The North Fork of Clear Creek drainage basin encompasses approximately 90% of Gilpin County in north-central Colorado near Central City, Colorado. Gilpin County is one of the most intensely mined counties in Colorado, particularly from Central City south to the county line. Three major tributaries to the North Fork of Clear Creek drain this heavily mined area, which are Chase Gulch, Nevada/Gregory Gulch, and Russell Gulch. Within these three drainages, there are an estimated 2,000 mine waste piles.

The North Fork of Clear Creek is within the Clear Creek Superfund study area. Superfund characterization activities within this basin have focused on mine drainages. Very few of the mine waste rock and mill tailing piles have been characterized in Gilpin County. The numerous waste rock and mill tailing piles contain acid forming materials (e.g. pyrite, chalcopyrite, etc.) and contain high levels of leachable zinc, copper, manganese, lead, and iron.

2.2 Project Objectives

The primary objective of this field investigation is to collect and provide surface soil and sediment data to the CDMG and USBR to support their respective investigations for the North Fork of Clear Creek drainage. This data may eventually be used by the CDMG and/or the USBR in order to determine metals loading from various mine waste pile sites to the North Fork of Clear Creek drainage.

The goal of this initial phase is to identify potential contaminant sources throughout a watershed. A site visit was conducted on 23 July 2002 to perform a cursory survey of project area to identify and prioritize waste piles. Due to the vast number of waste piles, but with limited investigative funds and right-of-entry (ROE) access agreements with the landowners, only 27 of the 43 highest priority waste piles identified in the Site Specific Addendum (SSA) of the Work Plan were sampled. In addition, four sediment sample locations from Chase Gulch were collected for data to ascertain if run-off from the waste piles has impacted the Chase Gulch drainage.

3 FIELD INVESTIGATION

3.1 Field Investigation Activities

A single round of sediment and surface soil samples were collected in accordance with the approved Work Plans. Sampling locations are shown on Figure 3-1 and listed in Table 3-1.

The following Standard Operating Procedures (SOPs) identified in the Site-Specific Addendum (SSA) to the RAMS Work Plan were adhered to during the course of this field investigation: A1 (Surface Soil/Rock Sampling Equipment and Procedures); A4 Soil/Rock Homogenization Equipment and Procedures, A7 (Investigative Derived Waste Procedures); A12 (Equipment Decontamination Procedures); A13 (Sample Handling, Documentation, and Tracking Procedures); and A14 (Field Documentation).

3.2 Surface Soil Samples

A total of twenty-seven (27) field samples and four duplicate samples of surface soil were collected from seventeen sampling locations from Chase Gulch (CHG-2 through CHG-11, CHG-13 through CHG-16, CHG-18, CHG-20, and CHG-21) and ten sampling locations from the lower Gregory Gulch (LGG-22, LGG-25 through LGG-27, LGG-31 through LGG-34, LGG-36, and LGG-37). Duplicate samples were collected from sampling locations CHG-8, CHG-11, LGG-26, and LGG-37. A visual reconnaissance was performed on each of the sampled waste piles. The latitude/longitude, approximate distance from a defined drainage channel, degree of erosion, volumetric measurements, presence and approximate size of vegetation kill zone, presence of vegetation on the waste piles, texture of waste pile, degree of cementation of the waste pile, and equipment access description were documented. This information is documented on the data sheets in Appendix B. The coordinates and sample identification numbers are listed in Table 3-1.

All surface soil samples were submitted to the USACE Environmental Chemistry Branch (ECB) Laboratory for total metals of the soil and leachable metals, pH, acidity, and conductivity from the water leachate of the soil.

3.3 Sediment Samples

A total of four field samples and one duplicate sample were collected of the creek sediment in Chase Gulch. A composite sample was collected from the banks or the sediment immediately adjacent to the creek. All sediment samples were submitted to the USACE Environmental Chemistry Branch (ECB) Laboratory for total metals of the sediment and leachable metals, pH, acidity, and conductivity from the water leachate of the sediment.

3.4 Sample Identification Scheme

The sample ID scheme presented in SOP A13 was modified to the following designation.

UU-VVV/VVV02-XXXX-ZZ

where:

UU = Project designation was replaced with **CO** (for Colorado RAMS)
VVV/VVV = Designation of sampling area location was replaced with

- **NCC/LGG** for North Fork of Clear Creek- Lower Gregory Gulch
- **NCC/CHG** for North Fork of Clear Creek -Chase Gulch

02 = Year of sampling
XXXX = **SS** (surface soil) or **SD** (sediment sample) plus the two-digit sample location number
ZZ = 2 Character Designation for Samples, where:

01 = Normal Field Sample
02 = QC Duplicate

Examples:
A surface soil sample from location #11 collected from Chase Gulch of the North Fork of Clear Creek site is:

CO-NCC/CHG02-SS11-01

The QC duplicate sample has the sample designation of:

CO-NCC/NGG02-SS11-02

3.5 Surveying

Sampling location coordinates listed in the Table 3-1 were based on the approximate center of all the sub-sampling locations as obtained from a hand-held Global Positioning System (GPS) device. These measurements were recorded on the Field Data Sheets (Appendix B) in longitude and latitude. The device has an approximate accuracy of plus-or-minus 25 to 75 feet. Since some piles were quite extensive and given the accuracy of the hand-held GPS device, the survey coordinates given for a particular mine waste pile may not correlate to the U.S. Geological Survey Map (USGS) quadrangle map (Figure 3-1).

The physical dimensions for the size of the mine waste piles were visually estimated or were measured by pacing the distances. This data was recorded on the Field Data Sheets (Appendix B).

Table 3-1

ID NO.	WASTE PILE NAME	DRAINAGE	LATITUDE	LONGITUDE
CHG-2	Two Sisters	Chase Gulch	N39º 48’ 32.7”	W105º 31’ 29.1”
CHG-3	Ellery	Chase Gulch	N39º 48’ 22.2”	W105º 30’ 43.0”
CHG-4	Belden Tunnel	Chase Gulch	N39º 48’ 27.3”	W105º 30’ 43.4”
CHG-5	Allie	Chase Gulch	N39º 48’ 23.8”	W105º 30’ 43.7”
CHG-6	Sans Souci	Chase Gulch	N39º 48’ 28.9”	W105º 30’ 37.1”
CHG-7	Castle Rock	Chase Gulch	N39º 48’ 27.8”	W105º 30’ 46.8”
CHG-8	Lower Centennial	Chase Gulch	N39º 48’ 24.3”	W105º 30’ 28.4”
CHG-9	Advance Tunnel	Chase Gulch	N39º 48’ 33.1”	W105º 30’ 50.5”
CHG-10	Hayseed Tunnel	Chase Gulch	N39º 48’ 40.7”	W105º 30’ 56.3”
CHG-11	Tucker	Chase Gulch	N39º 48’ 42.6”	W105º 30’ 56.7”
CHG-13	Centre Tunnel	Chase Gulch	N39º 48’ 26.5”	W105º 30’ 30.2”
CHG-14	Upper Centennial	Chase Gulch	N39º 48’ 22.9”	W105º 30’ 33.3”
CHG-15	Robert Emmet	Chase Gulch	N39º 48’ 27.7”	W105º 30’ 21.1”
CHG-16	Virginia Discovery	Chase Gulch	N39º 48’ 33.1”	W105º 30’ 29.3”
CHG-18	Bates	Chase Gulch	N39º 48’ 7.2”	W105º 30’ 59.3”
CHG-20	Bonanza Tunnel	Chase Gulch	N39º 48’ 20.0”	W105º 30’ 14.7”
CHG-21	Aetna	Chase Gulch	N39º 48’ 18.6”	W105º 30’ 16.0”
LGG-22	Boston	Gregory Gulch	N39º 47’ 58.1”	W105º 30’ 39.5”
LGG-25	Humboldt	Gregory Gulch	N39º 48’ 12.7”	W105º 30’ 6.4”
LGG-26	Winnebago	Gregory Gulch	N39º 48’ 14.1”	W105º 30’ 50.8”
LGG-27	Hunter-Gold Extension	Gregory Gulch	N39º 47’ 48.7”	W105º 30’ 38.5”
LGG-31	Next President	Gregory Gulch	N39º 47’ 56.8”	W105º 30’ 12.2”
LGG-32	Hartford	Gregory Gulch	N39º 47’ 57.0”	W105º 30’ 16.4”
LGG-33	Maine-Hamlet	Gregory Gulch	N39º 47’ 54.9”	W105º 30’ 34.4”
LGG-34	Vasa-Leavitt	Gregory Gulch	N39º 47’ 59.7”	W105º 30’ 23.6”
LGG-36	O.K. (Epizootic)	Gregory Gulch	N39º 47’ 54.1”	W105º 30’ 36.3”
LGG-37	German	Gregory Gulch	N39º 47’ 52.8”	W105º 30’ 32.7”
	SEDIMENT SAMPLES			
SD-1	Upstream of Tucker	Chase Gulch	N39º 48’ 43.6”	W105º 30’ 58.7”
SD-2	Downstream of Hayseed	Chase Gulch	N39º 48’ 36.7”	W105º 30’ 54.1”
SD-3	Downstream of Centennial	Chase Gulch	N39º 48’ 25.0”	W105º 30’ 27.0”
SD-4	Downstream of Bonanza	Chase Gulch	N39º 48’ 18.8”	W105º 30’ 15.0”

4 LABORATORY ANALYTICAL RESULTS

4.1 Data Quality Objectives

The Data Quality Objectives for this project are those presented in the RAMS Final Work Plan dated July 2002. The criteria in order to attain these objectives are given in the RAMS Final Work Plan and/or presented in this section. The Method Detection Limit (MDL), Method Reporting Limit (MRL), and QC criteria that will meet the data objectives for metals are given in Tables 6-5 and 6-6 of the RAMS Final Work Plan. The MDL, MRL, and QC criteria that will meet the data objectives for conductivity, pH, and acidity are given in Table 6-7 of the RAMS Final Work Plan.

4.2 Laboratory Analytical Sample Requirements

All surface soil and sediment samples were submitted to a laboratory for analysis for total metals for soil samples and analysis for metals, conductivity, pH, and acidity of the water leachate from the soil.

Laboratory analytical sample requirements are given in the following table:

TABLE 4-1: LABORATORY ANALYTICAL SAMPLE REQUIREMENTS

Parameter	Field	Quality Control Duplicate	Total
Soil Samples			
Surface soil **	27	4	31
Sediment **	4	1	5
Water Leachate Samples*			
Surface soil	27	4	31
Sediment	4	1	5

* The water leachate sample was derived by leaching the soil sample.
** Metals include Al, As, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, and Zn.

4.3 Sample Containers, Preservation and Holding Times

Sample container, preservation, and holding time requirements are given in the following table:

TABLE 4-2: SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR COMPOSITE SOIL SAMPLES

Parameter	Container	Maximum Holding Times	
		Digestion	Analysis
Composite Soil Sample*			
Metals[1]	1 x 8 ox Glass	6 months (Mercury – 28 days)	6 months (Mercury – 28 days)
Water Leachate**			
Leachate Metals[1]		6 months (Mercury – 28 days)	6 months (Mercury – 28 days)
Leachate pH			ASAP***
Leachate Acidity			ASAP***
Conductivity			ASAP***

* One 8 oz jar obtained in the field from each area is sufficient for all analyses.
** The water leachate process is performed in the laboratory by the method described in the Site Specific Work Plan..
*** ASAP in this instance means as soon as possible after leachate is obtained.
[1] Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn

4.4 Sample Labeling and Shipment

Immediately after sample collection, the samples were preserved as noted above, labeled, and placed into a cooler. Labeling was performed as specified in the SSA to the RAMS Work Plan. The Laboratory Identification Management System (LIMS) number was **LIMS # 6695.** The samples were stored in a secured place until shipped in a cooler with the appropriate chain-of-custody forms sealed and shipped by overnight delivery to the USACE ECB Laboratory located in Omaha, Nebraska.

