



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8

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Ref: 8EPR-ER

JUN 30 2017

ACTION MEMORANDUM – Joint EPA and USDA – Forest Service

SUBJECT: Documentation of a Time-Critical Removal Action at the Carribeau Mine Area within the Iron Springs Mining District Site in the Grand Mesa Uncompahgre National Forest, near Ophir, San Miguel County, Colorado

FROM: Hays Griswold and Joni Sandoval, On-Scene Coordinators
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THRU: Laura Williams, Unit Leader
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Scott Armentrout, Forest Supervisor
Grand Mesa Uncompahgre and Gunnison National Forests, Rocky Mountain Region

David Ostrander, Director
Emergency Response and Preparedness Program

TO: Betsy Smidinger, Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

Mary DeAgüero, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Site ID: A808

I. PURPOSE

The purpose of this Action Memorandum is to request and document approval of the removal action described herein at the Carribeau Mine Area (Carribeau), located within the Iron Springs Mining District Site in the San Juan Mountains of southwestern Colorado.

This time-critical removal action will mitigate threats posed by mine waste and tailings on private property and property under the jurisdiction of the U.S. Forest Service (USFS) located within one mile of the Town of Ophir, Colorado. Carribeau encompasses approximately 20 acres of wetlands and adjacent upland shorelines.

This removal is a joint action between the Environmental Protection Agency (EPA) and the USFS. The vast majority of the Carribeau is on private land. However, the Carribeau Mine adit and a

relatively small amount of waste rock are on USFS managed land. EPA will not do any work on USFS property that would disturb waste rock or the adit's natural blockage (caused by a cave-in). The only action planned on USFS property is the construction of a concrete block retaining wall adjacent to the stream coming from the adit, designed to ensure the stream remains in its current channel in the event of adit blockage failure. This measure protects the 2001 remedy conducted by USFS to divert the Carribeau adit drainage away from the waste rock pile. Otherwise, in the event the current blockage fails, the resulting flow could potentially overwhelm the shallow stream bed, destroy the repository and wash tailings down the Howard Fork River (Attachment 9). Conditions existing at Carribeau present a threat to public health and the environment and meet the criteria for initiating a removal action under 40 CFR 300.415(b)(2) of the National Contingency Plan (NCP).

This removal action involves no nationally-significant or precedent-setting issues. This time-critical removal action will not establish any precedent for how future response actions will be taken and will not commit the EPA to a course of action that could have a significant impact on future responses or resources.

II. SITE CONDITIONS AND BACKGROUND

Site Name:	Carribeau Mine Area
Superfund Site ID	A808
NRC Case Number	
CERCLIS Number:	CON000802855
Site Location:	San Miguel County, Colorado
Lat/Long:	37.857258/-104.847337
Potentially Responsible Party:	
NPL Status:	Not on the NPL
Removal Start Date:	TBD – FY 2017/3 rd Quarter

A. Site Description

1. Removal Site Evaluation

Carribeau is located within the Iron Springs Mining District Site (EPA SSID 08-QM) which is located in southwestern Colorado in San Miguel County. The Iron Springs Mining District Site includes national forest lands, the Town of Ophir and other privately owned lands, including the North Star Mill, the historic areas of the Old Dominion Mine, Montezuma Mine, Silver Bell Mine and Mill, as well as the Carribeau Mine. EPA and the USFS conducted removal actions at the North Star Mill and associated Carbonero tailings in 2009 and 2006, respectively.

Ophir was established in 1878 by prospectors exploring the Iron Springs region. Between 1878 and 1897, prospectors began staking claims and developing the various mines throughout the Iron Springs Mining District. The ore from the claims yielded gold, silver, copper, lead, zinc and tungsten. Although several veins were prospected near Ophir, and annual production was generally increasing, no mines produced large quantities of ore until the railroad reached the Ophir area about 1890. By 1947 many of the largest mines and mills in the district had fallen into disrepair.

The Carribeau Mine, in conjunction with the Montezuma Mine, produced ore, mostly silver and lead, almost every year from 1878 to 1936. The underground workings for the Montezuma Mine eventually connected to the Carribeau Mine workings. Peak years of production occurred in the late 1880s and early 1890s, and about 1899 to 1908.

Initially, the Carribeau Mine was worked through a tunnel and shaft above the 13th level. A lower access tunnel was eventually driven to intersect the ore zone at depth and possibly to drain the upper workings. The 13th level crosscut was apparently completed by about 1895. A mill was built near the adit of the 13th level in 1896 or 1897 and was removed in 1917. The main adit of the Carribeau Mine, located at the 13th level, is completely caved. The adit is located on USFS land just a few feet south of the boundary with private property. Mine water discharges from the rubble approximately 40 feet above the original adit entrance. It is unknown if there is water built up behind the cave-in, exerting pressure on the blockage. The discharge originally flowed over and down the waste rock pile and through the tailings pile eroding tailings into the Howard Fork River. Attachments 8 and 9 are sketch maps of these aforementioned features taken from a 2001 Colorado Geological Survey Open File Report entitled *History, Geology and Environmental Setting of Selected Mines Near Ophir, Uncompahgre National Forest, San Miguel County, Colorado*. Now, through efforts of the USFS in creating a diversion, the discharge flows through a shallow trench across the bench top of the waste rock dump and then into a ripped, run-down trench approximately three-feet wide (Attachment 9). The trench diverts the water along the eastern edge of the waste rock pile and eventually discharges into a beaver pond at the toe of the dump. This trench is adequate to carry the current water flows; however, should there be a sudden and large release of water from the adit, the trench would be quickly overwhelmed and the water would return to its previous course washing down through the waste rock and tailings below. This removal action proposes a protective measure to alleviate this potential problem which will be detailed later.

Carribeau contains approximately 24,000 cubic yards of tailings, ranging in depth from one to five feet, which are exposed at the surface throughout the private property and along the vertically cut riverbank in several areas of Howard Fork, a tributary of the San Miguel River (Attachment 1). Exposed tailings are sloughing into the river and, significant metals loading from surface water run-off through the tailings has been documented. Given the proximity of shallow groundwater and natural drainages, metals loading related to groundwater flow is also expected.

The mine tailings are not well vegetated, and drainage patterns indicate that erosion is occurring into Howard Fork during and after precipitation and snowmelt events. The tailings and waste rock are mineralized, contribute to acidification, and are heavily loaded with iron and other heavy metals (Attachment 3). The Carribeau Mine adit discharges over the bench of the waste rock, as mentioned, and into a USFS constructed ripped conveyance and into the beaver pond which serves as a settling basin where metals-laden sludges (mostly iron) build up before overflowing into the nearby Howard Fork.

The total estimated volume (Table 1.1) of the mill tailings and waste rock at the Carribeau is approximately 30,800 cubic yards (cy). Approximately 24,000 cy of the total volume are comprised of mill tailings, and 6,800 cy are waste rock. An EPA contractor in a June 2011 investigation used a GPS unit to estimate the lateral extent of the mill tailings and waste rock. During the same investigation, an inspection of the drill cuttings from 37 boreholes was used to determine the vertical extent of the mill tailings and waste rock. The field data were plotted on the digitized topographic map of the area and volumes were estimated with the assistance of GIS software. The lateral and vertical extent of those areas is shown in Attachments 4 and 5.

Table 1.1

Waste Rock/Tailings Locations	Waste Rock/Tailings Volumes (cy)
Main waste rock pile - located below main adit	6,800
Tailings - running west from the waste rock pile	24,000
Total waste rock and tailings	30,800

The large waste rock pile located at the mine adit consists of three segments. The eastern lobe appears to be relatively un-mineralized and was probably deposited during the excavation of the crosscut adit. The center lobe is about 45 feet high and toed into the mill ruins; it was likely used during the production phase of mining. The western lobe consists of an inclined bench or road that leads to the adit. This road or bench appears to be on a combination of colluvium and waste rock (Attachment 8).

A large tailings deposit is dispersed on private property west of the waste rock pile and runs east-west through the valley between the mountain slope and Howard Fork. The tailings range from 1.5 to 5 feet deep averaging 33 inches in depth. An avalanche shoot is visible up-gradient/adjacent to the tailings deposit and Howard Fork. Recent avalanches have occurred above the tailings making the waste rock more vulnerable to migration into Howard Fork.

2. Physical Location

The Iron Springs Mining District Site is located in San Miguel County, Colorado. It includes the Town of Ophir, a portion of Howard Fork River, surrounding national forest lands, and other privately owned lands. The 2010 U.S. Census lists the population of Ophir at 159.

Carribeau is located within the Iron Springs Mining District Site and is situated less than one mile west/southwest of Ophir in San Miguel County, Colorado. It is within Sections 34 and 35, Township 42 North, Range 9 West of the New Mexico Meridian, and Sections 2 and 3, Township 41 North, Range 9 West of the New Mexico Meridian. It is located in the Grand Mesa Uncompahgre National Forest near Ophir in the San Juan Mountains of southwestern Colorado (Attachment 1).

