FIELD GUIDE

FOR THE USFS ABANDONED MINE LAND INVENTORY PROJECT

-general guidelines for the field geologist-

Mine Openings - record all features shown on the topographic map if they are on, or affect, public land. Features that are identified by literature search or field reconnaissance should be recorded, depending on size and other factors, as detailed in the following paragraphs.

Prospect pits and exploratory holes are not typically recorded because their environmental degradation potential is usually negligible. Exceptions are made for any workings shown on topographic maps, and for deep pits or exploratory shafts that could be a physical hazard. A quantitative guideline would be a hole or pit less than 10' in depth will not be recorded. This guideline is adaptable to accommodate site-specific conditions such as steepness of sidewalls, ability to climb out of a hole, public access, interaction with surface- or ground water, etc.

Dumps, Tailings, and Spoils Piles

Generally dumps, tailings, or spoils piles less than 50 cubic yards in volume do not need to be recorded as their environmental degradation and physical hazard potential are usually negligible. Piles less than this size may be recorded according to the discretion of the field geologist. One important exception is that any mine waste interacting with flowing water should be recorded.

Determining When a Site Needs to be Visited

DON'T JUDGE A MINE OPENING BY ITS DUMP! Some shafts, mine vents, etc. will not have large dumps associated with the hole, but will still be very deep. The waste rock may have been taken out an adit at a lower mine level, leaving very little dump material around the mine opening. The geometry of nearby adits and shafts can give clues to the probability of a feature being a vent or a connecting shaft. The general rule is -- if you're not sure it's just a prospect pit or a shallow exploratory hole, go to the site.

If there is a shaft, adit, or quarry indicated on the topographic quadrangle, you must go to the site and record data for it, even if it is collapsed, filled, overgrown with vegetation, etc. Information that a mine feature is not a problem at all is just as useful to the USFS as information about problem sites.

GUIDE FOR USING THE USFS-AMLI FIELD DATA FORM

LOCATION AND IDENTIFICATION

(1) ID# - a numeric code used for location information and for linking all the database files together. It is important for this number to be correct.

fst = two digit code for the specific National Forest

rd = two digit code for the specific ranger district

xutm,yutm = Universal Transverse Mercator coordinates, shown on the map edge. This defines a 1000 square meter cell. The coordinates are taken from the bottom left-hand corner of the utm cell containing the inventory area (the smallest x,y coordinates defining the cell).

area# = number assigned to differentiate between more than one inventory area within a utm cell. Number sequentially from 1, 2, 3, etc.

(2) Site name – Name of the mine or workings from the map or from literature. Cite the literature source if appropriate. If a proper name is unknown, the name of a nearby geographical feature may be used.

(3) Other name/reference – as above if more than one name.

(4) Environmental Degradation – Environmental Degradation Ratings (EDRs) are somewhat subjective. This is necessary, and even desirable, so that the field geologist can take into account site-specific conditions such as geology, effluent discharge volume, placement of the feature in the drainage basin, surface water interactions, precipitation, etc. Numerical pH and conductivity values are useful tools. Natural waters from alpine basins generally have conductivities of less than 100 μS, and streams at lower elevations often have conductivities of 100-300 μS. In areas of intensely altered rock, natural waters can have low pH and high conductivity. In addition, conductivity may be elevated in areas underlain by limestone, gypsum, or other easily soluble rocks. Mine effluent pH and conductivity should be compared to background values when assessing the environmental degradation. Conductivity and pH values, as well as the other criteria listed on the following table are general guidelines, and should not be considered absolutes. Ratings are usually based on combinations of listed characteristics, but occasionally one aspect of a feature may fully justify a rating. (See table 1).

Table 1. General guidelines for assigning Environmental Degradation Ratings (EDR).