4.5 Sample Analysis

All samples were held at the ECB Laboratory and analyzed in the same sample analytical batch**.** The following analytical methods were used for the field samples and appropriate required quality control samples for this site:

Parameter	Method	Matrix
Metals	EPA Method 3050/6010B	Soil
Water Leachate**		
Metals	EPA Method 3010/6010B	aqueous leachate
pH	USDA 8C	aqueous leachate
Acidity	EPA 305.1	aqueous leachate
Conductivity	9050A	aqueous leachate

** The water leachate process is performed in the laboratory as is described in the Site Specific Work Plan.

4.6 Analytical Results

The analytical results for this project are provided in Tables 1 and 2 of the CDQAR. These tables include the MRL, the analytical results with units specified, and any data qualifiers. Data qualifiers are defined on the table and are described in the Chemical Data Quality Assessment Report (CDQAR), which is included as an attachment to this document (Attachment 1).

5 QUALITY CONTROL REVIEW

Quality control review consists of an evaluation of the field and analytical procedures and a review of the data to ensure that the appropriate QC compliance was met.

5.1 Field Quality Control

The project team reviewed all field documentation (e.g. field data sheets, chain-of-custody forms, etc.) for completeness. A review of the placement or coordinates of the sample was performed to ensure that this correlates to sample nomenclature. Placement and frequency of the quality control samples were reviewed to ensure compliance to set criteria.

5.2 Laboratory Quality Control

Laboratory Quality Control is provided in the CDQAR, which is included as an attachment to this document (Attachment 1).

5.3 Data Validation

Data validation information is provided in the CDQAR, which is included as an attachment to this document (Attachment 1).

5.4 Data Quality Summary

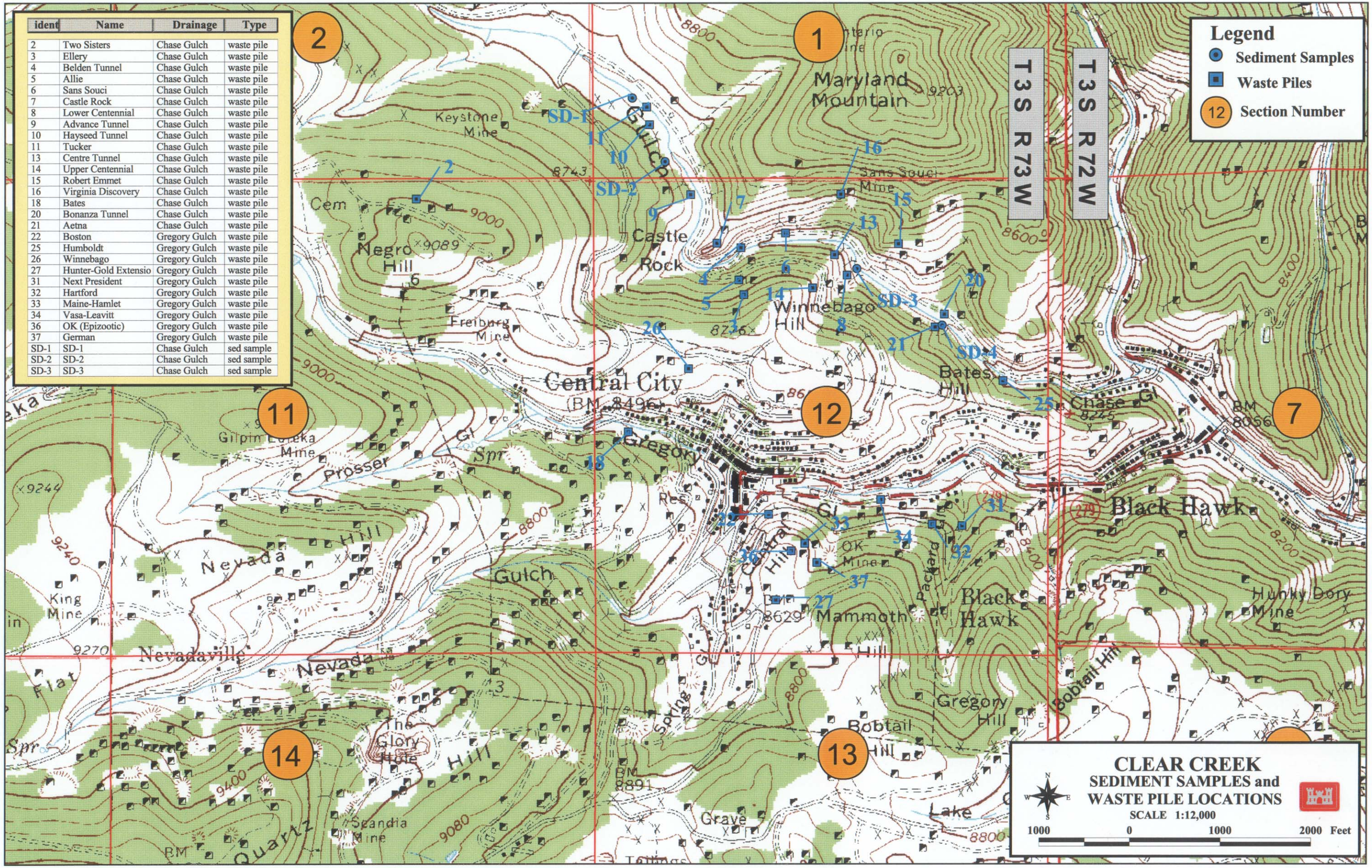
The CDQAR presents, in specific terms, the quality control practices utilized to achieve the goals of the site investigation at North Fork of Clear Creek, Colorado. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data.

The quality issues addressed in the CDQAR do not impact the usability of the data. The required qualifications have been applied to the data in Table 2 of the CDQAR. The reviewed data are usable and are suitable for addressing the overall objectives of this investigation.

6 SUMMARY

The project was executed in accordance with the RAMS Work Plan and the Site Specific Addendum for North Fork of Clear Creek in Colorado. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data. The minor quality issues addressed in the CDQAR do not impact the usability of the data. The reviewed data are usable and are suitable for addressing the overall objectives of this investigation.

FIGURE 3-1



ident	Name	Drainage	Type
2	Two Sisters	Chase Gulch	waste pile
3	Ellery	Chase Gulch	waste pile
4	Belden Tunnel	Chase Gulch	waste pile
5	Allie	Chase Gulch	waste pile
6	Sans Souci	Chase Gulch	waste pile
7	Castle Rock	Chase Gulch	waste pile
8	Lower Centennial	Chase Gulch	waste pile
9	Advance Tunnel	Chase Gulch	waste pile
10	Hayseed Tunnel	Chase Gulch	waste pile
11	Tucker	Chase Gulch	waste pile
13	Centre Tunnel	Chase Gulch	waste pile
14	Upper Centennial	Chase Gulch	waste pile
15	Robert Emmet	Chase Gulch	waste pile
16	Virginia Discovery	Chase Gulch	waste pile
18	Bates	Chase Gulch	waste pile
20	Bonanza Tunnel	Chase Gulch	waste pile
21	Aetna	Chase Gulch	waste pile
22	Boston	Gregory Gulch	waste pile
25	Humboldt	Gregory Gulch	waste pile
26	Winnebago	Gregory Gulch	waste pile
27	Hunter-Gold Extensio	Gregory Gulch	waste pile
31	Next President	Gregory Gulch	waste pile
32	Hartford	Gregory Gulch	waste pile
33	Maine-Hamlet	Gregory Gulch	waste pile
34	Vasa-Leavitt	Gregory Gulch	waste pile
36	OK (Epizootic)	Gregory Gulch	waste pile
37	German	Gregory Gulch	waste pile
SD-1	SD-1	Chase Gulch	sed sample
SD-2	SD-2	Chase Gulch	sed sample
SD-3	SD-3	Chase Gulch	sed sample

APPENDIX A

PHOTOGRAPHS OF MINE WASTE PILES

Site Number 2: Two Sisters

Site Number 3: Ellery

Site Number 4: Belden Tunnel

Site Number 5: Allie

Site Number 6: Sans Souci

Site Number 7: Castle Rock

Site Number 8: Lower Centennial

Site Number 9: Advance Tunnel

Site Number 10: Hayseed Tunnel

Site Number 11: Tucker

Site Number 13: Centre Tunnel

Site Number 14: Upper Centennial

Site Number 15: Robert Emmet

Site Number 16: Virginia Discovery

Site Number 18: Bates

Site Number 20: Bonanza Tunnel

Site Number 21: Aetna

Site Number 22: Boston

Site Number 25: Humboldt

Site Number 26: Winnebago

Site Number 27: Hunter-Gold Extension

Site Number 31: Next President

Site Number 32: Hartford

Site Number 33: Maine-Hamlet

Site Number 34: Vasa-Leavitt

Site Number 36: O.K. (Epizootic)

Site Number 37: German

APPENDIX B

FIELD DATA SHEETS

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #2 Two Sisters

Drainage Chase

Latitude N39° 48 ' 32.7 "

Average of 20 Readings

Longitude W105° 31 ' 29.1 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1 -2 (some)

Average top width 75'

Average top length 25' (short width)

Average bottom width 50'

Average bottom length 80'

Average height 30'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 100' x 20'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine w/ cobbles

Equipment Access (describe) Easy

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Uncemented

Cap-in-place

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #3 Ellery

Drainage Chase

Latitude N39° 48 ' 22.2 "

Average of 10 Readings

Longitude W105° 30 ' 43.0 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite _____

Galena _____

Other, (specify) _____

Country Rock 1 (flanks)

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 10'

Average top length 30'

Average bottom width 50'

Average bottom length 50'

Average height 40'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 50' x 100'

Vegetation on Pile (Y or N) N (few trees)

Texture (fine, coarse) coarse w/ some fines

Equipment Access (describe) Old rail grade or road leads to mine

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation Little

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #4 Beldin Tunnel

Drainage Chase

Latitude N39° 48 ' 27.3 "

Average of 14 Readings

Longitude W105° 30 ' 43.4 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite _____

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock 1

Secondary Sulfides 2

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 50'

Average top length 240'

Average bottom width 75'

Average bottom length 300'

Average height 15'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 75' x 3'

Vegetation on Pile (Y or N) N (yellow areas) Y (country rock)

Texture (fine, coarse) Boulders, cobbles, w/ gravel

Equipment Access (describe) Cross Chase Creek to access/ thick vegetation

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation Little

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #5 Allie

Drainage Chase

Latitude N39° 48 ' 23.8 "

Average of 8 Readings

Longitude W105° 30 ' 43.7 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1 (minor)

Galena

Other, (specify)

Country Rock

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 300'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 20'

Average top length 25'

Average bottom width 25'

Average bottom length 50'

Average height 30'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) None below pile

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine w/ some cobbles

Equipment Access (describe) Hard to access though a trail leads to mine

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation None

Cap-in-place

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #6 Sans Souci

Drainage Chase

Latitude N39° 48 ' 28.9 "

Average of 12 Readings

Longitude W105° 30 ' 37.1 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite _____

Galena _____

Other, (specify) _____

Country Rock _____

Secondary Sulfides 2

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'

Average top length 120'

Average bottom width 100'

Average bottom length 320'

Average height 90'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) _____

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine sand w/ cobbles

Equipment Access (describe) Base - no problem, Top - sleep slopes

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation _____

Cap-in-place _____

Amend and Revegetate X

Comments Greenish rock - malachite? Some biotite, some pinkish rock also.