The main adit of the Carribeau Mine is about ½ mile west of Ophir and is easily visible from Ophir Pass Road. Ophir is upstream of the mine. The mine is on the south side of

Howard Fork and is only accessible by vehicles when the stream is low enough to ford but can be accessed via a private property driveway and footbridge. The upper workings of the mine are difficult to access because of dense vegetation on this steep, north-facing mountain slope.

3. Site Characteristics

The Iron Springs Mining District surrounding the Carribeau Site geology includes Ophir stock and several smaller felsic to intermediate composition stocks and plugs (URS Report). Most mines were developed along the east to northeast trending silver-rich, base-metal veins (URS Report). Howard Fork flows west through a glacially eroded valley and joins the South Fork of the San Miguel River in the Illium Valley (URS Report, quoting CDPHE 1996).

The topography of the Carribeau Site consists of a narrow glaciated valley flanked by steep mountainsides. Elevations in the vicinity of the mine range from about 9,500 to 11,500 feet. Forest Road 640 (Ophir Pass Road) parallels Howard Fork and provides general access to the Ophir Mining District.

4. Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant or Contaminant

Based on sampling results as related to the EPA Regional Screening Levels (levels requiring mitigating action) illustrated in detail in Attachment 6, the metals concentrations in solid mining waste (the tailings pile) at the mine/mill present a serious human health threat. Residents use the immediate property, and long term (seasonal) camping spots on the Carribeau Site are rented out periodically. Lead and arsenic present the greatest risk to humans at the Carribeau. The levels of lead concentrations, ranging from 710 to 5,500 mg/kg, exceed screening levels for acceptable human health risk (Attachment 10). Antimony presents a moderate risk to humans at the Carribeau.

Wildlife are threatened at the Carribeau as well. Arsenic, with concentrations ranging from 160 to 1,500 mg/kg, as well as, copper, lead and zinc are all present in tailings and waste rock at levels above the EPA Ecological Soil Screening levels for large and small mammals and birds. Lead is present in the highest concentrations and exceeds the mammal and bird screening levels.

The water sampling results indicate exceedances of either acute and/or chronic aquatic life criteria for cadmium, iron and lead. Copper is also above standards for acute exposure in surface water samples taken at the Carribeau. All samples exceed trout chronic exposure criteria for silver.

Lead

The tailings pile is on the privately owned property. The owner of the property rents out spaces on this private property portion of the Carribeau Site as long-term camping sites. The campers typically have children that play in the sand-like tailings (this has been

observed by many EPA personnel over the last several years). Therefore, there is a distinct potential for humans to come into direct contact with toxic metals contamination in the tailings. Lead is classified as a B2 carcinogen by EPA, and lead compounds are known to cause acute health effects. Lead can enter the body via ingestion and inhalation. Children appear to be the segment of the population at greatest risk from the toxic effects of lead. Initially, lead travels in the blood to the soft tissues (heart, liver, kidney, brain, etc.). Then, it gradually redistributes to the bones and teeth where it tends to remain. Children exposed to high levels of lead have exhibited nerve damage, permanent mental retardation, colic, anemia, brain damage and death. Lead is a hazardous substance as defined by Section 101(14) of CERCLA.

Arsenic

Arsenic is a confirmed human carcinogen, producing tumors in the liver and renal system. It is also poisonous by subcutaneous, intramuscular and intraperitoneal routes. At lower doses, ingestion will induce adverse systemic skin and gastrointestinal effects. It is also classified as an experimental teratogen (potentially causing birth defects). Large doses of arsenic may be acutely fatal. Symptoms include fever, loss of appetite, enlarged liver and heart rhythm abnormalities. Sensory loss in the peripheral nervous system may also occur. Chronic exposure to arsenic generally results in skin lesions, liver injury and peripheral vascular disease. Peripheral vascular disease may progress to endarteritis obliterans and gangrene of the lower extremities (blackfoot disease). Arsenic is a human carcinogen based on observation of increased lung cancer mortality due to inhalation exposure and increased skin cancer in individuals exposed to arsenic via drinking water. Arsenic is a hazardous substance as defined by Section 101(14) of CERCLA.

5. NPL Status

The Carribeau Site is neither on nor currently being considered for inclusion on the Superfund National Priorities List (NPL).

6. Maps, Pictures, Other Geographic Representation

A map of the Carribeau Site is included as Attachment 1.

B. Other Actions to Date

1. Previous Actions

Beginning in 1976 several environmental studies were conducted within the Iron Springs Mining District and Howard Fork River Watershed. These studies are listed here for information purposes regarding other activities conducted in the watershed and mining district:

- Woodling (1976) reports limited populations of benthic fauna and fish in Howard Fork because of poor water quality (Neubert, 2001).

- Colorado Division of Minerals and Geology (CDMG) now Colorado Division of Reclamation, Mining, and Safety (DRMS) conducted an inventory of abandoned mines in 1980.
- In 1994, CDMG (now DRMS) conducted high flow (June) and low flow (November) sampling. Cadmium, copper, iron, lead, manganese and zinc were analyzed for total recoverable and dissolved concentrations. The report concluded that, in the main stem of Howard Fork, the metal concentrations increase as flow rate decreases. Despite the lower concentrations, metal loads in June were significantly higher because flow rates were four to six times greater than the November flow rates.
- The Colorado Department of Public Health and the Environment (CDPHE) began a series of environmental studies focusing on Howard Fork that culminated in a Site Investigation conducted in 1998. The study concluded that the major sources of metals in Howard Fork above Ophir Loop were the Carbonero Mine, Carbonero tailings and Carribeau Mine. With respect to the Carribeau, the CDPHE 1999 report concluded that there was a moderate increase in total aluminum, copper, iron, lead, manganese and zinc concentrations between two samples collected on Howard Fork above and below the Carribeau Mine complex.
- In 2000, the Colorado Geological Survey expanded the Iron Springs District Site inventory to include the Carribeau Mine and Carbonero tailings and included the collection of surface water, waste rock and tailings samples. The Colorado Geological Survey reported that the chemical analysis of the waste rock samples showed that the waste rock was potentially acid generating. The Survey also reported that several toxic metals are present in the samples including arsenic, chromium, copper, lead, nickel and zinc. Concentrations of lead were identified to be as high as 6,000 mg/kg in the mine water discharge samples.
- In 2001, the USFS conducted a time-critical removal action that diverted the water coming from the Carribeau adit that had been going through the waste rock pile to a new channel across the bench and down the east side of the pile and into a beaver pond.
- In 2009, the EPA conducted a time-critical removal action that consolidated contaminated materials from the North Star Mill upper tailings pile, lower mill tailings pile, and adjacent waste rock into a repository that was then capped and re-vegetated.
- In 2010, the USFS conducted a non-time critical removal action to address those tailings that had been transported via wooden flume from the North Star Mill (from the Carbonero Mine) to the valley floor. The USFS removal action consisted of pulling tailings from the 100-year flood plain, consolidating them in a repository, and capping the tailings with a geotechnical and rock barrier.
- CDMG (DRMS), among other mines, included information found from an investigation of the Carribeau Mine in Open File Report OF-02-13.
- The USFS commissioned an Engineering Evaluation /Cost Analysis (EE/CA) investigation and report on the Carribeau which was issued on August 1, 2002. The USFS contractor sampled in October of 2001 to collect information on the areal extent and the depth of the mine waste at the Carribeau Mine (Attachments 4 and 5). The waste volumes reported in that document are used for volume and

cost estimates in this proposed removal action. The document reported lead and barium at the highest concentrations (greater than 1,000 mg/kg) of the metals analyzed. Arsenic, silver, copper, antimony and manganese were also reported in high concentrations (100-1,000 mg/kg). Beryllium, cadmium, chromium, nickel, selenium, and mercury were reported in relatively low concentrations (<5 mg/kg).

- EPA conducted a Removal Assessment Site Evaluation of the Carribeau Mill Tailings Site (report dated March 29, 2012). The Analytical Results Report documents the work performed. In addition, EPA's data correlates well with the waste volumes and analytical information included in the CDMG and USFS reports regarding the characterization and delineation of mine waste at the Carribeau.

From 2007 forward, the EPA, USFS, CDPHE, Colorado Division of Reclamation Mining and Safety (DRMS), and local stakeholders have been coordinating and conducting surface water sampling throughout the watershed in order to assess baseline conditions and evaluate potential impacts from multiple sources in the Ophir valley. These actions are not directly related to the Carribeau Mine. However, once the potential impacts to the watershed are understood, cleanup of the multiple sources could be prioritized to achieve the greatest impact using focused activities, dependent upon various different factors. The Carribeau is a top priority.