Rating (EDR)	Feature usually displays one or more of the following characteristics:
1=EXTREME	• Contamination offsite is severe. • Receiving stream is "dead" or sterile at the mine and downstream. • Effluent has extremely low pH (<4). • Effluent has extremely high conductivity (>1500 μS; >1000 μS in alpine areas). • High flows of poor-quality water, relative to the receiving stream. • Abundant precipitate at the mine and in the receiving stream. • Very large dumps or tailings piles with evidence of severe erosion, especially if they have abundant sulfides.
2=SIGNIFICANT	• Receiving stream is significantly or obviously adversely affected, but not "dead" or sterile. • Effluent has low pH (<5). • Effluent has high conductivity (>1000 μS; >500 μS in alpine areas). • Moderate flows of poor-quality water, relative to the receiving stream. • High flows of moderate-quality water, relative to the receiving stream. • Moderate to abundant precipitate at the mine and/or in the receiving stream. • Large sulfide-rich dumps or tailings piles with evidence of moderate erosion. • Large dumps with sparse or no sulfides, but evidence of significant erosion.
3=POTENTIALLY SIGNIFICANT	• Evidence of degraded water quality, but serious effects are not obvious or detected. • Effluent has low pH (<5.5). • Effluent has moderate conductivity (>800 μS; >150 μS in alpine areas). • Poor-quality water with low or no flow (standing water). • Moderate to low flows of moderate-quality water, relative to the receiving stream. • Minor amounts of precipitate. • Very large dumps with little or no evidence of erosion and sparse or no sulfides. • Small and moderate-sized sulfide-rich dumps or tailings piles with evidence of moderate erosion.
4=SLIGHT	• Effluent with slightly acidic pH (<6.5). • Effluent with slightly elevated conductivity (600-800 μS; 100-150 μS in alpine areas). • Low flow volume with sparse or no precipitate. • Small to moderate-sized sulfide-rich dumps or tailings piles with little evidence of erosion.
5=NONE	• No effluent. • Effluent of high quality water. • Small dumps distant from surface water with little or no evidence of erosion.

(5) Mine Hazards – Features are given Physical Hazard Ratings (PHRs) based on definitions shown below.

E = EMERGENCY - This will seldom be noted on the data form since it reflects a "sudden danger or impairment that presents a high probability of substantial physical harm to the health, safety, or general welfare of people before the danger can be abated under normal program operation procedures" [Office of Surface Mining Rules and Regulations, Section 872.5(c)]. An emergency involves a sudden and recent change on which immediate action should be taken.

1 = EXTREME DANGER - This means a "condition that could reasonably be expected to cause substantial physical harm to persons, property....and to which persons or improvements on real property are currently exposed" [OSM Rules and Regulations 872.5(e)]. Sites falling in this category will generally have a high degree of exposure to the chance of injury or damage. A high degree of peril coupled with a high degree of jeopardy being placed on persons or property, either knowingly or unknowingly, is generally involved. Easy access to the general public is a factor. Situations involving open vertical shafts, unstable adits (incompetent rock), very high highwall, or collapsed stopes near roads or towns would fall into this category.

2 = DANGEROUS - The specific mining feature may be as perilous as in a #1 situation, but may be less likely to cause injury or damage because of the remoteness of the site or other constraints on uncontrolled access to the site.

3 = POTENTIALLY DANGEROUS - any open or partially filled adit, moderate height highwall, etc. that is not close to a road or town and would be infrequently accessed by people. This includes situations where the exact hazard is unknown, but could involve a degree of risk at certain times or under certain conditions.

4= (not used during this inventory) - In order to maintain some degree of consistency, this Mine Hazard rating system is based on one used by Colorado Division of Minerals and Geology during an earlier, less detailed inventory. In the earlier inventory, a rating of "4" indicated possible environmental degradation, rather than physical hazard. The "4" rating is not applicable for physical hazards in this inventory.

5 = NO SIGNIFICANT HAZARD - includes collapsed or filled features that are being naturally or intentionally reclaimed, stable mine dumps, and mine sites where all physical hazards have been effectively mitigated.

(7) Quad name and date - write in the name and the last USFS revision or modification date (including "USFS correction guides") listed in the bottom left-hand corner of the PBS quad.

(10) Water Cataloguing Unit # - the number assigned to the drainage basins in Colorado according to the "Hydrologic Unit Map 1974–State of Colorado" published by the USGS.