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #7 Castle Rock

Drainage Chase

Latitude N39° 48 ' 27.8 "

Average of 12 Readings

Longitude W105° 30 ' 46.8 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 2

Secondary Sulfides 1

Approximate Distance from Drainage Channel 225'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 15'

Average top length 60'

Average bottom width 90'

Average bottom length 90'

Average height 100'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y*

Approximate Size (l x w)

Vegetation on Pile (Y or N) Y

Texture (fine, coarse) coarse

Equipment Access (describe) Hard to access - steep slopes- steep slopes for equipment

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation Some natural cementation

Cap-in-place

Amend and Revegetate

Comments *Rubble zone – killing zone

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #8 Lower Centennial

Drainage Chase

Latitude N39° 48 ' 24.3 "

Average of 12 Readings

Longitude W105° 30 ' 28.4 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock 1 (flanks)

Secondary Sulfides _____

Approximate Distance from Drainage Channel 0 - 2'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width 2'

Average top length 50'

Average bottom width 10'

Average bottom length 150'

Average height 15'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y (to creek)

Approximate Size (l x w) 2' x 150'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) medium coarse

Equipment Access (describe) Near road but must cross Chase Creek

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

Comments Tires in gully between piles. Duplicate sample.

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #9 Advance Tunnel

Drainage Chase

Latitude N39° 48 ' 33.1 "

Average of 12 Readings

Longitude W105° 30 ' 50.5 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 2

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock 1

Secondary Sulfides 2

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 30'

Average top length 200'

Average bottom width 75'

Average bottom length 225'

Average height 15'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) _____

Vegetation on Pile (Y or N) N (very little)

Texture (fine, coarse) med-coarse to med-fine

Equipment Access (describe) Access to base, steep slopes

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #10 Hayseed

Drainage Chase

Latitude N39° 48 ' 40.7 "

Average of 12 Readings

Longitude W105° 30 ' 56.3 "

Mineralogy (1= present, 2= abundant)

Pyrite 1

Sphalerite 2

Chalcopyrite 1

Galena 1

Other, (specify)

Country Rock 2

Secondary Sulfides 2

Approximate Distance from Drainage Channel 3

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'

Average top length 50'

Average bottom width 50'

Average bottom length 75'

Average height 15'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w)

Vegetation on Pile (Y or N) N (very little)

Texture (fine, coarse) fine

Equipment Access (describe) Easy access

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation None

Cap-in-place

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #11 Tucker

Drainage Chase

Latitude N39° 48 ' 42.6 "

Average of 12 Readings

Longitude W105° 30 ' 56.7 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 2

Chalcopyrite 1

Galena 1

Other, (specify)

Country Rock 2

Secondary Sulfides 1

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 90'

Average top length 150'

Average bottom width 200'

Average bottom length 200'

Average height 50'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w)

Vegetation on Pile (Y or N) Y

Texture (fine, coarse) coarse

Equipment Access (describe) Relatively accessible

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Very little

Cap-in-place

Amend and Revegetate X

Comments Duplicate sample

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #13 Centre

Drainage Chase

Latitude N39° 48 ' 26.5 "

Average of 10 Readings

Longitude W105° 30 ' 30.2 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 2

Approximate Distance from Drainage Channel A = 15', B = 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width A = 5', B = 10'

Average top length A = 15', B = 75'

Average bottom width A = 10', B = 50'

Average bottom length A = 20', B = 100'

Average height A = 12', B = 12'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) A = 15' x 25'
B = In creek

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Cross creek from road

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

Comments Two piles: A - one from shaft, B - next to creek

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #14 Upper Centennial

Drainage Chase

Latitude N39° 48 ' 22.9 "

Average of 10 Readings

Longitude W105° 30 ' 33.3 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock 1 (very little)

Secondary Sulfides 2

Approximate Distance from Drainage Channel > 500'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 45'

Average top length 25'

Average bottom width 55'

Average bottom length 150'

Average height 80'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 150' x 50' (runs into lower piles)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) Mostly fine w/ some coarse country rock

Equipment Access (describe) Road access to top - very steep slopes

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation little

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #15 Robert Emmet

Drainage Chase

Latitude N39° 48 ' 27.7 "

Average of 10 Readings

Longitude W105° 30 ' 21.1 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify) bricks

Country Rock 1

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 1000'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'

Average top length 200'

Average bottom width 80'

Average bottom length 225'

Average height 50'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 250' x 100'

Vegetation on Pile (Y or N) N (except country rock)

Texture (fine, coarse)

Equipment Access (describe) Very steep but trail is present

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation Loosely cemented

Cap-in-place

Amend and Revegetate X

Comments Some red minerals

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #16 Virginia Discovery

Drainage Chase

Latitude N39° 48 ' 33.1 "

Average of 10 Readings

Longitude W105° 30 ' 29.3 "

Mineralogy (1= present, 2= abundant)

Pyrite 1 (very minor)

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 2

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'

Average top length 200'

Average bottom width 25'

Average bottom length 250'

Average height 40'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 250' x 100'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine to medium

Equipment Access (describe) Very steep - old trail leads to mine

---

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation Loose - little

Cap-in-place

Amend and Revegetate X

Comments Red minerals, pyrite

Sample - Red rock, chalcopyrite w/ pyrite

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #18 Bates

Drainage Chase

Latitude N39° 48 ' 7.2 "

Average of 6 Readings

Longitude W105° 29 ' 59.3 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 1000'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 20'

Average top length 20'

Average bottom width 30'

Average bottom length 30'

Average height 10'

Estimated Volume

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) 50' x 100'

Vegetation on Pile (Y or N) Y (few trees)

Texture (fine, coarse) medium coarse

Equipment Access (describe) Very easy access

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Little

Cap-in-place X

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #20 Bonanza

Drainage Chase

Latitude N39° 48 ' 20.0 "

Average of 15 Readings

Longitude W105° 30 ' 14.7 "

Mineralogy (1= present, 2= abundant)

Pyrite 1 (minor)

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 2

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 30'

Average top length 750'

Average bottom width 75'

Average bottom length 1000'

Average height 50'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 600' x 25' (to road)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Access easy except steep slopes

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation Some cementation

Cap-in-place X

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #21 Aetna

Drainage Chase

Latitude N39° 48 ' 18.6 "

Average of 8 Readings

Longitude W105° 30 ' 16.0 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 25'

Average top length 50'

Average bottom width 10'

Average bottom length 75'

Average height 20'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 100' x 30'

Vegetation on Pile (Y or N) N (few trees)

Texture (fine, coarse) fine

Equipment Access (describe) Cross creek from road

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation little

Cap-in-place

Amend and Revegetate X

Comments Tunnel weeping water

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #22 Boston

Drainage Gregory

Latitude N39° 47 ' 58.1 "

Average of 10 Readings

Longitude W105° 30 ' 39.5 "

Mineralogy (1= present, 2= abundant)

Pyrite 1

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock

Secondary Sulfides 2

Approximate Distance from Drainage Channel

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep)

Average top width 15'

Average top length 500'

Average bottom width 200'

Average bottom length 1000'

Average height 100'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 1000' x 50' (street/bldgs)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) mostly fine w/ coarse

Equipment Access (describe) Hard access from top. Bottom from street.

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation little

Cap-in-place

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #25 Humboldt

Drainage Gregory

Latitude N39° 48 ' 12.7 "

Average of 10 Readings

Longitude W105° 31 ' 6.4 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock _____

Secondary Sulfides 2

Approximate Distance from Drainage Channel > 300'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 2

Average top width 25'

Average top length 50'

Average bottom width 25'

Average bottom length 75'

Average height 20'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 100' x 75'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Easy access from road

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Some surface crust

Cap-in-place X

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #26 Winnebago

Drainage Gregory

Latitude N39° 48 ' 14.1 "

Average of 10 Readings

Longitude W105° 30 ' 50.8 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock _____

Secondary Sulfides 1

Approximate Distance from Drainage Channel _____

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3 (one gully 4)

Average top width 100'

Average top length 150'

Average bottom width 100'

Average bottom length 200'

Average height 50'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 200' x 75'

Vegetation on Pile (Y or N) N (some trees)

Texture (fine, coarse) coarse

Equipment Access (describe) Accessible by roads

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation _____

Cap-in-place X

Amend and Revegetate X

Comments Duplicate sample

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #27 Hunter-Gold

Drainage Gregory

Latitude N39° 47 ' 48.7 "

Average of 12 Readings

Longitude W105° 30 ' 38.5 "

Mineralogy (1= present, 2= abundant)

Pyrite

Sphalerite 1

Chalcopyrite 1

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

Approximate Distance from Drainage Channel > 200'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 1

Average top width 10'

Average top length 30'

Average bottom width 10'

Average bottom length 50'

Average height 6'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 75' x 20'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) coarse w/ some fine

Equipment Access (describe) Easy

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal X

Cementation Some cement

Cap-in-place X

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #31 Next President

Drainage Gregory

Latitude N39° 47 ' 56.8 "

Average of 10 Readings

Longitude W105° 30 ' 12.2 "

Mineralogy (1= present, 2= abundant)

Pyrite 1

Sphalerite 1

Chalcopyrite 2

Galena

Other, (specify)

Country Rock 1

Secondary Sulfides 1

Approximate Distance from Drainage Channel 100' (gulch)

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'

Average top length 200'

Average bottom width 100'

Average bottom length 300'

Average height 50'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 1000' x 100'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) mostly fine

Equipment Access (describe) Road cut to site

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation

Cap-in-place

Amend and Revegetate X

Comments

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #32 Hartford

Drainage Gregory

Latitude N39° 47 ' 57.0 "

Average of 10 Readings

Longitude W105° 30 ' 16.4 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock _____

Secondary Sulfides 2

Approximate Distance from Drainage Channel 90' (to gulch)

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 30'

Average top length 75'

Average bottom width 50'

Average bottom length 100'

Average height 25'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 125' x 90' (to gulch)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Road access

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation some cement

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #33 Mainc Hamlet

Drainage Gregory

Latitude N39° 47 ' 54.9 "

Average of 9 Readings

Longitude W105° 30 ' 34.4 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite _____

Galena _____

Other, (specify) _____

Country Rock _____

Secondary Sulfides 1

Approximate Distance from Drainage Channel 0

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 15'

Average top length 20'

Average bottom width 50'

Average bottom length 100'

Average height 30'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 75' x 100' (to Harveys)

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine

Equipment Access (describe) Steep ridges from Epizodic, old trail on right flank looking downgrade

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Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation little

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #34 Vasa - Levant

Drainage Gregory

Latitude N39° 47 ' 59.7 "

Average of 10 Readings

Longitude W105° 30 ' 23.6 "

Mineralogy (1= present, 2= abundant)

Pyrite _____

Sphalerite 1

Chalcopyrite 1

Galena _____

Other, (specify) _____

Country Rock 1 (on flanks)

Secondary Sulfides 2

Approximate Distance from Drainage Channel 50'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 50'

Average top length 1000'

Average bottom width 100'

Average bottom length 1200'

Average height 50'

Estimated Volume _____

Vegetation Kill Zone Present (Y or N) N

Approximate Size (l x w) (1200' x ?) highway cuts off toe

Vegetation on Pile (Y or N) N

Texture (fine, coarse) mostly fine w/ coarse

Equipment Access (describe) Toe - easy from highway. Top - difficult.

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal _____

Cementation _____

Cap-in-place _____

Amend and Revegetate X

Comments _____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #36 OK (Epizodic) Drainage Gregory

Latitude N39° 47 ' 54.1 " Average of 9 Readings

Longitude W105° 30 ' 36.3 "

Mineralogy (1= present, 2= abundant) Pyrite

Sphalerite 1 Chalcopyrite 1 (minor)

Galena Other, (specify)

Country Rock 1 Secondary Sulfides 2

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 50' Average top length 50'

Average bottom width 75' Average bottom length 100'

Average height 30' Estimated Volume

Vegetation Kill Zone Present (Y or N) Y Approximate Size (l x w) 125' x 50'

Vegetation on Pile (Y or N) N Texture (fine, coarse) fine (some boulders)

Equipment Access (describe) Very steep - old access road on right flank looking down slope

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Reclamation Measures (check if feasible) Run-on Diversion X

Removal Cementation little

Cap-in-place Amend and Revegetate X

Comments Some malachite - green, Some red - cinnabar?