EPA has conducted several Carribeau Site visits to assess any changes in conditions. The last Carribeau Site visit was conducted on September 25, 2015. As one of the four primary sources of metals in the Howard Fork, the Carribeau Mine waste rock and tailings are prioritized as a time-critical removal action.

No previous EPA removal actions have been conducted at the Carribeau Site.

2. Current Actions

There are no current removal actions at the Carribeau Site.

C. State and Local Authorities' Role

1. State and Local Actions to Date

Significant efforts have been made by various state and local stakeholders to determine the quantity and quality of water (for potential hydropower) at the Carribeau Site, in the Howard Fork and the San Miguel rivers, as well as to explore effective methods to reduce the discharge of metals from the Carribeau Site. These stakeholders include USFS, the Bureau of Land Management and DRMS.

2. Potential for Continued State/Local Response

Neither the state nor local authorities have the resources or authority to conduct a response action at this time. EPA will continue to coordinate with state and local representatives and keep them apprised of all activities related to this removal action.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

Conditions at the Carribeau Site present a threat to public health and the environment, and meet the criteria for initiating a removal action under 40 CFR 300.415(b) (2) of the NCP.

Pursuant to 40 CFR 302.4, the heavy metals found at the Carribeau Site are listed as hazardous substances and have been reported at levels that, according to multiple metals toxicity guidance documents, present a direct threat to public health and the environment. Exposure to these metals could lead to both acute and chronic health effects in both humans and wildlife. Because of the unstable conditions and toxicity of the contaminants, the reports conclude there is a threat to public health and welfare and meet the criteria for initiating a removal action under 40 CFR §300.415(b)(2) of the NCP.

EPA has considered all the factors described in 40 CFR 300.415(b)(2) of the NCP and determined that the following factors apply at the Carribeau Site.

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;

The toxic metals in the tailings present an actual and potential exposure to humans residing or camping at the Carribeau Site. Potential pathways of human and animal exposure to contaminants include ingestion of the fine tailings while walking or during play and/or inhalation of airborne dust from the on-site mine waste dump.

(iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;

Soil concentrations of greater than 1,000 mg/kg lead and 1,000 mg/kg arsenic were reported in the Carribeau Site. Overland flow that develops during snowmelt and rainfall or avalanche events entrains contaminated soils from exposed waste piles and deposits them as sediment into Howard Fork. The mine water discharge had concentrations of lead as high as 6,000 mg/kg. In addition, water, oxygen and bacteria chemically and biologically react with the sulfide metals in the tailings forming acid mine drainage (AMD) which leaches the toxic metals out of the tailings into solution releasing them into the watershed.

(v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released;

Seasonal flooding is a regular occurrence in this high alpine environment from intense summer rain storms, rapid springtime snowmelt or a combination of the two. This contributes to increased migration of the toxic metals in the tailings across the Carribeau as well as into Howard Fork. These conditions also contribute to the formation of AMD as mentioned above and release the toxic metals into the watershed.

(vii) The availability of other appropriate federal or state response mechanisms to respond to the release;

There are no other federal or state mechanisms that are available to respond to the release.

IV. ENDANGERMENT DETERMINATION

Exposure to the heavy metals associated with tailings and waste rock have a detrimental effect on both human health and ecosystems. While elevated concentrations of some heavy metals occur naturally in certain areas, the Carribeau Site contains metals concentrations substantially greater than conditions found in natural settings. In addition, the mine wastes are highly mobile due to their homogenous, fine-grained character and location of the deposition on the ground surface directly adjacent to Howard Fork. The actual or threatened releases of these hazardous substances from the Carribeau Site, if not addressed by implementing the response action described in this Action Memorandum, may present an imminent and substantial endangerment to public health, welfare or the environment.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. Proposed Actions

1. Proposed Action Description

The following removal actions are proposed to reduce the potential of human exposure to lead and arsenic from contaminated Carribeau Site mine wastes and to mitigate the ongoing significant metals-loading to Howard Fork, a tributary of the San Miguel River, to mitigate environmental impacts.

The removal action will be conducted by EPA in cooperation with the USFS. Funds obtained by EPA and the USFS in a settlement agreement will be used to fund this removal action.

The removal action proposed will be a total source removal and encapsulation. The tailings are very distinct from surrounding soils and easily identified. The tailings exhibit the typical characteristics of tailings from a stamp mill that operated until it was replaced with a ball mill in 1917. The bulk of the tailings came from the 20 stamp mill. The tailings are a bright yellow color, homogenous and very fine grained throughout (Attachment 11). They were conveyed in a slurry by wooden flumes and were spread out into the flats next to the river. The tailings filled the low areas of the flats where they now sit with depths ranging from zero to five feet thick. No vegetation grows on the tailings (Attachment 12). It will be very easy to identify and excavate all of the tailings, leaving clean native soils. New clean soil will replace the removed tailings to maintain original grade and contours for drainage.

Discrete tasks include, but are not limited to:

- Build an on-site repository. The location of the repository will be at the south central/southeast end of the Carribeau Site. The design includes a combination of 3:1 side slopes and/or riprap, a soil cap, and vegetated cover. Approximately 19,000 cubic yards of soil will be excavated from the toe of the mountain to

construct the repository. The excavated soil will be used to construct a cover over the consolidated tailings and waste rock. An additional 10,000 cubic yards of clean soil may need to be imported to complete the cover.

- Excavation and consolidation of approximately 24,000 cubic yards of tailings and 6,800 cubic yards of waste rock. See Attachment 11 for an illustration of the aerial extent of the tailings.
- Placement of tailings and waste rock in the on-site repository, and construction of a suitable cover. An environmental covenant for the on-site repository with the property owner will be negotiated as a post removal site control.
- The USFS constructed channel that conveys the water flow from the adit to the beaver pond will be enlarged and armored with grouted riprap. This will be done as one element of the protective measures explained below.
- If the adit located at the Carribeau Site failed, the adit blockage could destroy the repository and carry large amounts of contaminated tailings into the Howard Fork. To protect the repository from such an event, a wall of large concrete blocks will be constructed along the west side of the channel on the bench that conveys the water from the adit to the armored channel (shown on Attachment 9). This will ensure the water will stay in its present course on the way to the beaver pond and will not seek its old course down the dump destroying the repository.
- Another protective measure will entail the construction of a six-foot high dike along and adjacent to the beaver dam of the beaver pond (shown on Attachment 9). This dike is not a dam for the purpose of containing the water of the beaver pond. The beaver dam will continue to function for that purpose. The dike is a secondary containment measure for the purpose of containing a large surge of water in the event of a catastrophic failure of the adit blockage. The dam will contain the surge of water and allow it to back up into the wetlands to the east. The wetlands would act as a surge containment feature. In addition, it would protect the clean soil ground cover that replaced and/or covered the tailings.
- Restoration to include revegetation of the excavated area to protect against erosion, repair and restoration of excavated areas.
- Installation of a bridge to provide access to the Carribeau Site.

As mentioned previously mine waste and tailings at the Carribeau Site are visually very apparent and distinct from surrounding soil. They have a distinct yellow-orange color, lack organic material, are homogenous, and are very fine in grain size. Accordingly, excavation of the wastes will be guided by visual cues. In some rare cases, the geology and topography of the Carribeau Site will be considered to determine depth of excavation. In some instances, excavation may be limited to approximately three feet in depth at the excavation face. However, no cleanup levels for lead or arsenic are proposed because the amount of clean fill that replaces the tailings will provide adequate protection of human health and the environment. With regard to the mine waste rock, excavations will cease if there is risk of de-stabilizing an existing slope.

2. Contribution to Remedial Performance

This effort will, to the extent practical, contribute to any future remedial effort at the Carribeau Site. However, no further federal action is anticipated at this time.

3. Engineering Evaluation/Cost Analysis (EE/CA)

This is a time-critical removal action; thus, an EE/CA is not required.

4. Applicable or Relevant and Appropriate Requirements (ARARs)

This time-critical removal action will attain, to the extent practicable, considering the exigencies of the situation, applicable or relevant and appropriate requirements. In determining whether compliance with an ARAR is practicable, the lead agency may consider appropriate factors, including the urgency of the situation and the scope of the removal action to be conducted. Identified ARARs are included as Attachment 7.

5. Project Schedule

The work is anticipated to begin in July 2017 and should be completed by July of 2018.

B. Estimated Costs*

Consolidate Tailings in Repository/Redirecting Adit Flow	\$1,337,000
Extramural Cost Contingency (20%)	\$ 267,400
Total Removal Action Project Ceiling	\$1,604,400

*EPA direct and indirect costs, although cost recoverable, do not count toward the Removal Ceiling for this removal action. Liable parties may be held financially responsible for costs incurred by the EPA as set forth in Section 107 of CERCLA.