ENVIRONMENTAL INFORMATION

(28) Vegetation type adjacent to site - use more than one category if appropriate.

(29) Evidence of intentional reclamation - evidence of reclamation includes re-grading, replacing topsoil, seeding, erosion control, fencing, sealing of mine openings.

(30) Size of disturbed area in acres - always give an estimate. Helpful rules of thumb: an acre =

43,560 ft^2 which is about equal to a football field playing area; a city block is about 5 to 6 acres.

TABULAR INFORMATION - pages 2-3 on the data form

Refer to the "Codes for Tabular Information" on page 5 of the data form. If the mine and dump features are associated, they should have the same last digit (i.e. dump #201 is related to adit #101, dump #202 to shaft #102). If an opening has no related dump, the corresponding dump # should be left blank and vise versa.

ADITS, SHAFTS, AND OPENINGS - all recorded mine openings must have an EDR and PHR.

Depth - For shafts (or pits), this means vertical distance from ground surface to the bottom of the shaft. For adits, this means horizontal distance from the portal to the back of the mine. If unknown, note the visible distance and add a "+" to the number.

Access deterrents - Indicates man-made access deterrents; use only those codes listed. More than one may be used if appropriate. A collapsed or filled mine opening is not used as a deterrent here.

Deterrent condition - Indicate the condition if there is an actual deterrent. If there is no deterrent (access deterrents=N) leave this item blank.

DUMPS, TAILINGS, AND SPOIL BANKS

Steepest slope angle - use the clinometer on the Brunton compass to determine this. Often these angles will be around 35 degrees.

Size of materials - Fine= powdery or silty, gravel= larger than sand up to about 3 inches diameter or "throwing rocks," cobbles are brick size, boulders are over 12 inches in diameter.

Stability - Unstable slopes show evidence of past failure, potentially unstable slopes appear to be likely to fail due to high slope angles and/or undercutting or removal of toe material by a stream.

Water erosion of feature - Rills are under 9" across and gullies are over 9" across. Sheet wash shows even overall erosion, but fines are absent.

Access deterrents/Deterrent condition - as above in ADITS, SHAFTS, & OPENINGS

DRAINAGE/WATER SAMPLES

Distance from stream - the distance from the sample location to the receiving stream.

Lab water sample No. - indicate the number given to water samples taken for laboratory analysis. When labeling the sample, use the inventory area id# (top page 1) appended with the water sample item # (300 series) for both the preserved (acidized) and neutral sample bottles.

GPS READINGS - if Global Positioning System equipment is used, record the entire latitude and longitude displayed on the GPS recorder and the mine feature.

DIAGRAM OF PROBLEM AREA - always sketch a detailed map of the inventory area. Locate and label all mine features and water test/sample locations along with roads, trails, streams, mine drainage, buildings, structures, fences, etc. It is sometimes helpful to outline patented land inholdings within the inventory area if pertinent. A separate larger scale sketch of important mine features is sometimes warranted.

COMMENTS - These may include anything the field geologist deems worth mentioning about the mine feature. Usually, comments will expand on any associated environmental degradation, physical hazards, historical structures, machinery, relation to other features, etc. Include identifiable mineralogy of dump (or vein) material, especially any acid-forming minerals (mainly sulfides, sulfosalts). Also note the presence of any neutralizing host or country rock (limestone, dolomite, marble, or other carbonate).

GUIDELINES FOR WATER AND SOIL SAMPLING FOR LAB ANALYSIS

Water Sampling

Water samples for laboratory analysis should be taken at sites that have very significantly degraded water. These will generally be sites with "Environmental Degradation (E.D.) Ratings" of 1 or 2. All sites with an E.D. rating of 1 (and water associated with it) should be sampled for lab analysis. Most sites with an E.D. rating of 2 should be sampled, but the field geologist may use discretion based on the site conditions.