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site #37 German

Drainage Gregory

Latitude N39° 47 ' 52.8 "

Average of 12 Readings

Longitude W105° 30 ' 32.7 "

Mineralogy (1= present, 2= abundant)

Pyrite 1

Sphalerite 1

Chalcopyrite

Galena 1

Other, (specify)

Country Rock

Secondary Sulfides 2

Approximate Distance from Drainage Channel 75'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) 3

Average top width 25'

Average top length 75'

Average bottom width 100'

Average bottom length 200'

Average height 100'

Estimated Volume

Vegetation Kill Zone Present (Y or N) Y

Approximate Size (l x w) 250' x 75'

Vegetation on Pile (Y or N) N

Texture (fine, coarse) fine to medium fine

Equipment Access (describe) To top by old road (trees are in road)

Reclamation Measures (check if feasible)

Run-on Diversion X

Removal

Cementation little

Cap-in-place

Amend and Revegetate X

Comments Pyrite

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-1 Drainage Chase

Latitude N39° 48 ' 43.6 " Average of 3 Readings

Longitude W105° 30 ' 58.7 "

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

Approximate Distance from Drainage Channel _____

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

Comments Upstream of Tucker

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-02 Drainage Chase

Latitude N39° 48 ' 36.7 " Average of 3 Readings

Longitude W105° 30 ' 54.1 "

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

Approximate Distance from Drainage Channel 0'

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

Comments From the stream bed, down stream of Hayseed

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-3 Drainage Chase

Latitude N39° 48 ' 25.0 " Average of 5 Readings

Longitude W105° 30 ' 27.0 "

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

Approximate Distance from Drainage Channel _____

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

Comments _____

_____

_____

_____

NORTH FORK OF CLEAR CREEK WASTE ROCK SAMPLING

Sampling Site SD-4 Drainage Chase

Latitude N39° 48 ' 18.8 " Average of 10 Readings

Longitude W105° 30 ' 15.0 "

Mineralogy (1= present, 2= abundant) Pyrite _____

Sphalerite _____ Chalcopyrite _____

Galena _____ Other, (specify) _____

Country Rock _____ Secondary Sulfides _____

Approximate Distance from Drainage Channel _____

Erosion (0= none, 1= sheet wash, 2= rills less than 6" deep, 3= rills over 6-12" deep, 4= gullies over 12" deep) _____

Average top width _____ Average top length _____

Average bottom width _____ Average bottom length _____

Average height _____ Estimated Volume _____

Vegetation Kill Zone Present (Y or N) _____ Approximate Size (l x w) _____

Vegetation on Pile (Y or N) _____ Texture (fine, coarse) _____

Equipment Access (describe) _____

Reclamation Measures (check if feasible) Run-on Diversion _____

Removal _____ Cementation _____

Cap-in-place _____ Amend and Revegetate _____

Comments Next to creek: where a drainage from the Bonanza drains into creek.

QC/QA

ATTACHMENT 1

CHEMICAL DATA QUALITY ASSESSMENT REPORT (CDQAR) FOR SURFACE SOIL SAMPLES NORTH FORK OF CLEAR CREEK, COLORADO

OMAHA DISTRICT
U.S. ARMY
CORPS OF ENGINEERS

Chemical Data Quality Assessment Report (CDQAR)

For

Soil Samples Obtained at

North Fork of Clear Creek, Colorado

April 2003

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ACRONYMS AND ABBREVIATIONS

ABA	Acid Base Accounting
ADP	Analytical Data Package
ASTM	American Standard Testing Materials
^{o}C	Degrees Celsius
CDMG	Colorado Division of Minerals and Geology
CDQAR	Chemical Data Quality Assessment Report
CENWO	Corps of Engineers, Omaha District
COC	Chain-of-Custody
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
DUP	Duplicate
eV	Electron volt
ECB	Environmental Chemistry Branch
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
Ft	Foot/Feet
GPS	Global Positioning System
HSA	Hollow Stem Auger
I.D.	Inner Diameter
IDW	Investigative Derived Waste
Kg	Kilogram
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
MRL	Method Reporting Limit
µg/L	Micrograms per Liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
mg	Milligram
Min	Minute
mL	Milliliters
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MW	Monitoring Well
N/A	Not Applicable
ND	non-detect
NPDES	National Pollutant Discharge Elimination System
O.D.	Outer Diameter
PID	Photoionization Detector
ppb	Parts per Billion (measured in water as µg/L)

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAMS	Restoration of Abandoned Mine Sites
RPD	Relative Percent Difference
SSHP	Site Safety Health Plan
SOP	Standard Operating Procedure
SSA	Site-Specific Addendum
TMDL	Total Maximum Daily Load
U.S.	United States
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
WRDA	Water Resource Development Act

1 INTRODUCTION

1.1 QUALITY CONTROL SUMMARY

This Chemical Data Quality Assessment Report (CDQAR) describes the operations and procedures followed by USACE to conduct the investigation of soil and sediment samples obtained from the abandoned mine area of North Fork of Clear Creek, Colorado. Field work was performed by USACE Omaha and Albuquerque Districts. Analytical services were provided by a US Army Corps of Engineers laboratory, the Environmental Chemistry Branch Laboratory located in Omaha, Nebraska.

The field and sample analyses were performed in accordance with the general Site Work Plan for the Restoration of Abandoned Mines prepared by U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, July 2002 and the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, August 2002.

This CDQAR includes a summary of the quality assurance (QA) and quality control (QC) procedures and an evaluation of data quality and data usability with respect to Data Quality Objectives (DQOs) established for this field investigation.

1.2 REPORT ORGANIZATION

Section 2 of this report provides a discussion of project objectives. Procedures employed to control and evaluate the quality of sample collection, transportation, storage, and analysis are presented in Section 3. Section 4 discusses data evaluation, and the results of QC evaluations are in Section 5. Conclusions and recommendations are presented in Section 6.

2 PROJECT DESCRIPTION

2.1 PROJECT PURPOSE

The primary objective of this field investigation is to collect and provide surface soil and sediment data to the CDMG and USBR to support their respective investigations for the North Fork of Clear Creek drainage. This data may eventually be used by the CDMG and/or the USBR in order to determine metals loading from various mine waste pile sites to the North Fork of Clear Creek drainage.

2.2 ANALYTICAL SERVICES

The Environmental Chemistry Branch (ECB) laboratory provided analytical services for total metals of the soil/sediment samples and total metals, pH, acidity and conductivity of the water leachate from the soil/sediment samples. Laboratory address is given below:

US Army Corps of Engineers
Environmental Chemistry Branch (ECB) Laboratory
420 South 18th Street
Omaha, NE 68102

ECB Laboratory reported all non-detect results as "u". The non-detect values are given in the data tables as 'u' less than the Method Detection limits (MDL). The MDL is the minimum concentration of a substance that can be measured and reported with 99 per cent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The reporting limit (RL) is determined by the laboratory and takes into account impacts from sample matrix, sample preparation, and instrument limitations. The RL represents the concentration at which the laboratory can both determine the presence of an analyte and accurately quantify the amount present. The laboratory reported detections below the RL and higher than the MDL with a "J" laboratory qualifier, which indicates a greater degree of uncertainty associated with the quantitative result. The J qualified values are considered valid and useable. Reporting limits may increase for an individual environmental sample due to high concentrations of target analytes, matrix effects, or other interferences.

2.3 DATA QUALITY OBJECTIVES

The DQOs for this site are based on the objective of the investigation, which is to collect soil data of sufficient quality so that the data users can assess the effects of former mine operations at this area and then evaluate the need for any additional response action.

2.3.1 Data Collected

The data collected at the North Fork of Clear Creek were from samples obtained from soil/sediment samples and sent to the labs given above.

Field Measurements (Field Screening Data)
No field screening of samples were performed.

Off-Site Analysis (Definitive Level Data)
Definitive level data was collected from twenty-seven (27) soil sample locations and four (4) sediment sample locations. The total number of soil samples analyzed was 31 soil samples (27 primary samples plus four QC samples) and five sediment samples (four primary samples and one QC sample). All samples were analyzed for total metals. The water leachate derived from these same soil samples was also analyzed for total leachable metals, pH, acidity, and conductivity. The metals suite is: Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn. Sections 3.0 and 4.0 give the field and laboratory quality control procedures and the result of the quality control process is given in Section 5.0. The data quality objectives for this data are to ensure that the data adheres to criteria in Sections 3.0, 4.0, and 5.0.

3 FIELD QUALITY CONTROL PROCEDURES

3.1 PROJECT PLANNING

The field investigation was conducted as described in the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, 29 August 2002. The plan was written by CENWO to ensure the quality of data derived from the investigation. The plan provides a discussion of the project work scope and general procedures to be followed for field and laboratory activities.

3.2 DOCUMENTED FIELD ACTIVITIES

This section summarizes the equipment, procedures, and methods undertaken to ensure quality of the sample collection activities. Investigation activities and QC procedures were recorded and documented in the field using appropriate field forms. Prior to sample collection, as well as between sample locations, field equipment was decontaminated.

3.2.1 Soil/Sediment Samples

A total twenty-seven (27) soil samples and four (4) sediment samples were collected by CENWO personnel between 9 –13 September 2002 and were sent off site for analysis.

3.2.2 Management of Investigation Derived Waste (IDW)

IDW was handled as described in the Site Specific Work Plan for the North Fork of Clear Creek, Colorado, August 2002.

3.2.3 Decontamination Procedures

The field instruments were decontaminated in the field as described in the Standard Operating Procedures.

3.2.4 Other Documentation and Reporting of Field Activities

All field activities were thoroughly documented in indelible ink using the following forms:

- Field Data Sheets
- Chain of Custody Record
- Sample Labels

Field personnel initiated Chain of Custody (COC) documentation as samples were collected and selected for laboratory analysis. Sample custody was maintained from sample collection through the completion of the laboratory analysis.

3.2.5 Sample Labeling, Handling, and Shipping

All documentation, handling, and shipping employed for this field effort were in concurrence with the procedures described in the Work Plan.

Labeled samples were placed in sealed Ziploc brand bags and packed in waterproof plastic ice chests with sufficient packaging material placed around and between the sample jars. Sample containers and holding times used for this project are shown in Table 3-1.

Every cooler contained a COC form, prepared in triplicate, which identified all of the sample containers, analytical requirements, time and date sampled, preservatives, and other pertinent field data. Samples were shipped by an overnight courier to ECB Laboratory to enable analysis within holding times. Upon receipt in the laboratory, the Sample Custodian opened the shipping containers, compared the contents with the COC record, ensured that the document control information was accurate and complete, and dated the form. A Sample Receipt Form was also used by the laboratory to log in samples and document their integrity upon arrival. These forms are provided in the Analytical Data Packages.

3.3 FIELD QUALITY CONTROL SAMPLES

Duplicate samples were collected for this field effort as follows: four soil samples and one sediment sample. The results of the field QC samples and their impact on data quality are discussed in Section 4.

Table 3-1
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR COMPOSITE SOIL SAMPLES

Parameter	Container	Maximum Holding Times	
		Digestion	**Analysis**
Composite Soil Sample*			
Metals[1]	1 x 8 ox Glass	6 months (Mercury – 28 days)	6 months (Mercury – 28 days)
Water Leachate**			
Leachate Metals[1]		6 months (Mercury – 28 days)	6 months (Mercury – 28 days)
Leachate pH			ASAP***
Leachate Acidity			ASAP***
Conductivity			ASAP***

* One 8 oz jar obtained in the field from each area is sufficient for all analyses.
** The water leachate process is performed in the laboratory by the method described in the Site Specific Work Plan..
*** ASAP in this instance means as soon as possible after leachate is obtained.
[1] Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, K, Ag, Zn

4 EVALUATION OF DATA QUALITY

The laboratory analytical data was reviewed and verified by ECB Laboratory and then evaluated by the CENWO project chemist for compliance with project objectives.