VI. EXPECTED CHANGES IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

A delay in action or no action at the Carribeau Site would increase the actual or potential threats to the public health and/or the environment.

VII. OUTSTANDING POLICY ISSUES

None

VIII. ENFORCEMENT

A separate Enforcement Addendum has been prepared providing a confidential summary of current and potential future enforcement activities.

IX. RECOMMENDATION

This decision document represents the selected removal action for the Carribeau Mine Area within the Iron Springs Mining District Site in San Miguel County, Colorado, developed in accordance with CERCLA as amended, and is not inconsistent with the NCP. This decision is based on the administrative record for the Carribeau Site.

Conditions at the Carribeau Site meet the NCP Section 300.415(b) criteria for a removal action and I recommend your approval of the proposed removal action. The total project ceiling, if approved, will be \$1,604,400; of this amount, an estimated \$760,977 will be funded from EPA and USFS combined special account monies, \$350,000 from supplemental USFS funds, and \$493,423 from EPA Regional removal allowance.

Approve: Betsy Smidinger Date: 6/30/2017
Betsy Smidinger, Assistant Regional Administrator
EPA Office of Ecosystems Protection and Remediation

Disapprove: _____ Date: _____
Betsy Smidinger, Assistant Regional Administrator
EPA Office of Ecosystems Protection and Remediation

Approve: _____ Date: _____
Mary DeAgüero, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Disapprove: _____ Date: _____
Mary DeAgüero, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Concur: _____ Date: _____
Scott G. Armentrout, Forest Supervisor
USDA-Grand Mesa Uncompahgre and Gunnison National Forest

Concur: _____ Date: _____
Mathew Zumstein, Norwood District Ranger

USDA-Norwood Ranger District

Recommended: _____ Date: _____

Linda K. Lanham, On-Scene Coordinator
USDA-Grand Mesa Uncompahgre and Gunnison National Forests

- Attachments:**
- Attachment 1: Location Map of Carribeau Mine Site
 - Attachment 2: Waste Rock Sample Analysis
 - Attachment 3: Table of Analysis of Tailings and Waste Rock Samples.
 - Attachment 3a: Table of Analysis of Waste Rock Samples.
 - Attachment 4: Tailings Sample Location Map.
 - Attachment 5: Waste Rock Sample Location Map.
 - Attachment 6: Table of Soil Sample Results Compared to Screening Criteria.
 - Attachment 7: ARAR List.
 - Attachment 8: Sketch map from Colorado Geological Survey showing locations of waste rock dumps, benches, ponds, etc. prior to USFS diversion.
 - Attachment 9: Sketch map from Colorado Geological Survey showing locations of USFS diversion, proposed protective concrete block wall and dike.
 - Attachment 10: Inorganic Soil Sample Results.
 - Attachment 11: Areal View of Tailings Showing Distinct Characteristics.
 - Attachment 12: Picture of Tailings Showing Distinct Characteristics

VIII. ENFORCEMENT

A separate Enforcement Addendum has been prepared providing a confidential summary of current and potential future enforcement activities.

IX. RECOMMENDATION

This decision document represents the selected removal action for the Carribeau Mine Area within the Iron Springs Mining District Site in San Miguel County, Colorado, developed in accordance with CERCLA as amended, and is not inconsistent with the NCP. This decision is based on the administrative record for the Site.

Conditions at the Site meet the NCP Section 300.415(b) criteria for a removal action and I recommend your approval of the proposed removal action. The total project ceiling, if approved, will be \$1,604,400; of this amount, an estimated \$1,604,400 will be funded from EPA and USFS combined special account monies and the Regional removal allowance. The EPA special account money is \$403,300. The USFS special account money is \$357,677. Included is a potential for USFS supplemental monies of \$350,000. Also included is a potential for \$493,423 from the EPA regional advice of allowance.

Approve: _____ Date: _____
David A. Ostrander, Director
Emergency Response & Preparedness Program

Disapprove: _____ Date: _____
David A. Ostrander, Director
Emergency Response & Preparedness Program

Approve: Mary C DeAguiar Date: 5/4/16
Mary DeAguiro, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Disapprove: ~~_____~~ Date: _____
Mary DeAguiro, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Concur: Scott G. Armentrout Date: 4/14/2016
Scott G. Armentrout, Forest Supervisor
Grand Mesa Uncompahgre and Gunnison National Forest

Concur:  Date: 04/11/16
Mathew Zumstein, Norwood District Ranger
Norwood Ranger District

Recommended:  Date: 3/30/16
Linda K. Lanham, On-Scene Coordinator
Grand Mesa Uncompahgre and Gunnison National Forests

Attachments:

- Attachment 1: Location Map of Carriveau Mine Site
- Attachment 2: Waste Rock Sample Analysis
- Attachment 3: Table of Analysis of Tailings and Waste Rock Samples.
- Attachment 3a: Table of Analysis of Waste Rock Samples.
- Attachment 4: Tailings Sample Location Map.
- Attachment 5: Waste Rock Sample Location Map.
- Attachment 6: Table of Soil Sample Results Compared to Screening Criteria.
- Attachment 7: ARAR List.

This decision document represents the selected removal action for the Carribeau Mine Area within the Iron Springs Mining District Site in San Miguel County, Colorado, developed in accordance with CERCLA as amended, and is not inconsistent with the NCP. This decision is based on the administrative record for the Carribeau Site.

Conditions at the Carribeau Site meet the NCP Section 300.415(b) criteria for a removal action and I recommend your approval of the proposed removal action. The total project ceiling, if approved, will be \$1,604,400; of this amount, an estimated \$760,977 will be funded from EPA and USFS combined special account monies, \$350,000 from supplemental USFS funds, and \$493,423 from EPA Regional removal allowance.

Approve: _____ Date: _____
Betsy Smidinger, Assistant Regional Administrator
EPA Office of Ecosystems Protection and Remediation

Disapprove: _____ Date: _____
Betsy Smidinger, Assistant Regional Administrator
EPA Office of Ecosystems Protection and Remediation

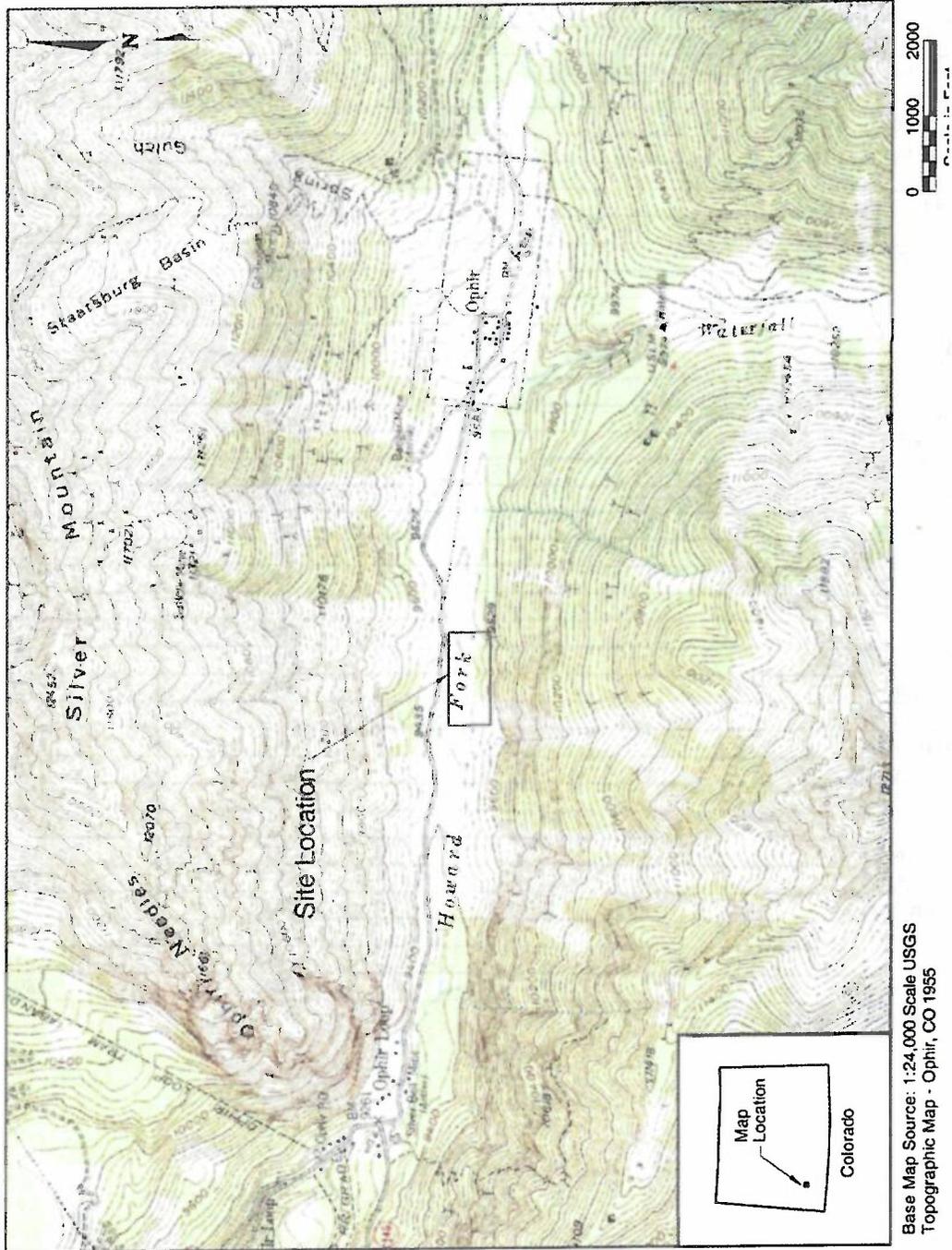
Approve: Mary C DeAguiro Date: 7/5/17
Mary DeAguiro, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Disapprove: _____ Date: _____
Mary DeAguiro, Director of Engineering
USDA-Forest Service, Rocky Mountain Region

