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Reconnaissance Investigation of Critical Minerals in Mine-Related Waste, Colorado

by

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LIST OF ACRONYMS

BLM	U.S. Bureau of Land Management
Bonita Peak	Bonita Peak Superfund Site
cm	centimeters
COMB	Colorado Mineral Belt
DOE	U.S. Department of Energy
DRMS	Colorado Division of Reclamation, Mining and Safety
EarthMRI	USGS Earth Mapping Resources Initiative
EPA	U.S. Environmental Protection Agency
ICP	inductively coupled plasma
km	kilometers
LOD	lower limit of determination
m3	cubic meters
Ma	million years
m	meter
mm	millimeter
MS	mass spectrometry
OES	optical emission spectrometry
ppm	parts per million
QA/QC	quality assurance/quality control
REEs	rare earth elements
RPD	relative percent difference
RSD	relative standard deviation
SU	sampling unit
TotalHREE	total heavy REEs (Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y)
TotalLREE	total light REEs (La, Ce, Pr, Nd, Sm, Eu, and Gd)
TotalREE	total REEs (all the REEs + Sc)
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USGS ACP	U.S. Geological Survey Analytical Chemistry Project
WDXRF	wavelength dispersive x-ray fluorescence

Mineral	**Chemical Formula**
aikinite	$PbCuBiS_3$
altaite	$PbTe$
argentite	Ag_2S
barite	$BaSO_4$
bismuthinite	Bi_2S_3

calcite	$CaCO_3$
chalcopyrite	$CuFeS_2$
dolomite	$CaMg(CO_3)_2$
fluorspar	CaF_2
galena	PbS
hematite	Fe_2O_3
hessite	Ag_2Te
lillianite	$Pb_{3-2x}Ag_xBi_{2+x}S_6$
limonite	FeO(OH)·nH2O
magnetite	$Fe^{2+}Fe^{3+}{}_2O_4$
matildite	$AgBiS_2$
pyrite	FeS_2
siderite	$FeCO_3$
sphalerite	ZnS
tennantite	$Cu_6(Cu_4C^{2+}{}_2)\ As_4S_{12}S$ (C^2+ = Fe2+, Zn, Cd, Hg and/or other species)
tetrahedrite	$Cu_6(Cu_4C^{2+}{}_2)\ Sb_4S_{12}S$
quartz	SiO_2
rhodochrosite	$MnCO_3$
rhodonite	$CaMn_3Mn[Si_5O_{15}]$
specularite	Fe_2O_3

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DISCLAIMER

The material presented here is from a limited reconnaissance study and is intended for general information purposes only. Those making use of or relying upon the material, previous exploration results, results of this investigation, and any other information provided herein assume all risks and liability arising from such use or reliance. Certain sites included in this report are on private land. Permission to access these sites was obtained prior to sampling. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government, State of Colorado, Colorado Geological Survey, and the Colorado School of Mines.

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INTRODUCTION

Mining plays a critical role in history by providing the materials necessary to support the development of technologies. Over the course of human history, mining evolved from a localized activity providing needed materials for an individual or small group, to a full-scale industry focused on meeting a global demand for raw materials (Dold, 2020). The mineral mining industry is based on providing commodities for use in the most current technologies and products at any given time. Elements and compounds within mineral deposits that have little demand, or that cannot be extracted economically, are discarded because they have little market value or the cost to extract them outweighs the value. Modern technologies increasingly depend on some of the elements and compounds that were not mined or recovered in the past and were discarded as waste. Additionally, there has been an increase in demand for several minor, or trace, metals that typically occur in low concentrations (~<0.1%) within some ore deposits (Nassar and others, 2015) that may not form economic deposits on their own. Several commodities, including trace metals, were recently deemed "critical", referred to as "critical minerals" by the U.S. Geological Survey (USGS) (Fortier and others, 2018; USGS, 2022) or "critical materials" by the U.S. Department of Energy (DOE, 2023), based on several factors. In Colorado, many of these critical minerals are associated with historically mined mineral deposits but were not recovered as byproducts during this time due to the lack of demand or cost to extract. Therefore, critical minerals may occur in historic waste piles located throughout the state.

The USGS is conducting a nationwide effort, with the assistance of states, to evaluate the ability of mine waste to contribute to the U.S. critical minerals supply with the goal of estimating the potential critical mineral endowment of mine waste nationwide. The main goal of this investigation is to support the evaluation of potential critical mineral endowment of mine waste in Colorado. To achieve this goal, the USGS is developing a national mine waste database that includes chemical concentration data, locations, and volume estimates of mine-related waste (USGS, 2025a). Additionally, information collected during this investigation may provide a better understanding of potential mineral deposit hosts of critical minerals (as there is seldom geochemistry data associated with trace elements at some sites) and a preliminary understanding of other characteristics of mine waste to assist with potential reprocessing and management of this material. This investigation was conducted in conjunction with the early stages of this program under the USGS Earth Mapping Resources Initiative (EarthMRI) (USGS, 2025b) who provided funding, laboratory analysis, and the preliminary sampling protocol for this project. It is reconnaissance in nature - Colorado was one of three states first chosen for this program and the USGS is revising sampling protocols based on their field visits and input from the first few projects to improve this process.