The following section is a description of the laboratory review procedures used to ensure data quality and the project chemists' assessment of project deliverables. Data usability was determined by comparing the project DQOs against the quality of the final analytical results.

4.1 LABORATORY QUALITY CONTROL SAMPLES

This section provides a description of laboratory QC samples: laboratory control samples, method blanks, and surrogate spike samples (organic analyses only), and matrix spike/matrix spike duplicate.

4.1.1 Laboratory Control Samples (LCS)

The laboratory analyzed a spike blank sample in duplicate to evaluate the precision and accuracy within an analytical batch. The nomenclature for these samples is a laboratory control sample (LCS). LCS sample pairs consisted of analyte-free water that was spiked with selected target compounds. LCS results are included in the QC section of each laboratory's data package, which are included in the Analytical Data Packages.

4.1.2 Method Blank Analyses

A laboratory method blank is a contaminant free matrix sample (e.g. a method blank is often a volume of distilled water carried through the entire analytical scheme) that is subjected to the same analytical procedures as the field samples. The method blank is used in all analyses to verify that the determined concentrations do not reflect contamination. One method blank is performed with every batch of samples (approximately 20 samples). If consistent high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis is halted until the system is brought under control.

4.1.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The laboratory analyzed a spiked environmental sample and duplicate to evaluate the performance of the method as applied to a particular project matrix. A MS is an environmental sample in which known concentrations of certain target analytes have been added before sample manipulation from the preparation, and determinative procedures have been implemented. The results of the MS are evaluated in conjunction with other QC information to determine if the effect of the matrix can bias the analysis.

4.2 LABORATORY DATA VALIDATION ACTIVITIES

All analytical data generated by ECB Lab was checked for completeness and evaluated for overall quality prior to final report generation as outlined in the Quality Assurance Program Plan (QAPP) and specified in each laboratory's Standard Operating Procedures (SOPs). This process consisted of data generation and reduction plus three levels of documented review. Each step of the review process involved evaluation of data quality based on QC data results and the professional judgement of the reviewer(s). All reviews were documented by the reviewer's signature and the date reviewed.

The analyst who generated the raw analytical data performed the first level review. Primary emphasis of the review was on correctness and completeness of the data set. All data were generated and reduced following method-specific SOPs. Each analyst reviewed the quality of the work based on the guidelines established in the SOP. The first review ensured that:

- Sample preparation and analysis information was correct and complete;
- The appropriate SOPs had been followed;
- QC parameters were within method control limits; and
- Documentation was complete

The second level review was structured so that all calibration data and QC sample results were reviewed and 10 percent of the analytical results were confirmed against the bench and instrument sheets. This shall include a complete review of instrument data scans to ensure accurate peaks and retention time, and correct peak integrations have been performed. If no problems were found with the data package, the review was considered complete. If any problems were found with the data package, an additional 10 percent of the samples were checked to the bench sheet. The process was continued for each batch until no errors were found or until each data package was reviewed in its entirety. All second level reviews were performed by a laboratory supervisor, data review specialist, or QA officer to ensure that:

- Calibration data were appropriate to the method and completely documented;
- QC samples were within established guidelines;
- Qualitative identification of sample components was correct;
- Quantitative values were calculated correctly;
- Documentation was complete and correct;
- The data were ready for final reporting; and;
- The data package was complete and ready for data archive.

An important element of the second review was the documentation of any errors identified and corrected during the review process.

Before the final report was released, a third review was performed to check each data package for completeness and to ensure that the data met the overall objectives of the project. The laboratory Program Administrator, as stated in the QAPP, did this review. The review was performed to ensure that:

- Target analyte lists were complete as specified in the sampling and analysis plan;
- Data package checklist items were present;
- Case narratives accurately documented analytical conditions;
- All non-conformances were addressed and closed.

The Analytical Data Packages (ADPs) contain the following:

- Cover page, identifying project and remarks
- Summary and discussion of method QC and shipping and/or chain-of-custody errors

- Sample receipt information including copies of Cooler Receipt Forms
- Chain-of-Custody (COC) information including copies of COCs
- Analytical Test Results

As part of the review process, both contract laboratories applied data qualifiers to specific results to indicate usability and/or special analytical conditions. The following qualifiers were used to flag data:

B	The compound was also observed in the method blank.
J	Estimated concentration below the Reporting Limit.
u	The compound was not detected.
M	Reporting limit higher than normal due to matrix interferences.
D	Derived from a dilution of extract.

All investigative and QC sample summary results have been submitted in the Analytical Data Packages. A summary of laboratory quality control issues is found in the data package. The data package as obtained from the laboratory is attached as Appendix B.

4.3 CENWO PROJECT CHEMIST QUALITY EVALUATION

In addition to the internal validation conducted by ECB Lab, the CENWO project chemist performed data validation of the data set. This included an evaluation and validation of samples based on:

- Initial sample inspection and COC documentation;
- Holding Times;
- Field Duplicate Analyses;
- Laboratory Control Samples;
- Method Blank Analyses;
- Matrix Spike/Matrix Spike Duplicate recoveries;
- Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters as they apply to this CDQAR; and
- An overall assessment of data compared to the project DQOs.

The CENWO project chemist received data from the laboratory in hard copy format. The USACE Guidance for the Review of Performance-Based Definitive Chemical Data was used to perform the review and validation of the data.

The first step in evaluating and validating the data was to group the samples according to analytical batch or work group. A table was generated which show all analytical batches (project samples and laboratory QC samples). The batches are shown on Table 4-1. After analytical batching, the batches were reviewed to ensure that the proper QC (type and frequency) was analyzed according to the QAPP for each batch. Next, sample duplicate frequency was evaluated for compliance with the QAPP. Chain-of-custody forms and Cooler Receipt Forms were then reviewed. Any problems found were documented and the impact on sample results was determined and explained.

Holding times were evaluated for compliance with extraction and analysis holding time requirements. Matrix spike recoveries were evaluated for all samples. MS/MSD results were re-calculated on at least one sample per batch. Data qualifier flags were applied as appropriate. Surrogate spike recoveries were evaluated for all samples and surrogate recoveries were re-calculated on at least one sample per batch.

Next, LCS results were reviewed for all samples. LCS recoveries were re-calculated on one sample per batch. Relative Percent Differences (RPDs) for MS/MSD and LCS/LCSD pair calculations were verified for all batches. The 5X and 10X rule (as discussed in the Functional Guidelines for the Evaluation of Chemical Data) was used for evaluation of method blank results. The completeness percentage for surrogates, LCS, MS/MSD and holding times was then calculated.

A summary of the data review/validation results is given in section 5.

As discussed previously, data qualifier flags were applied to out-of-control data as appropriate. The following qualifiers were used to indicate data usability:

u: The analyte was not detected relative to the method reporting limit.

UN: The result is reported as a tentative non-detection. There is uncertainty with whether or not the non-detection is valid at the stated method reporting limit.

X: The data is tentatively rejected because project-specific data quality objectives have not been met or have not been demonstrated.

J: The target analyte is positively identified but the quantitative result is an estimate and the direction of bias is unknown. The flag indicates a significant quantitative (rather than a qualitative) uncertainty exists.

J-: The target analyte is present but the reported concentration is an estimated value that is believed to be biased low. (i.e. the actual concentration in the environmental sample believed to be higher than the reported concentration)

J+: The target analyte is present but the reported concentration is an estimated value that is believed to be biased high. (i.e. the actual concentration in the environmental sample is believed to be lower than the reported concentration)

R: Data is rejected due to the serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. The data is not useable.

Daily Quality Control Reports and COC documentation were compared against laboratory reports to check conformity of sample identification numbers. Analytical results were compared

to daily activity logs to identify sampling procedures/activities that may have impacted data quality.

Table 4-1 Analytical Batches

North Fork Clear Creek, Colorado

Batch	Analyses	Sample ID
WG11258	Metals (soil)	CO-NCC-CHG02-SS11
		CO-NCC-CHG02-SS10
		CO-NCC-CHG02-SS11 dup
		CO-NCC-CHG02-SS09
		CO-NCC-CHG02-SD-01
		CO-NCC-CHG02-SD02
		CO-NCC-CHG02-SS07
		CO-NCC-CHG02-SS06
		CO-NCC-CHG02-SS04
		CO-NCC-CHG02-SS16
		CO-NCC-CHG02-SS15
		CO-NCC-CHG02-SS02
		CO-NCC-CHG02-SS08
		CO-NCC-CHG02-SS08 dup
		CO-NCC-CHG02-SD-03
		CO-NCC-CHG02-SS14
		CO-NCC-CHG02-SD-04
		CO-NCC-CHG02-SS-03
		Method Blank
		Laboratory Matrix Duplicate
		Matrix Spike (MS)/Matrix Spike Duplicate (MSD)
		Laboratory Control Sample (LCS)
WG11267	Metals (soil)	CO-NCC-CHG02-SS14
		CO-NCC-CHG02-SD04
		CO-NCC-CHG02-SS03
		CO-NCC-CHG02-SS13
		CO-NCC-CHG02-SS20
		CO-NCC-CHG02-SS21
		CO-NCC-LGG02-SS25
		CO-NCC-LGG02-SS26
		CO-NCC-LGG02-SS26 dup
		CO-NCC-CHG02-SS05
		CO-NCC-CHG02-SD04 dup
		CO-NCC-CHG02-SS18
		CO-NCC-LGG02-SS27
		CO-NCC-LGG02-SS33
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS

Batch	Analyses	Sample ID
WG11268	Metals (soil)	CO-NCC-LGG02-SS37
		CO-NCC-LGG02-SS37 dup
		CO-NCC-LGG02-SS36
		CO-NCC-LGG02-SS22
		CO-NCC-LGG02-SS34
		CO-NCC-LGG02-SS31
		CO-NCC-LGG02-SS32
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
WG11333	Metals (water leachate)	CO-NCC-CHG02-SS11
		CO-NCC-CHG02-SS10
		CO-NCC-CHG02-SS11 dup
		CO-NCC-CHG02-SS09
		CO-NCC-CHG02-SD-01
		CO-NCC-CHG02-SD02
		CO-NCC-CHG02-SS07
		CO-NCC-CHG02-SS06
		CO-NCC-CHG02-SS04
		CO-NCC-CHG02-SS16
		CO-NCC-CHG02-SS15
		CO-NCC-CHG02-SS02
		CO-NCC-CHG02-SS08
		CO-NCC-CHG02-SS08 dup
		CO-NCC-CHG02-SD-03
		CO-NCC-CHG02-SS14
		CO-NCC-CHG02-SD-04
		CO-NCC-CHG02-SS-03
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
WG11334	Metals (water leachate)	CO-NCC-CHG02-SS13
		CO-NCC-CHG02-SS20
		CO-NCC-CHG02-SS21
		CO-NCC-LGG02-SS25
		CO-NCC-LGG02-SS26
		CO-NCC-LGG02-SS26 dup
		CO-NCC-CHG02-SS05
		CO-NCC-CHG02-SD04 dup
		CO-NCC-CHG02-SS18
		CO-NCC-LGG02-SS27
		CO-NCC-LGG02-SS33