Concur: 15/ _____ Date: _____
Scott G. Armentrout, Forest Supervisor
USDA-Grand Mesa Uncompahgre and Gunnison National Forest

Concur: 15/ _____ Date: _____
Mathew Zumstein, Norwood District Ranger

Attachment 1: Site Map of Carribeau Mine



ATTACHMENT 2



Table 3-4. Waste Rock Samples Collected at Carribean Mine

PARAMETER	MWR-2000-1 Carribean Composite	MWR-2000-2 Carribean Channel
PH	5.50	4.43
Neutralization potential (tons CaCO ₃ /1,000 tons)	5.6	0.4
Potential acidity (tons CaCO ₃ /1,000 tons)	14.3	7.7
Net acid-base potential (tons CaCO ₃ /1,000 tons)	-8.8	-7.4
Gold (oz/ton)	0.007	0.15
Silver (oz/ton)	0.34	1.24
Mercury (ppm)	0.1	0.2
Al ₂ O ₃ (%)	15.5	15.8
BaO (%)	0.26	0.28
CaO (%)	0.78	0.23
Chlorine (%)	<0.02	<0.02
Fe ₂ O ₃ (%)	6.51	4.06
K ₂ O (%)	4.28	4.47
MgO (%)	1.05	0.69
MnO (%)	0.27	0.02
Na ₂ O (%)	0.56	0.22
P ₂ O ₅ (%)	0.14	0.07
SiO ₂ (%)	64.8	70.2
Sulfur (%)	1.13	1.10
TiO ₂ (%)	0.63	0.53
Arsenic (ppm)	64	71
Chromium (ppm)	94	65
Cobalt (ppm)	11	<10
Copper (ppm)	322	96
Lead (ppm)	1044	6102
Molybdenum (ppm)	<10	<10
Nickel (ppm)	14	<10
Niobium (ppm)	17	12
Rubidium (ppm)	130	148
Strontium (ppm)	161	170
Thorium (ppm)	36	171
Tin (ppm)	110	130
Tungsten (ppm)	<10	10
Uranium (ppm)	14	15
Vanadium (ppm)	85	94
Yttrium (ppm)	50	55
Zinc (ppm)	249	263
Zirconium (ppm)	220	189

Source: Neubert (2001)

ATTACHMENT 3

Table 3-6. Tailings and Waste Rock Samples - Total Metals Results

Metals, Total Solids (mg/Kg)															
Sample Number	Ag	As	Ba	Be	Cd	Cr	Cn	Cu	Mn	Hg	Ni	Pb	Sb	Se	Zn
Reporting Limit	1.2	1.2	1.2	0.58	0.58	1.2	0.57	2.3	1.2	0.038	4.7	0.93	1.2	1.5	2.3
101001-1	132	850	1820	0.073B	0.12B	2.9J	ND	742	82.1J	0.86	0.78B	5730	261	2.1	1361
101001-2	134	743	2360	0.082B	0.30B	2.8J	ND	652	77.0J	0.82	0.55B	5590	261	1.8	1461
101001-3	104	459	1810	0.096B	2.4	1.9J	ND	482	469J	0.80	1.4B	4260	251	1.9	540J
101001-4	142	824	1590	0.062B	2.3	1.7J	ND	487	32.2J	1.9	0.32B	4830	371	2.0	573J
101001-5	107	884	984	0.051B	0.52B	1.4J	ND	384	24.2J	0.61	0.32B	3050	310	2.0	145J
101001-6	44.8	118	608	0.12B	1.6	5.2J	ND	242	155J	1.0	2.0B	2760	61.3	2.9	363J
101001-7	69.2	121	648	0.32B	4.2	4.4J	0.31B	278	860J	0.49	3.0B	7180	51.1	3.5	856J

Table 3-7. Tailings and Waste Rock Samples - Leachate Metals Results

Metals, Leachate Extraction (mg/L)														
Sample Number	Ag	As	Ba	Be	Cd	Cr	Cu	Hg	Mn	Ni	Pb	Sb	Se	Zn
Reporting Limit	0.10	0.10	1.0	0.50	0.050	1.0	2.0	0.00020	1.0	4.0	0.030	0.10	0.050	2.0
101001-1	0.0033 B	0.0057 B	0.23 B,J	0.00022 B,J	0.0024 B	0.0046 B,J	0.27 B,J	<0.00020 B	0.30 B	0.0017 B	0.10	<0.10	<0.050	0.32 B
101001-3	<0.10	<0.10	0.21 B,J	<0.50	0.0091 B	0.0018 B,J	0.18 B,J	<0.00020 B	1.9	0.0081 B	8.3	<0.10	<0.050	1.5 B
101001-4	0.0021 B	<0.10	0.32 B,J	<0.50	<0.050	0.0011 B,J	0.095 B,J	0.000030 B	0.023 B	<4.0	0.041	<0.10	<0.050	0.11 B
101001-6	<0.10	<0.10	0.074 B,J	0.00030 B,J	0.0028 B	<1.0	0.34 B,J	0.000057 B	1.4	0.0062 B	1.5	<0.10	<0.050	0.46 B

B=Estimated result. Result is less than RL.
J=Method blank contamination. The associated method blank contains the target analyte at a reportable level.