Water Sampling Procedures:

1 a) All water samples to be analyzed for dissolved constituents will be filtered with a disposable 0.45-micron filter attached to the 60-cc syringe. The disposable filter should be rinsed by forcing 20 cc of sample water through it, **before** dispensing filtrate into the sample bottle. (i.e. the filtered acidified (FA) and filtered unacidified (FU) subsample bottles)

b) Samples to be analyzed for total recoverable constituents are unfiltered raw water. (i.e. raw acidified (RA) subsample bottle)

2) All sample bottles must be **filled** to the bottom of the neck of the bottle. This insures there is enough sample to do the analyses needed.

3) Required analyses for water samples are:

Metals, Dissolved Phase:("FA" Bottle)
Aluminum
Cadmium
Calcium
Chromium (total)
Copper
Iron
Lead
Magnesium
Manganese
Nickel
Potassium
Silver
Sodium
Zinc

Metals, Total Recoverable Phase:("RA" Bottle)
Antimony
Aluminum
Arsenic
Iron
Thallium
Zinc

Anions (dissolved phase):("FU" Bottle)
Chloride
Fluoride
Sulfate
Dissolved Oxygen (done in field)
Alkalinity (done in field)

Other water sample analyses which may be requested on a site-specific basis are:

Barium (Trec)
Beryllium (TRec)
Mercury (Diss)
Molybdenum(TRec)
Selenium (Diss)
Uranium (Diss)

4) Analyses for total recoverable metals, dissolved metals, and total hardness are performed on the preserved (HNO3 acidized) FA and RA subsamples. Samples should be acidified to pH=< 2.

5) Analyses for total alkalinity, sulfate, or other anions are performed on the neutral (unpreserved) sample. These have a 14-day holding time including delivery to the lab.

6) If water samples for cyanide analysis are needed, bottles with NaOH preservative must be ordered from the CDPHE Inorganic Lab. If water samples for mercury are needed, glass bottles with nitric acid must be ordered from the CDPHE Inorganic Lab.

7) All water samples should be refrigerated, but not frozen. Use a cooler in the field.

8) A Health Dept. **"Water Quality Data" form** which lists constituents for analysis must accompany every water sample we send them. The **constituents you want analyzed from a certain sample must be circled or highlighted** on the form. I've indicated our required analyses above. Optional analyses can be added - you may want data for other constituents that apply to specific sites (some likely ones are listed).

8) A **chain of custody form** must accompany any set of samples sent to the lab.

9) Samples should be sent by UPS or dropped off to:

Sherri Alexander/Inorganic Lab
Colorado Dept. of Health
Room 153
4210 East 11th Street
Denver, CO 80220

Dump, Tailings, or Spoils Sampling

Sampling of dumps, tailings, or spoils piles will generally be rare. Samples should only be taken if there is evidence of: 1) extreme erosion into a perennial receiving stream, 2) significant amounts of material becoming airborne (aided by vehicles, machinery etc.), or 3) very frequent visitation/recreation at the site (possibility of frequent ingestion episodes). Sites where tailings are well impounded and/or "high and dry" will not be sampled.

Dump, Tailings, or Spoils Sampling Procedures:

1) Samples should be of the "composite" type. The composite sample should be taken from 10 different subsample locations, equally spaced on the top and slopes of the dump. Try to obtain material from the surface to 6 inches below the surface. Each subsample should be approximately 100 cubic centimeters. Attempt to collect material that is sand size or less. (Smaller grain sizes have larger surface areas for water-rock interaction and there are no lab grinding fees!) Take the sample from material that has not been in contact with your digging tool to avoid contamination. The sample can be put into a 1-gallon heavy-duty zip-lock type bag. Label with the date, time, site ID#, and the sampler's name. Indicate the subsample locations on a large-scale field sketch of the dump.

2) Soil samples must be analyzed for concentrations of the following constituents:

Aluminum	Iron	Silver
Arsenic	Lead	Zinc
Cadmium	Manganese	Paste pH
Chromium	Mercury	Acid-base potential
Copper	Nickel	Neutralization potential

   ⇒ Site-specific constituents such as barium, beryllium, selenium, uranium, or radionuclides (gross alpha, gross beta) may also be analyzed.

3) A **chain of custody form** must accompany any set of samples sent to the lab.

4) Samples should be sent by UPS or dropped off to:

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   Colorado Dept. of Public Health and Environment
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