Batch	Analyses	Sample ID
		CO-NCC-LGG02-SS37
		CO-NCC-LGG02-SS37 dup
		CO-NCC-LGG02-SS36
		CO-NCC-LGG02-SS22
		CO-NCC-LGG02-SS34
		CO-NCC-LGG02-SS31
		CO-NCC-LGG02-SS32
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
M020912	Water Leachate Conductivity	CO-NCC-CHG02-SS11
		CO-NCC-CHG02-SS10
		CO-NCC-CHG02-SS11 dup
		CO-NCC-CHG02-SS09
		CO-NCC-CHG02-SD-01
		CO-NCC-CHG02-SD02
		CO-NCC-CHG02-SS07
		CO-NCC-CHG02-SS06
		CO-NCC-CHG02-SS04
		CO-NCC-CHD02-SS16
		CO-NCC-CHG02-SS15
		CO-NCC-CHG02-SS02
		CO-NCC-CHG02-SS08
		CO-NCC-CHG02-SS08 dup
		CO-NCC-CHG02-SD-03
		Method Blank
		Laboratory Matrix Duplicate
		LCS
M020922	Water Leachate Conductivity	CO-NCC-CHG02-SS14
		CO-NCC-CHG02-SD04
		CO-NCC-CHG02-SS03
		CO-NCC-CHG02-SS13
		CO-NCC-CHG02-SS20
		CO-NCC-CHG02-SS21
		CO-NCC-CHG02-SS25
		CO-NCC-CHG02-SS26
		CO-NCC-CHG02-SS26 dup
		CO-NCC-CHG02-SS05
		CO-NCC-CHG02-SD04 dup
		CO-NCC-CHG02-SS18
		CO-NCC-LGG02-SS27
		CO-NCC-LGG02-SS33
		CO-NCC-LGG02-SS37

Batch	Analyses	Sample ID
		CO-NCC-LGG02-SS37 dup
		CO-NCC-LGG02-SS36
		CO-NCC-LGG02-SS22
		CO-NCC-LGG02-SS34
		CO-NCC-LGG02-SS31
		CO-NCC-LGG02-SS32
		Method Blank
		Laboratory Matrix Duplicate
		LCS/LCSD
M020912	Water Leachate pH	CO-NCC-CHG02-SS11
		CO-NCC-CHG02-SS10
		CO-NCC-CHG02-SS11 dup
		CO-NCC-CHG02-SS09
		CO-NCC-CHG02-SD-01
		CO-NCC-CHG02-SD02
		CO-NCC-CHG02-SS07
		CO-NCC-CHG02-SS06
		CO-NCC-CHG02-SS04
		CO-NCC-CHG02-SS16
		CO-NCC-CHG02-SS15
		CO-NCC-CHG02-SS02
		CO-NCC-CHG02-SS08
		CO-NCC-CHG02-SS08 dup
		CO-NCC-CHG02-SD-03
		pH = 4.0
		PH = 7.0
M020922	Water Leachate pH	CO-NCC-CHG02-SS14
		CO-NCC-CHG02-SD04
		CO-NCC-CHG02-SS03
		CO-NCC-CHG02-SS13
		CO-NCC-CHG02-SS20
		CO-NCC-CHG02-SS21
		CO-NCC-LGG02-SS25
		CO-NCC-LGG02-SS26
		CO-NCC-LGG02-SS26 dup
		CO-NCC-CHG02-SS05
		CO-NCC-CHG02-SD04
		CO-NCC-CHG02-SS18
		CO-NCC-LGG02-SS27
		CO-NCC-LGG02-SS33
		CO-NCC-LGG02-SS37
		CO-NCC-LGG02-SS37 dup
		CO-NCC-LGG02-SS36
		CO-NCC-LGG02-SS22

Batch	Analyses	Sample ID
		CO-NCC-LGG02-SS34
		CO-NCC-LGG02-SS31
		CO-NCC-LGG02-SS32
		pH = 4.0
		pH = 7

5 RESULTS OF QUALITY CONTROL ACTIVITIES AND ANALYSES

Field QC activities consisted of collecting appropriate field QC samples (field duplicates, trip blanks), daily communication between the CENWO field team and ECB Lab, and consistent interaction between the CENWO field team and CENWO Technical Manager.

5.1 FIELD QC PROCEDURES AND FIELD QC ANALYSES

5.1.1 Documentation of Field Quality Procedures

Daily Reports and Daily Quality Control Reports (DQCRs) were completed to summarize daily investigation procedures and document QC activities. These reports summarize samples collected, environmental conditions, instrument problems, and any non-routine situations that may have impacted sample integrity. These reports were reviewed concurrently with the COC forms and the analytical results from the laboratories to identify potential sampling anomalies or confirm sample identifications. The DQCR reports show collection procedures were adequate to ensure data results met project objectives.

5.1.2 Field Duplicate Analyses

Field duplicate samples were collected as indicated in Table 4-1, and also one sample in each batch for metals was run in duplicate for precision for the batch can be determined. Relative percent difference (RPD) of each analyte was within compliance so no qualification was required for the metals results because of precision for the soils and soils leachate. Field duplicates were analyzed for five sets of samples for conductivity, pH, and acidity and the RPDs were within criteria, so no qualifications were applied.

5.2 LABORATORY QC PROCEDURES AND LABORATORY QC ANALYSES

The USACE project chemist conducted a review of laboratory QC procedures. All issues identified, and their respective solutions are discussed below and required qualifications are given in section 5.

5.2.1 Initial Sample Inspection and COC Documentation

ECB Laboratory inspected all shipping containers and compared the contents with the appropriate COC documentation. Information from the sample check-in procedures was recorded on the Cooler Receipt Form. This form was used to document that samples listed on the COC forms agreed with samples contained in the coolers, COC forms were filled out properly, samples were not broken, custody seals were intact, and cooler temperatures were less than or equal to 4°C. These forms are included in the Analytical Data Packages. No problems or deficiencies were found with the sample shipments or COC documentation.

5.2.2 Holding Times

Samples were delivered daily by the overnight courier to ECB Laboratory to ensure all analyses were completed within the required holding times. Part of the CENWO chemist evaluation included reviewing sample extraction and analysis dates to ensure holding times were met. Based on CENWO's review of the laboratory data, all samples were extracted and analyzed within the required holding times.

5.2.3 Method Blank Analyses

Method blanks were analyzed to assess existence and magnitude of contamination problems and measure the representativeness of the analytical process. Blanks reflect the amount of contamination introduced into the environmental samples during sample collection, transfer from the site to the laboratory or analysis. In particular, method blanks reflect laboratory contamination from both the determinative and preparatory method. At least one method blank must be reported for each preparation batch of samples. All blanks were clean except in the following:

Analytical Batch:

WG11258: Cu = 1.0 mg/Kg
Zn = 2.0 mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

WG11267: Cu = 2.6 mg/Kg
Zn = 2.2 mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

WG111268: Zn = 0.6J mg/Kg

No qualification since the sample values for these metals were greater than 10 times the blank contamination.

5.2.4 Laboratory Control Samples

Laboratory control samples are evaluated to assess overall method performance and are the primary indicators of laboratory performance. Laboratory control samples are method blanks which are typically spiked with all target analytes of interest. The percent recovery is used as a measure of accuracy and bias. The relative percent difference (RPD) for duplicate LCS recoveries is normally used as a measure of precision. When both a laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) are processed for a batch of samples, there is no significant physical distinction between the LCS and the LCSD. Both the LCS and the LCSD must satisfy the same recovery acceptance criteria. At least one LCS must be reported with each batch of samples. Multiple LCSs may be required to evaluate method precision. For example, a laboratory control sample and a laboratory control sample duplicate (LCSD) may be analyzed to provide information on the precision of the analytical method. The generation of control chart limits for precision via the analysis of LCS/LCSD pairs is an effective means to measure method precision. LCS and LCSD results are included in the QC section of the laboratory's data package. No qualifications were applied due to the LCS. The recoveries were with set criteria for all metals and conductivity results.

5.2.5 Surrogate Recovery

Surrogates are organic compounds, which are similar in chemical composition to the analytes of interest. Surrogates are spiked into environmental and batch QC samples prior to sample preparation and analysis. Surrogate recoveries for environmental samples are used to evaluate matrix interference on a sample-specific basis. High or low surrogate recoveries indicate problems in instrument performance, extraction procedures, or severe matrix effects. Samples for metals analysis are not spiked with surrogate analytes. No surrogate is added to samples for conductivity analysis.

5.2.6 MS/MSD Recovery

Matrix Spike (MS) and matrix spike duplicate (MSD) results are examined to evaluate the impact of matrix effects on overall analytical performance. A matrix spike is a representative environmental sample that is spiked with target analytes of interest prior to being taken through the entire analytical process in order to evaluate analytical bias for an actual matrix. A matrix duplicate is a collocated or a homogenized sample that is processed through the entire analytical procedure in order to evaluate overall precision for an actual matrix.

It should be noted that MS recovery failure and poor precision may arise because of (i) poor sampling technique, (ii) inadequate homogenization, or (iii) from matrix effects associated with the preparatory or determinative portion of an analytical method. Matrix interferences may be "positive" or "negative" in nature. Results of MS/MSD analyses are included in the Analytical Data Packages.

<u>Metals</u>: One set of MS/MSD samples were analyzed for each metals analytical batch. Analytical batches WG11258, WG11267, and WG11268 had recoveries and/or RPD values our of criteria.

WG11258 and WG11268: Aluminum and Zinc MS recoveries were each high, but the % recovery determination would be hard due to high initial sample concentration. The MS/MSD RPD was generally acceptable. All other quality control indicators were acceptable for these batches. No qualifications were applied to the data in these batches.

WG11267: Lead has erratic MS recoveries for this analytical batch. It may be due to high initial samples concentrations of lead. All other quality control indicators were acceptable for this batch. No qualifications were applied to the data in this batch.

5.2.7 Completeness of Data Packages

The CENWO Chemist reviewed the data package and confirmed the completeness of the data package. All the planned sampling activities were executed and all the laboratory analyses were performed.

5.3 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY (PARCC)

DQOs and their corresponding measurement indicators were specified in the Sampling and Analysis Plan. To achieve the project DQOs, specific PARCC goals are established for laboratory and field sampling procedures. These PARCC parameters are the measurement tools for determining the usability of generated data.

Precision and accuracy goals were based on knowledge of each analytical measurement system. For this CDQAR, precision was measured using the RPD between two replicated sample analyses. The precision evaluation encompassed laboratory precision (LCS samples), and combined field/laboratory precision (MS/MSD samples).

Accuracy was measured using the percent recovery of surrogates, MS/MSD samples, and LCS sample pairs. Spike recoveries form field samples and laboratory QC samples are compared to established control limits to determine a laboratory's ability to accurately determine both qualitative and quantitative results.

Representativeness is the degree to which the data accurately and precisely portrayed the environmental conditions being studied. For the site investigation, sampling procedures and sample locations were selected to bias samples in areas of potential places of contamination. All sampling was conducted using known approved field procedures to minimize variability.

Completeness refers to the amount of valid data obtainable from a measurement system compared to the expected amount of data. The SAP established a completeness goal of 90 percent for laboratory QC requirements. This goal was attained by the data for this project.

5.4 DATA TABLES

The qualified data is given in Appendix A.

5.5 ANALYTICAL DATA PACKAGE

Data Sheets as Obtained from Environmental Chemistry Laboratory will be given upon request as hard copy of the Analytical Data Package.

6 CONCLUSIONS

This CDQAR presents, in specific terms, the quality control practices utilized to achieve the goals of the site investigation at North Fork of Clear Creek, Colorado. The analytical program for this project conformed to the CENWO General Chemistry SOS and the General Geology SOS. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data.

The quality issues addressed in Section 5 of this report do not impact the usability of the data. The required qualifications have been applied to the data in Appendix A, Table 1, and 2. The reviewed data are usable and are suitable for addressing the overall objective of this investigation.