ATTACHMENT 4

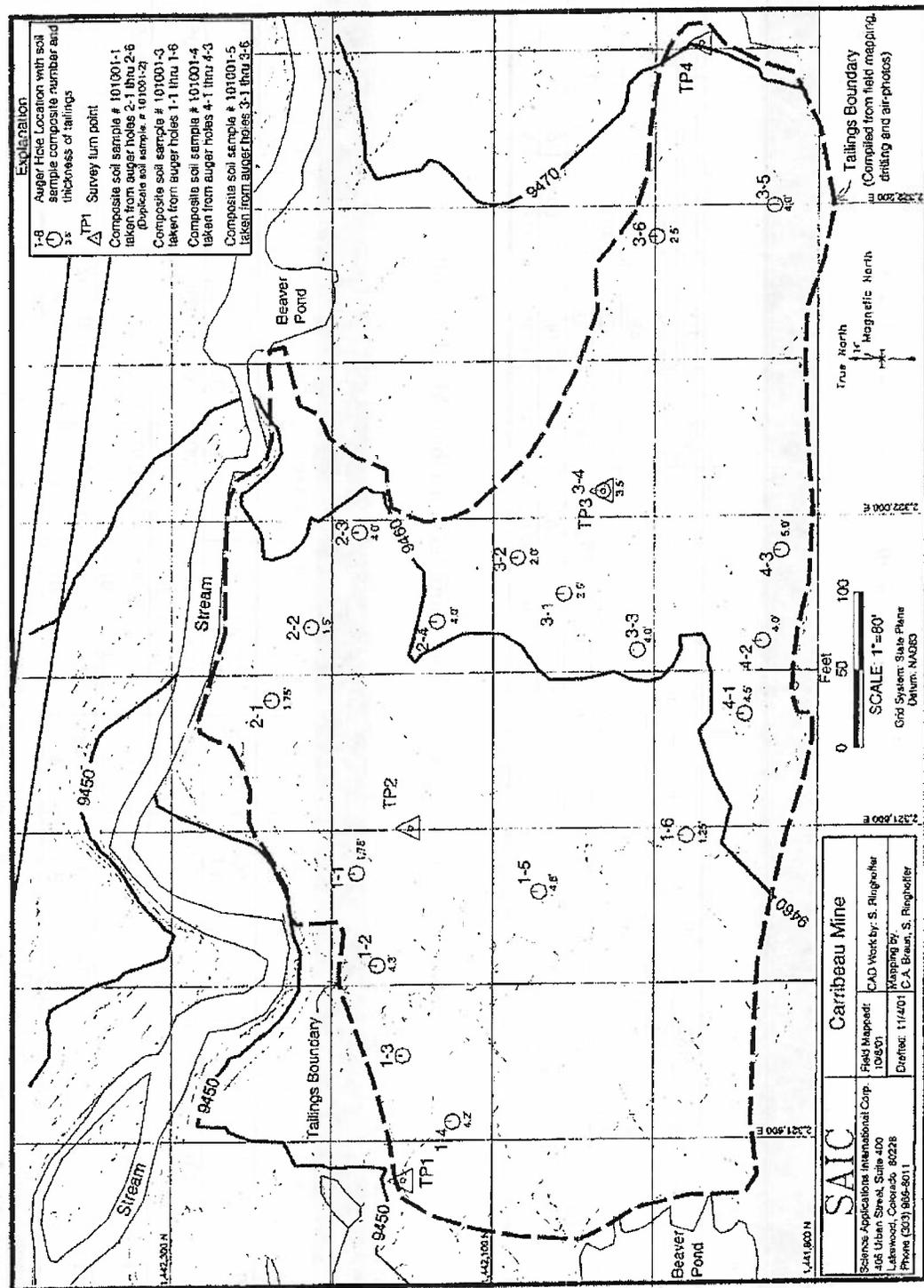


Figure 3.1
 Carribeau Tailings Sample Locations



ATTACHMENT 5

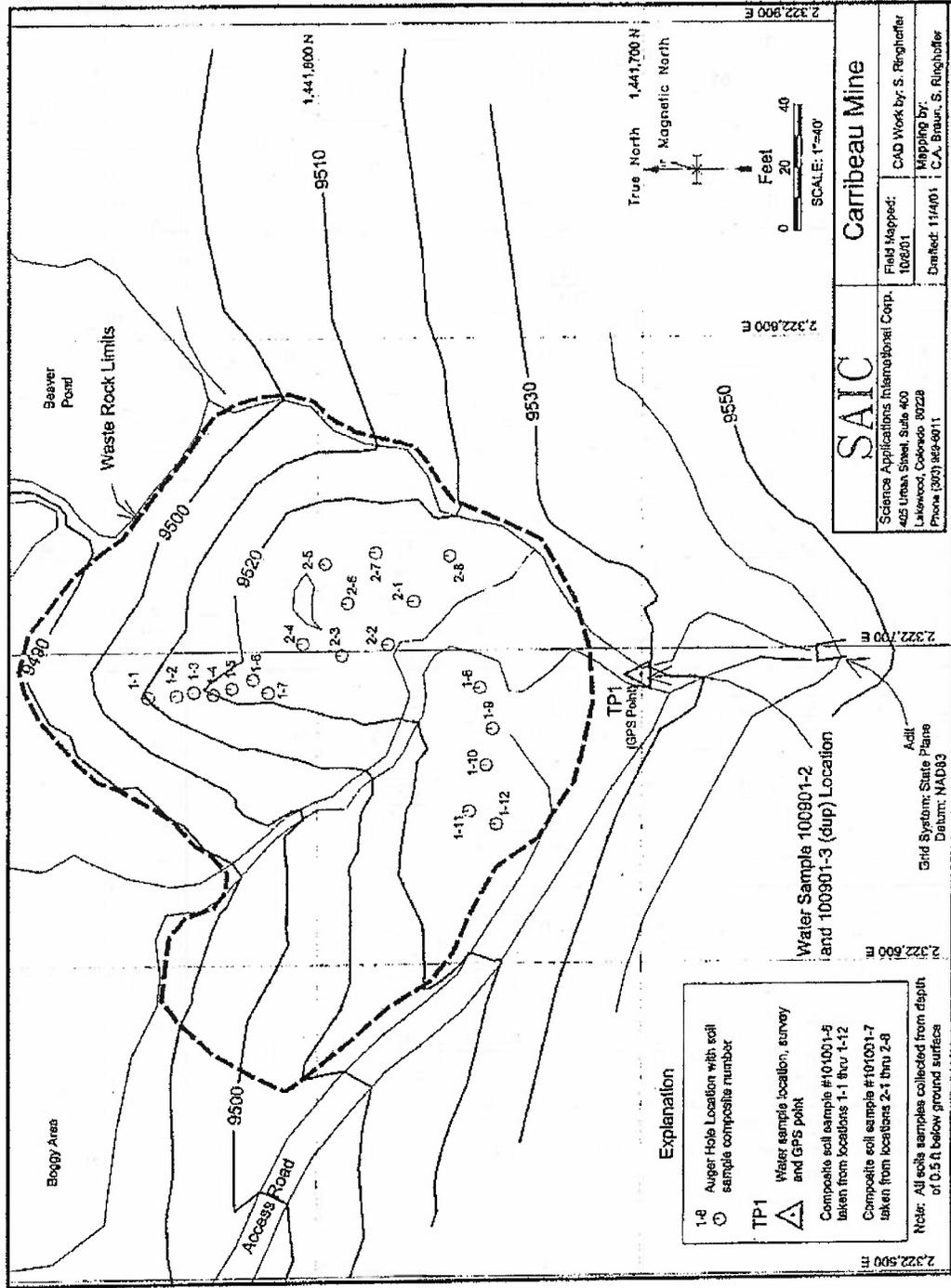


Figure 3.2
 Carribeau Waste Rock Sample Locations

Explanation

- 1-d Auger Hole Location with soil sample composite number
- TP1 Water sample location, survey and GPS point
- Composite soil sample #10-001-5 taken from locations 1-1 thru 1-12
- Composite soil sample #10-001-7 taken from locations 2-1 thru 2-8

Note: All soils samples collected from depth of 0.5 ft below ground surface

ATTACHMENT 6



Table 3-12. Comparison of Metal Concentrations in Soil and Waste Rock to BLM Human Risk Management Criteria

Sample Number	Hg	Sb	As	Cd	Cu	Pb	Ni	Se	Ag	Zn	Mn
<i>Resident</i>	<i>2</i>	<i>3</i>	<i>1</i>	<i>3</i>	<i>250</i>	<i>400</i>	<i>135</i>	<i>35</i>	<i>35</i>	<i>2000</i>	<i>960</i>
101001-1	0.86	261	850	0.12B	742	5730	0.78	2.1	132	136	82.1
101001-2	0.82	261	743	0.30B	652	5590	0.55B	1.8	134	146	77.0
101001-3	0.80	251	459	2.4	482	4260	1.4B	1.9	104	540	469
101001-4	1.9	371	824	2.3	487	4830	0.32B	2.0	142	573	32.2
101001-5	0.61	310	884	0.52B	384	3050	0.32B	2.0	107	145	24.2
101001-6	1.0	61.3	118	1.6	242	2760	2.0B	2.9	44.8	363	155
101001-7	0.49	51.1	121	4.2	278	7180	3.0B	3.5	69.2	856	860
<i>Camper</i>	<i>40</i>	<i>50</i>	<i>20</i>	<i>70</i>	<i>5000</i>	<i>1000</i>	<i>2700</i>	<i>700</i>	<i>700</i>	<i>40000</i>	<i>19000</i>
101001-1	0.86	261	850	0.12B	742	5730	0.78	2.1	132	136	82.1
101001-2	0.82	261	743	0.30B	652	5590	0.55B	1.8	134	146	77.0
101001-3	0.80	251	459	2.4	482	4260	1.4B	1.9	104	540	469
101001-4	1.9	371	824	2.3	487	4830	0.32B	2.0	142	573	32.2
101001-5	0.61	310	884	0.52B	384	3050	0.32B	2.0	107	145	24.2
101001-6	1.0	61.3	118	1.6	242	2760	2.0B	2.9	44.8	363	155
101001-7	0.49	51.1	121	4.2	278	7180	3.0B	3.5	69.2	856	860
<i>ATV Driver</i>	<i>550</i>	<i>750</i>	<i>300</i>	<i>950</i>	<i>70000</i>	<i>1000</i>	<i>38000</i>	<i>9600</i>	<i>9600</i>	<i>550000</i>	<i>250000</i>
101001-1	0.86	261	850	0.12B	742	5730	0.78	2.1	132	136	82.1
101001-2	0.82	261	743	0.30B	652	5590	0.55B	1.8	134	146	77.0
101001-3	0.80	251	459	2.4	482	4260	1.4B	1.9	104	540	469
101001-4	1.9	371	824	2.3	487	4830	0.32B	2.0	142	573	32.2
101001-5	0.61	310	884	0.52B	384	3050	0.32B	2.0	107	145	24.2
101001-6	1.0	61.3	118	1.6	242	2760	2.0B	2.9	44.8	363	155
101001-7	0.49	51.1	121	4.2	278	7180	3.0B	3.5	69.2	856	860
<i>Worker</i>	<i>60</i>	<i>100</i>	<i>12</i>	<i>100</i>	<i>7400</i>	<i>2000</i>	<i>4000</i>	<i>1000</i>	<i>1000</i>	<i>60000</i>	<i>28000</i>
101001-1	0.86	261	850	0.12B	742	5730	0.78	2.1	132	136	82.1
101001-2	0.82	261	743	0.30B	652	5590	0.55B	1.8	134	146	77.0
101001-3	0.80	251	459	2.4	482	4260	1.4B	1.9	104	540	469
101001-4	1.9	371	824	2.3	487	4830	0.32B	2.0	142	573	32.2
101001-5	0.61	310	884	0.52B	384	3050	0.32B	2.0	107	145	24.2
101001-6	1.0	61.3	118	1.6	242	2760	2.0B	2.9	44.8	363	155
101001-7	0.49	51.1	121	4.2	278	7180	3.0B	3.5	69.2	856	860
<i>Surveyor</i>	<i>450</i>	<i>600</i>	<i>100</i>	<i>500</i>	<i>59000</i>	<i>2000</i>	<i>32000</i>	<i>8000</i>	<i>8000</i>	<i>450000</i>	<i>220000</i>
101001-1	0.86	261	850	0.12B	742	5730	0.78	2.1	132	136	82.1
101001-2	0.82	261	743	0.30B	652	5590	0.55B	1.8	134	146	77.0
101001-3	0.80	251	459	2.4	482	4260	1.4B	1.9	104	540	469
101001-4	1.9	371	824	2.3	487	4830	0.32B	2.0	142	573	32.2
101001-5	0.61	310	884	0.52B	384	3050	0.32B	2.0	107	145	24.2
101001-6	1.0	61.3	118	1.6	242	2760	2.0B	2.9	44.8	363	155
101001-7	0.49	51.1	121	4.2	278	7180	3.0B	3.5	69.2	856	860