Appendix A

Table 1

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS11			CO-NCC/CHG02-SS10			CO-NCC/CHG02-SS11 dup			CO-NCC/CHG02-SS09		
Date Collected		**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**
Silver	0.2	8.65	1		23.7	1		7.33	1		7.12	1	
Arsnic	0.6	49.6	3		22	3		38.1	3		9.8	3	
Aluminum	6	4300	18		3100	18		5080	18		2470	18	
Calcium	20	3210	60		1170	60		4010	60		387	60	
Cadmium	0.1	7.81	0.5		44.9	0.5		14.3	0.5		0.507	0.5	
Chromium	0.4	4.69	2		2.47	2		7.15	2		1.4	2	J
Copper	0.4	174	2	B	271	2	B	160	2	B	13.7	2	B
Iron	8	32200	24		24000	24		31200	24		18200	24	
Potassium	20	3660	60		3850	60		3620	60		3610	60	
Magnesium	8	2160	24		1180	24		2450	24		442	24	
Manganese	0.2	1020	0.8		1040	0.8		899	0.8		497	0.8	
Lead	0.4	3960	8		20900	4		2770	4		401	2	
Zinic	0.6	2230	8	B	9070	4	B	3550	4	B	274	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SD01			CO-NCC/CHG02-SD02			CO-NCC/CHG02-SS07			CO-NCC/CHG02-SS06		
Date Collected		**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**
Silver	0.2	< .2	1	u	1.01	1		7.24	1		7.02	1	
Arsnic	0.6	10	3		15	3		11	3		13	3	
Aluminum	6	4530	18		6240	18		6370	18		2360	18	
Calcium	20	1730	60		1940	60		5940	60		2020	60	
Cadmium	0.1	< .1	0.5	u	1.21	0.5		19.8	0.5		0.34	0.5	J
Chromium	0.4	31.6	2		24	2		24.2	2		8.24	2	
Copper	0.4	32.4	2	B	38.7	2	B	127	2	B	41.6	2	B
Iron	8	24000	24		18900	24		59100	96		28300	24	
Potassium	20	1920	60		2450	60		3390	60		3340	60	
Magnesium	8	1430	24		2310	24		3960	24		345	24	
Manganese	0.2	929	0.8		847	0.8		1950	3.2		304	0.8	
Lead	0.4	81.9	2		133	2		4270	8		3670	8	
Zinic	0.6	226	2	B	384	2	B	4020	8	B	446	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS04			CO-NCC/CHG02-SS16			CO-NCC/CHG02-SS15			CO-NCC/CHG02-SS02		
Date Collected		**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**
Silver	0.2	1.87	1		5.18	1		2.51	1		4.67	1	
Arsnic	0.6	9.9	3		15	3		9.8	3		18	3	
Aluminum	6	4660	18		2170	18		5890	18		6260	18	
Calcium	20	583	60		162	60		2340	60		2070	60	
Cadmium	0.1	< .1	0.5	u	1.82	0.5		1.51	0.5		4.41	0.5	
Chromium	0.4	5.53	2		2.27	2		8.46	2		5.4	2	
Copper	0.4	140	2	B	72.5	2	B	65.7	2	B	94.4	2	B
Iron	8	33000	24		16100	24		29600	24		26900	24	
Potassium	20	4030	60		2980	60		3470	60		3770	60	
Magnesium	8	1600	24		241	24		2630	24		2850	24	
Manganese	0.2	559	0.8		63.3	0.8		456	0.8		972	0.8	
Lead	0.4	1040	2		4120	8		425	2		4190	8	
Zinic	0.6	258	2	B	599	2	B	513	2	B	1380	8	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS08			CO-NCC/CHG02-SS08 dup			CO-NCC/CHG02-SD03			CO-NCC/CHG02-SS05		
Date Collected		**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**	**9/10/02**	**RL**	**Qual**
Silver	0.2	1.56	1		4.45	1		2.16	1		2.7	1	
Arsnic	0.6	9.3	3		18	3		14	3		4.9	3	
Aluminum	6	5470	18		5210	18		9760	18		5910	18	
Calcium	20	898	60		756	60		1940	60		810	60	
Cadmium	0.1	< .1	0.5	u	8.77	0.5		1.43	0.5		1.2	0.5	
Chromium	0.4	13.6	2		10.8	2		31.9	2		38.6	2	
Copper	0.4	91.3	2	B	329	2	B	54.9	2	B	152	2	B
Iron	8	27600	24		28900	24		22100	24		11800	24	
Potassium	20	3950	60		3890	60		4010	60		3300	60	
Magnesium	8	2210	24		1980	24		4170	24		2470	24	
Manganese	0.2	522	0.8		351	0.8		738	0.8		290	0.8	
Lead	0.4	291	2		341	2		151	2		373	2	
Zinic	0.6	248	2	B	1440	2	B	574	2	B	223	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS14			CO-NCC/CHG02-SD04			CO-NCC/CHG02-SS03			COCC/CHG02-SS13		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Silver	0.2	3.77	1		1.13	1		8.3	1		2.37	1	
Arsnic	0.6	25	3		11	3		9.5	3		13	3	
Aluminum	6	3180	18		4720	18		2400	18		2730	18	
Calcium	20	1170	60		1180	60		65.1	60		221	60	
Cadmium	0.1	0.32	0.5	J	3.1	0.5		0.42	0.5	J	0.14	0.5	J
Chromium	0.4	2.56	2		13	2		1.1	2	J	1.2	2	J
Copper	0.4	96.1	2	B	42.3	2	B	49.9	2	B	30.4	2	B
Iron	8	37400	24		16500	24		13300	24		28700	24	
Potassium	20	3800	60		2520	60		2890	60		3920	60	
Magnesium	8	796	24		1950	24		291	24		570	24	
Manganese	0.2	265	0.8		352	0.8		38.1	0.8		150	0.8	
Lead	0.4	588	2		338	2		392	2		172	2	
Zinic	0.6	277	2	B	697	2	B	125	2	B	198	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS20			CO-NCC/CHG02-SS21			CO-NCC/LGG02-SS25			CO-NCC/LGG02-SS26		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Silver	0.2	6.31	1		1.36	1		4.24	1		0.89	1	J
Arsnic	0.6	41	3		31.5	3		24	3		12	3	
Aluminum	6	3750	18		6050	18		2450	18		3830	18	
Calcium	20	3910	60		3550	60		567	60		236	60	
Cadmium	0.1	6.29	0.5		< .1	0.5	u	0.34	0.5	J	< .1	0.5	u
Chromium	0.4	5.1	2		2.28	2		4.27	2		4.18	2	
Copper	0.4	70.2	2	B	25.2	2	B	212	2	B	42.4	2	B
Iron	8	44700	24		52600	48		36500	24		18600	24	
Potassium	20	4400	60		4770	60		3960	60		2550	60	
Magnesium	8	1510	24		2640	24		578	24		892	24	
Manganese	0.2	389	0.8		351	0.8		467	0.8		163	0.8	
Lead	0.4	4430	8		923	2		637	2		207	2	
Zinic	0.6	1430	8	B	336	2	B	186	2	B	95.1	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/LGG02-SS26			CO-NCC/CHG02-SD04			CO-NCC/CHG02-SS18			CO-NCC/LGG02-SS27		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Silver	0.2	0.82	1	J	0.64	1	J	1.7	1		4.2	1	
Arsnic	0.6	8.3	3		8.1	3		19	3		28	3	
Aluminum	6	4170	18		3540	18		4720	18		2400	18	
Calcium	20	221	60		842	60		653	60		366	60	
Cadmium	0.1	< .1	0.5	u	1.37	0.5		0.49	0.5	J	< .1	0.5	u
Chromium	0.4	4.38	2		8.52	2		3.94	2		5.43	2	
Copper	0.4	100	2	B	52.7	2	B	46.2	2	B	294	2	B
Iron	8	18400	24		13700	24		17500	24		18100	24	
Potassium	20	2480	60		2030	60		3150	60		2250	60	
Magnesium	8	904	24		1310	24		1780	24		805	24	
Manganese	0.2	158	0.8		265	0.8		317	0.8		38.1	0.8	
Lead	0.4	148	2		202	2		403	2		190	2	
Zinic	0.6	97.2	2	B	379	2	B	168	2	B	22.4	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/LGG02-SS33			CO-NCC/LGG02-SS37			CO-NCC/LGG02-SS37 dup			CO-NCC/LGG02-SS36		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Silver	0.2	7.86	1		5.77	1		5.66	1		8.28	1	
Arsnic	0.6	42.7	3		60.3	3		43.1	3		39.7	3	
Aluminum	6	5520	18		3070	18		2930	18		3220	18	
Calcium	20	1150	60		122	60		147	60		283	60	
Cadmium	0.1	< .1	0.5	u	< .1	0.5	u	< .1	0.5	u	< .1	0.5	u
Chromium	0.4	9.95	2		4.33	2		4.36	2		3.58	2	
Copper	0.4	118	2	B	241	2		194	2		786	2	
Iron	8	49500	48		36500	24		32100	24		25800	24	
Potassium	20	3980	60		4210	60		3850	60		3500	60	
Magnesium	8	2100	24		823	24		742	24		658	24	
Manganese	0.2	172	0.8		37.7	0.8		33.4	0.8		39.2	0.8	
Lead	0.4	659	2		134	2		122	2		245	2	
Zinic	0.6	108	2	B	13.4	2	B	19	2	B	39	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 1 (cont)

Soil Sample Analysis

Sample	MDL	CO-NCC/LGG02-SS22			CO-NCC/LGG02-SS34			CO-NCC/LGG02-SS31			CO-NCC/LGG02-SS32		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Silver	0.2	2.38	1		3.2	1		4.6	1		5.31	1	
Arsnic	0.6	17	3		36.9	3		30.2	3		38	3	
Aluminum	6	3920	18		2910	18		2390	18		2370	18	
Calcium	20	329	60		398	60		510	60		408	60	
Cadmium	0.1	< .1	0.5	u	< .1	0.5	u	< .1	0.5	u	< .1	0.5	u
Chromium	0.4	5.42	2		2.68	2		2.52	2		1.2	2	J
Copper	0.4	66.2	2		75.8	2		310	2		102	2	
Iron	8	24600	24		38600	24		27000	24		26500	24	
Potassium	20	3380	60		2880	60		3190	60		3180	60	
Magnesium	8	671	24		591	24		367	24		385	24	
Manganese	0.2	63.3	0.8		47.8	0.8		55.7	0.8		35.5	0.8	
Lead	0.4	474	2		166	2		326	2		214	2	
Zinic	0.6	63	2	B	114	2	B	65.6	2	B	38.5	2	B

MDl = method detection limit RL = reporting limit units = mg/kg

B = analyte detected in method blank J = estimate u = non detect less than MDL

Table 2

Water Leachate Sample Analysis

Sample ug/l	MDL	CO-NCC/CHG02-SS11			CO-NCC/CHG02-SS10			CO-NCC/CHG02-SS11dup			CO-NCC/CHG02-SS09		
Date Collected		**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**
Aluminum	30	< 30	90	u	< 30	90	u	< 30	90	u	5440	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	7.8	15	J
Cadmium	0.5	66.1	2.5		1620	2.5		83.7	2.5		83.7	2.5	
Calcium	100	190000	300		90500	300		168000	300		50800	300	
Chromium	2	< 2	10	u	2.1	10	J	< 2	10	u	3.2	10	J
Copper	2	2.5	10	J	81.5	10		< 2	10	u	63.3	10	
Iron	40	< 40	120	u	< 40	120	u	< 40	120	u	243	120	
Lead	2	< 2	10	u	71.7	10		< 2	10	u	307	10	
Magnesium	40	54100	120		60100	120		51100	120		30700	120	
Manganese	1	2540	4		23800	40		3880	4		24200	20	
Potassium	100	4490	300		5460	300		4230	300		1950	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	7640	20		221000	100		10800	20		15300	50	
Conductivity umho/cm		1310			1720			1340			831		
pH		6.71			6.34			6.57			4.79		
Acid Concentration mole/l		1.95×10^{-7}			4.57×10^{-7}			2.69×10^{-7}			1.62×10^{-5}		
Acidity mg/l		95			550			32			84		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SD01			CO-NCC/CHG02-SD02			CO-NCC/CHG02-SS07			CO-NCC/CHG02-SS06		
Date Collected		**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**	**09/09/02**	**RL**	**Qual**
Aluminum	30	735	90		1880	90		< 30	90	u	80400	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	29.4	15	
Cadmium	0.5	< .5	2.5	u	< .5	2.5	u	3.08	2.5		155	2.5	
Calcium	100	2620	300		12500	300		74400	300		210000	300	
Chromium	2	< 2	10	u	3.2	10	J	< 2	10	u	153	10	
Copper	2	< 2	10	u	4.9	10	J	< 2	10	u	717	10	
Iron	40	820	120		1690	120		< 40	120	u	168000	120	
Lead	2	5.4	10	J	13.6	10		< 2	10	u	1370	10	
Magnesium	40	760	120		2910	120		40900	120		22400	120	
Manganese	1	27.1	4		23.5	4		252	4		18000	20	
Potassium	100	741	300		741	300		2420	300		1550	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	105	10		98.9	10		44	10		31500	50	
Conductivity umho/cm		49.1			132			820			3490		
pH		7.25			7.5			7.84			2.45		
Acid Concentration mole/l		5.62×10^{-8}			3.16×10^{-8}			1.45×10^{-8}			3.55×10^{-3}		
Acidity mg/l		<20			<20			<20			1630		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS04			CO-NCC/CHG02-SS16			CO-NCC/CHG02-SS15			CO-NCC/CHG02-SS02		
Date Collected		**09/10/02**	**RL**	**Qual**	**09/10/02**	**RL**	**Qual**	**09/10/02**	**RL**	**Qual**	**09/10/02**	**RL**	**Qual**
Aluminum	30	< 30	90	u	812	90		< 30	90	u	< 30	90	u
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	< 3	15	u
Cadmium	0.5	0.7	2.5	J	63	2.5		5.78	2.5		128	2.5	
Calcium	100	4570	300		14700	300		38000	300		23800	300	
Chromium	2	< 2	10	u	< 2	10	u	< 2	10	u	< 2	10	u
Copper	2	< 2	10	u	180	10		< 2	10	u	6.7	10	J
Iron	40	94	120	J	< 40	120	u	43	120	J	56	120	J
Lead	2	2.4	10	J	1460	10		< 2	10	u	29.3	10	
Magnesium	40	2500	120		2540	120		8070	120		10200	120	
Manganese	1	782	4		2270	4		1410	4		4490	4	
Potassium	100	1290	300		7000	300		2520	300		5060	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	52.6	10		11400	20		1180	10		16600	30	
Conductivity umho/cm		104			312			349			355		
pH		6.64			4.03			6.5			6.05		
Acid Concentration mole/l		2.30×10^{-7}			9.33×10^{-5}			3.16×10^{-7}			8.91×10^{-7}		
Acidity mg/l		<20			47			<20			41		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS08			CO-NCC/CHG02-SS08 dup			CO-NCC/CHG02-SD03			CO-NCC/CHG02-SS14		
Date Collected		**09/10/02**	**RL**	**Qual**	**09/10/02**	**RL**	**Qual**	**09/10/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Aluminum	30	166	90		132	90		3210	90		2390	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15		< 3	15	u
Cadmium	0.5	1.7	2.5	J	2.54	2.5		< .5	2.5		29.7	2.5	
Calcium	100	6110	300		6720	300		7060	300		80000	300	
Chromium	2	< 2	10	u	< 2	10	u	4.9	10		< 2	10	u
Copper	2	2.1	10	J	2.3	10	J	8.7	10		69.4	10	
Iron	40	406	120		217	120		2680	120		< 40	120	u
Lead	2	6.5	10	J	2.8	10	J	24.1	10		29.9	10	
Magnesium	40	2040	120		2220	120		2150	120		13000	120	
Manganese	1	851	4		968	4		52.6	4		6630	8	
Potassium	100	4130	300		3950	300		782	300		3630	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5		< 1	5	u
Zinc	3	379	10		537	10		106	10		8040	20	
Conductivity umho/cm		125			126			89.1			706		
pH		6.69			6.66			7.31			6.21		
Acid Concentration mole/l		2.04×10^{-7}			2.19×10^{-7}			4.99×10^{-8}			6.17×10^{-7}		
Acidity mg/l		<20			<20			<20			46		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SD04			CO-NCC/CHG02-SS03			CO-NCC/CHG02-SS13			CO-NCC/CHG02-SS20		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Aluminum	30	66	90	J	1270	90		22300	90		41200	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	5.3	15	J
Cadmium	0.5	30.7	2.5		< .5	2.5	u	59	2.5		925	2.5	
Calcium	100	19600	300		1150	300		39900	300		280000	300	
Chromium	2	< 2	10	u	< 2	10	u	3.5	10	J	13.1	10	
Copper	2	< 2	10	u	8.2	10	J	669	10		1040	10	
Iron	40	368	120		2850	120		1040	120		3590	120	
Lead	2	16.4	10		117	10		14.6	10		399	10	
Magnesium	40	4010	120		239	120		12900	120		79500	120	
Manganese	1	3190	4		43	4		14100	12		42300	20	
Potassium	100	1970	300		1610	300		2310	300		1540	300	
Silver	1	< 1	5	u	1.4	5	J	< 1	5	u	< 1	5	u
Zinc	3	6040	20		52.9	10		12700	30		87100	50	
Conductivity umho/cm		226			47.1			1090			3260		
pH		6.39			6.8			2.91			3.16		
Acid Concentration mole/l		4.07×10^{-7}			1.59×10^{-7}			1.23×10^{-3}			7.24×10^{-7}		
Acidity mg/l		22			<20			245			337		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS21			CO-NCC/LGG02-SS25			CO-NCC/LGG02-SS26			CO-NCC/LGG02-SS26 dup		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**	**09/11/02**	**RL**	**Qual**
Aluminum	30	58	90	J	5430	90		1150	90		1140	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	< 3	15	u
Cadmium	0.5	0.86	2.5	J	88.5	2.5		11.2	2.5		11.6	2.5	
Calcium	100	13600	300		78900	300		15300	300		15300	300	
Chromium	2	< 2	10	u	2.2	10	J	< 2	10	u	< 2	10	u
Copper	2	< 2	10	u	1800	10		115	10		118	10	
Iron	40	373	120		110	120	J	< 40	120	u	< 40	120	u
Lead	2	10	10		14.2	10		< 2	10	u	2.8	10	J
Magnesium	40	1180	120		37400	120		4930	120		5250	120	
Manganese	1	509	4		29400	20		4660	4		4920	4	
Potassium	100	2730	300		1920	300		2340	300		2350	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	253	10		9640	50		2140	10		2250	10	
Conductivity umho/cm		151			989			244			247		
pH		6.74			3.57			4.44			4.33		
Acid Concentration mole/l		1.82×10^{-7}			2.69×10^{-4}			3.63×10^{-5}			4.68×10^{-5}		
Acidity mg/l		<20			100			24			31		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/CHG02-SS05			CO-NCC/CHG02-SD04 dup			CO-NCC/CHG02-SS18			CO-NCC/LGG02-SS27		
Date Collected		**09/11/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**
Aluminum	30	3580	90		< 30	90	u	1290	90		82200	90	
Arsenic	3	< 3	15	u	< 3	15	u	6.4	15	J	369	15	
Cadmium	0.5	< .5	2.5	u	33.6	2.5		< .5	2.5	u	< .5	2.5	u
Calcium	100	821	300		20400	300		2370	300		21100	300	
Chromium	2	15.2	10		< 2	10	u	< 2	10	u	50.8	10	
Copper	2	45.2	10		< 2	10	u	6.3	10	J	12300	30	
Iron	40	2970	120		257	120		3610	120		328000	360	
Lead	2	33.8	10		9.3	10	J	199	10		< 2	10	u
Magnesium	40	386	120		4190	120		415	120		14900	120	
Manganese	1	34.3	4		3200	4		163	4		1780	4	
Potassium	100	1000	300		1830	300		1160	300		1540	300	
Silver	1	1.6	5	J	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	117	10		6220	20		61.6	10		2400	10	
Conductivity umho/cm		36.8			233			53.5			2710		
pH		6.95			6.29			6.75			2.35		
Acid Concentration mole/l		1.12×10^{-7}			5.13×10^{-7}			1.78×10^{-7}			4.47×10^{-3}		
Acidity mg/l		<20			26			<20			1270		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/LGG02-SS33			CO-NCC/LGG02-SS37			CO-NCC/LGG02-SS37dup			CO-NCC/LGG02-SS36		
Date Collected		**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**
Aluminum	30	54900	90		35600	90		37100	90		6580	90	
Arsenic	3	< 3	15	u	< 3	15	u	< 3	15	u	< 3	15	u
Cadmium	0.5	14.2	2.5		1.1	2.5	J	1	2.5	J	7.08	2.5	
Calcium	100	66600	300		17500	300		19500	300		28800	300	
Chromium	2	48.6	10		24.9	10		26.3	10		3.4	10	J
Copper	2	2280	10		9960	30		10100	30		2420	10	
Iron	40	35800	120		42900	120		48500	120		1430	120	
Lead	2	22.7	10		< 2	10	u	9.6	10	J	< 2	10	u
Magnesium	40	16600	120		5480	120		5800	120		3290	120	
Manganese	1	8230	8		921	4		967	4		759	4	
Potassium	100	1720	300		2000	300		2040	300		1370	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	3230	10		1190	10		1210	10		1620	10	
Conductivity umho/cm		1730			1610			1730			581		
pH		2.66			2.48			2.41			3.04		
Acid Concentration mole/l		2.19×10^{-3}			3.31×10^{-3}			3.89×10^{-3}			9.12×10^{-4}		
Acidity mg/l		616			512			551			100		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL

Table 2 (cont)

Water Leachate Sample Analysis

Sample	MDL	CO-NCC/LGG02-SS22			CO-NCC/LGG02-SS34			CO-NCC/LGG02-SS31			CO-NCC/LGG02-SS32		
Date Collected		**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**	**09/12/02**	**RL**	**Qual**
Aluminum	30	43300	90		75100	90		106000	90		154000	90	
Arsenic	3	< 3	15	u	92.1	15		265	15		2380	15	
Cadmium	0.5	13.8	2.5		< .5	2.5	u	< .5	2.5	u	6.59	2.5	
Calcium	100	60500	300		67400	300		61300	300		36300	300	
Chromium	2	31.8	10		39.3	10		57.2	10		70.4	10	
Copper	2	2120	10		3180	10		14900	50		10800	100	
Iron	40	56200	120		422000	360		592000	600		1140000	1200	
Lead	2	82.9	10		30	10		< 2	10	u	67.6	10	
Magnesium	40	12400	120		14500	120		20000	120		20500	120	
Manganese	1	3190	4		2770	4		7290	20		6370	40	
Potassium	100	1710	300		1530	300		1240	300		1520	300	
Silver	1	< 1	5	u	< 1	5	u	< 1	5	u	< 1	5	u
Zinc	3	3610	10		2970	10		3850	10		6510	100	
Conductivity umho/cm		1930			3020			3520			5040		
pH		2.4			2.21			2.25			2.6		
Acid Concentration mole/l		3.98×10^{-3}			6.17×10^{-3}			5.62×10^{-3}			2.51×10^{-3}		
Acidity mg/l		587			1790			2690			5030		

MDL = method detection limit RL = reporting limit

B = analyte detedted in method blank J = estimate u = nondetect less than MDL