All concentrations in mg/kg

Concentrations exceeding risk management criteria are shown in shaded cells.

BLM Risk Management Criteria for metals are shown in italics.

ATV: All terrain vehicle

Source: Ford, 1996

Attachment 7

Applicable or Relevant and Appropriate Requirements

Location-Specific ARARs

Requirement	Citation	Applicability
Wetland	Clean Water Act section 404; 40 CFR Part 230, 33 CFR Parts 320-330	Prohibits discharge of dredged or fill materials into wetlands without permit (substantive provisions to be followed to extent practicable).
Wetland	Executive Order 11990-Applies to Federal Actions affecting wetlands. Actions must be implemented to minimize the destruction, loss or degradation of wetlands. Compensatory mitigation for unavoidable impacts to wetlands may be required.	Federal requirements applying to portions of the Carriveau Mine Site located in probable wetlands area adjacent to Howard Fork.
Floodplain	Executive Order 11988-Applies to Federal Actions affecting floodplains. Actions must be implemented to minimize potential harm to or within the floodplain and to restore or preserve floodplain valued.	Federal requirements applying to portions of the Carriveau Mine Site located on the Howard Fork floodplain or removal actions affecting the floodplains.

Action-Specific ARARs

Requirements	Citation	Application
Hazardous and Solid Waste	State of Colorado Regulations Pertaining to Solid Waste Disposal Sites and Facilities, 6 CCR 1007-2 CDPHE, Hazardous Materials & Waste Management Division, 6 CCR, 1007 Parts 260-279	Federal and State requirements related to the management of hazardous and solid waste generated from the removal actions performed at the Carriveau Mine Site.
Mine waste and tailings management	Colorado Fugitive Dust Control Play/Opacity Regulation No. 1. (5 CCR 1001-3, pursuant to CRS § 25-7-101 et. seq.)	State requirements applicable to removing, storing, stockpiling and transporting excavated materials such as mine waste or tailings that may generate dust.
	Colorado Mined Land Reclamation Regulations (2 CCR 401-1 Rule 3, pursuant to CRS § 34-32-101 et. seq.)	State requirements applicable to former mining sites.

ATTACHMENT 8

Carribeau Adit and Waste Rock Dump Map showing location of benches, ponds, wetlands in tailings, and location of adit water flow previous to USFS construction of riprapped diversion.

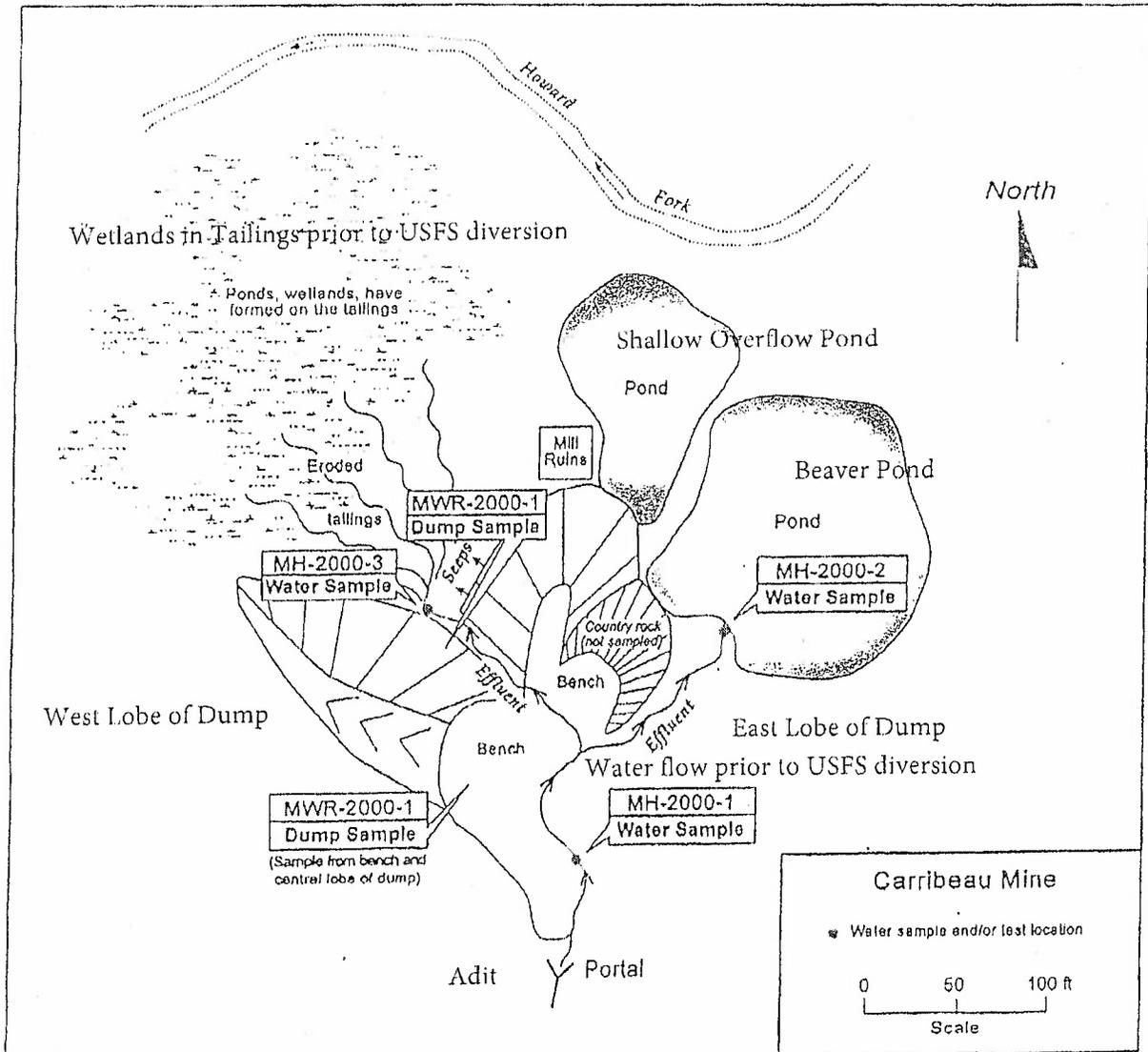


Figure 50. Sketch map of the surface at the 13th level of the Carribeau Mine.

Attachment 9

CGS Map of Carribeau Adit and Dump area showing location of USFS diversion and proposed protective concrete block wall and protective dike

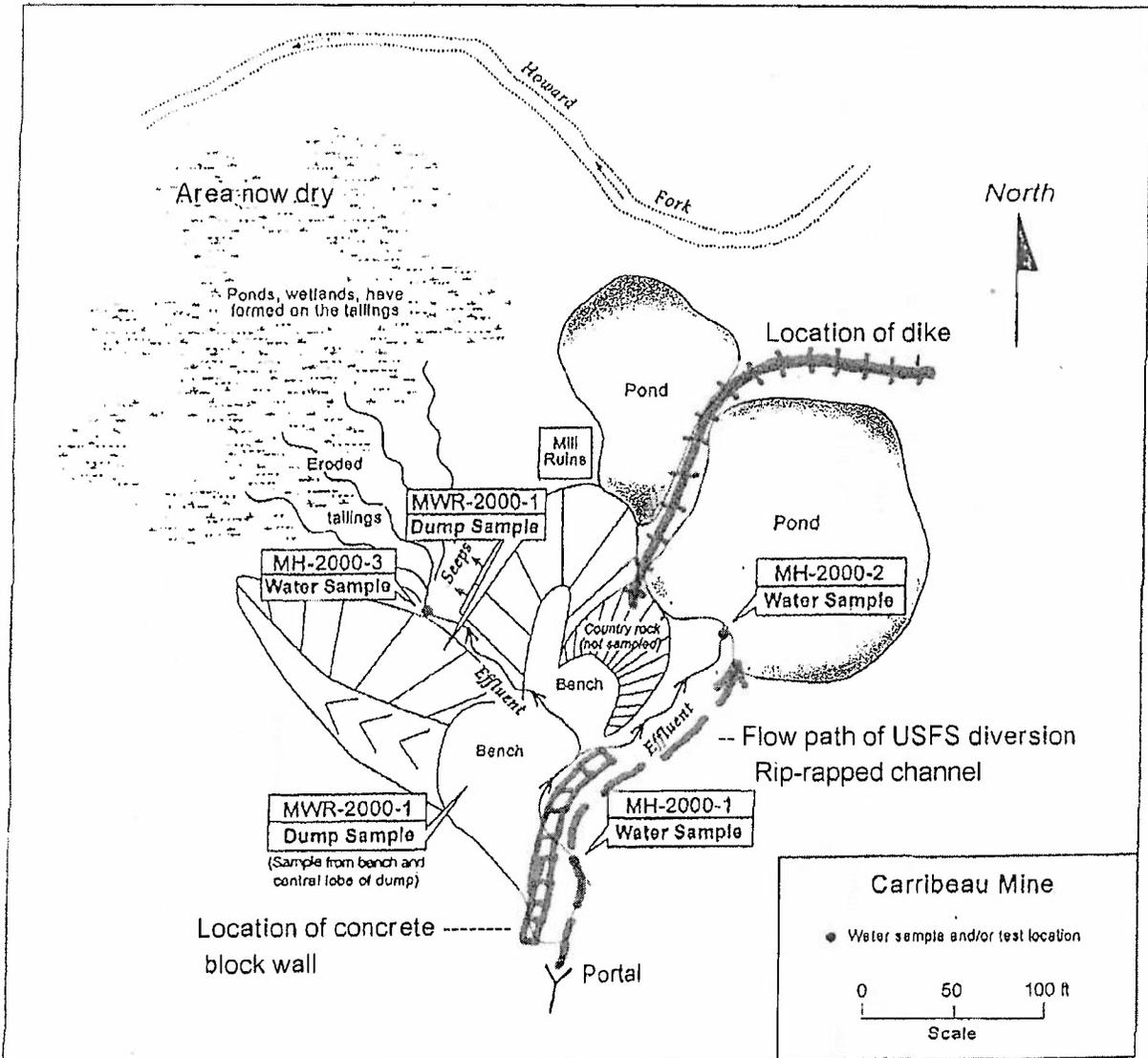


Figure 50. Sketch map of the surface at the 13th level of the Carribeau Mine.

ATTACHMENT 10

TABLE 4
 Inorganic Soil Sample Results
 Concentrations in milligrams per kilogram, mg/kg (parts per million [ppm])

UOS Sample ID:	Colorado Soil Residential Evaluation Values 07/2011	CMSO001 1107052-1 6/28/2011	CMSO003 1107052-2 6/28/2011	CMSO006 1107052-3 6/28/2011	CMSO008 1107052-4 6/28/2011	CMSO009 1107052-5 6/28/2011	CMSO011 1107052-6 6/28/2011	CMSO012 1107052-7 6/28/2011	CMSO014 1107052-8 6/28/2011
Analytic (Abbrev)									
Aluminum (Al)	77,000	1,300	3,100	640	240	790	450	970	1,700
Antimony (Sb)	31	230	150	190	170	230	380	260	630
Arsenic (As)	0.39	550	450	370	720	580	740	860	1,500
Barium (Ba)	15,000	1,000	1,200	870	570	1,200	430	710	930
Beryllium (Be)	160	0.30J	0.084J	0.22J	0.085U	0.058J	0.088U	0.31J	0.22J
Cadmium (Cd)	70	5.4	1.3J	2.9	1.2J	0.83J	1.5J	3.9	6.1
Calcium (Ca)	-	590	1,200	510	65U	65J	67U	1,000	770
Chromium (Cr)	120,000	1.1J	4.7J	2.30J	0.84U	1.1	0.86U	1.80J	0.92U
Cobalt (Co)	23	14	9	13	0.52J	1.1J	0.46B	19	11
Copper (Cu)	3,100	660	560	290	320	470	340	500	610
Iron (Fe)	55,000	55,000 E	35,000	29,000	24,000	19,000	22,000	41,000	57,000
Lead (Pb)	400	2,400	3,700	1,700	2,100	3,300	2,700	2,900	4,700
Magnesium (Mg)	-	280J	1,600	170J	150J	240	210J	290J	710
Manganese (Mn)	9,200	2,400E	820	3,100	42	80	29	5,300	2,200
Nickel (Ni)	1,500	5.3J	3.7J	8.6J	0.87J	0.62J	0.79U	15	6.9J
Potassium (K)	-	260J	620	180U	240J	430	210J	280J	440J
Selenium (Se)	390	1.80J	1.4U	1.4U	1.4U	1.1	1.7J	2.6J	3

Attachment 11

Areal (Goggle Earth Pro) view of Carribeau Tailings showing distinct color, visibility, outline, and boundaries of the tailings. Also shown is how the tailings have filled in the low areas of the flats by the river.



ATTACHMENT 10 (cont.)

TABLE 4, cont.
 Inorganic Soil Sample Results
 Concentrations in milligrams per kilogram, ug/kg (parts per million (ppm))

Analyte: (Abbrev)	URS Sample ID:	Colorado Soil Residential Evaluation Values 07/20/11	CMSO015 1107052-9 6/28/2011	CMSO016 1107052-10 6/29/2011	CMSO019 1107052-12 6/29/2011	CMSO022 1107052-13 6/29/2011	CMSO023 1107052-14 6/29/2011	CMSO024 1107052-15 6/29/2011	CMSO025 1107052-16 6/29/2011	CMSO03001 1107052-11 6/28/2011
Aluminum (Al)		77,000	540	840	13,000	10,000	14,000	14,000	23,000	11,000
Antimony (Sb)		31	850	55	31	23	16 J	18 J	35 J	1.8 U
Arsenic (As)		0.39	1,400	160	290	290	300	300	560	14
Barium (Ba)		15,000	1,100	430	10	370	280	350	220	270
Beryllium (Be)		160	0.095 U	0.041 J	5.3	1.8 J	6.2	6.2 J	6.3	0.48 J
Cadmium (Cd)		70	2.80	0.37 J	19	5.6	24	24	12	0.47 J
Calcium (Ca)		-	72 U	52 J	10,000	10,000	13,000	15,000	8,800	5,100
Chromium (Cr)		120,000	0.93 U	2	9.7	6.6 J	12	13 J	12 J	13
Cobalt (Co)		23	1.1 J	0.33 J	160	67	220	230	200	8.3
Copper (Cu)		3,100	540	120	2,900	890	3,300	3,300	4,600	43
Iron (Fe)		55,000	38,000	14,000	290,000	120,000	330,000	300,000	400,000	24,000
Lead (Pb)		400	5,500	1,200	1,200	1,000	710	960	1,200	120
Magnesium (Mg)		-	240 J	400	1,100	3,000	1,200	990 J	620 J	3,900
Manganese (Mn)		9,200	67	52	45,000	15,000	64,000	61,000	33,000	950
Nickel (Ni)		1,500	0.85 U	0.95 J	100	35	140	150	68	9.4 J
Potassium (K)		-	250 J	520	910	1,000	520 J	680 J	450 U	1,600
Selenium (Se)		390	3	0.75	17 U	4.5	28 U	39 U	36 U	1.7 U

Attachment 12

Picture of tailings along Howard Fork River showing the tailing's characteristic, distinct color, homogeneity, and fine grained nature resting on native soils. Also shown is how the tailings filled in the low spots of the flats indicated by the "island" of pine trees surrounded by tailings. The depth here ranges between two and three feet.

Important Note: Since the picture was taken these tailings have been pulled back from the river by a voluntary action by the property owner so they do no longer slough into the river.