The tasks associated with this project ultimately included: the collection and analysis of 126 waste rock or tailing samples from 47 subunits at 22 historic mine waste pile sites located within areas of interest and; volume estimates of the sampled waste piles. This report includes the background information associated with these sites, the sampling methods, laboratory results, and a preliminary evaluation of these results with respect to the critical minerals and other commodities. This investigation is reconnaissance in nature and the data associated with this project are not intended to fully characterize potential economic resources or provide a complete assessment of other conditions at these sites. In addition to this investigation, another investigation targeting critical minerals in mine water was conducted simultaneously and the results are included in a separate report (Colorado Geological Survey Open-File Report 24-11). The data associated with this and other EarthMRI investigations is published by the USGS and made available to the public (USGS, 2025b).

BACKGROUND

Mineral deposits occur throughout Colorado and include numerous ore deposit types and mineral systems. Many of these deposits were mined for several commodities including Zn, Cu, Au, Pb, Mo, Ag, F, W, U, V, and Fe. Although a few Mo and Au mines are still active in Colorado today, many mines operated in Colorado between the late-1850s and 1990s and generally targeted these commodities. Although one commodity may have driven the economics of these operations, relatively larger mines that operated in Colorado historically produced several commodities from one mine (e.g., typically, Au, Ag, Zn, Pb, and Cu). As indicated above, modern technologies require several of these commodities but also require other trace elements that may be associated with these deposits. Many of these trace elements were not recovered during the beneficiation process and may be present in historic mine waste piles. Furthermore, many of these trace elements, as well as some compounds and major commodities (e.g., Zn and Cu), have been deemed "critical" by the USGS and the DOE.

Critical Mineral Focus Areas

Following a 2017 Presidential Executive Order (White House, 2017), the USGS released an updated list of critical minerals in 2022 (USGS, 2022) summarized in **Table 1**. These minerals are defined as non-fuel resources essential to U.S. economic and national security with supply chains vulnerable to disruption (Fortier and others, 2018). As technologies and supply chains evolve, the criticality of specific minerals may change, prompting periodic revisions to both the list and its underlying criteria. The DOE has also released a critical materials assessment focused on energy applications, which includes several USGS designated critical minerals and additional elements such as copper (DOE, 2023) (**Table 1**).

The USGS has employed a mineral systems approach to assist in defining and prioritizing critical mineral focus areas (focus areas) based on the current understanding of how ore deposits that contain critical minerals form and their relationship to broader geologic frameworks and tectonics (Hofstra and Kreiner, 2020). By linking mineral systems to deposit types, principal commodities, historical production, and critical mineral associations, focus areas were developed to determine targets for future exploration. The minerals systems approach is simplified however, as the actual deposits are complex, and several ore deposits may contain several mineral systems. These mineral systems, deposit types, and critical minerals associations may change based on future research thereby changing the focus areas (see USGS, 2025a, 2025b for more information).

Focus areas were generally mapped based on a mineral system framework and their associated mineral deposit types that could possibly host critical minerals (Dicken and others, 2022; Hammarstrom and others, 2023). Sixty-nine focus areas were delineated in Colorado (Dicken and others, 2022). During this investigation, samples were collected from mine waste piles located in one or more focus areas as identified in Dicken and others (2022) as indicated in **Table 2**.

Mine Waste Pile Sampling Areas

Numerous precious and base metal deposits in Colorado are associated with tectonic and magmatic events that occurred between ~75 and ~4 million years ago (Ma) in the Southern Rocky Mountains. While many of these deposits are concentrated along the ~400 km southwest–northeast-trending Colorado Mineral Belt (COMB) (Tweto and Sims, 1963; Wilson and Sims, 2003; Chapin, 2012; Wilson, 2017), significant mineralization also occurs in adjacent regions outside the traditional COMB footprint (**Figure 1**). These deposits reflect multiple mineralizing episodes across diverse geologic settings. This investigation focused on historic mine waste piles within selected EarthMRI focus areas, several of which lie within or proximal to the COMB (**Figure 1**). Sampling sites were generally associated with legacy mining operations that predate modern environmental regulations. **Table 2** summarizes the sampled sites, including their associated focus areas, mineral systems, deposit types, and target commodities. Additional site-specific context is provided in the results section to support interpretation of geochemical findings.

METHODS

The sampling protocol employed in this investigation was initially devised by the USGS for this project and modified in the field, if necessary, based on local conditions. All samples were submitted to the USGS Analytical Chemistry Project (ACP) who tracks samples, submits samples to the analytical laboratory, performs quality assurance/quality control (QA/QC) of the data, and disseminates the analytical results to project managers and the public. The sampling procedures are summarized below.

Field Methods

Prospective waste piles were visually surveyed to assess their physical characteristics, stability, and apparent uniformity. In Colorado, although most of the historic mines have been closed for several decades, many are privately owned and the lands around them, including the waste piles, are located within a patchwork of patented claims. Therefore, several areas that were originally proposed for sampling were avoided due to the difficulty in contacting numerous landowners and determining the exact location of these boundaries.

As this is a reconnaissance investigation and per USGS guidance, mine waste pile volumes were not a limiting factor for site selection. Generally, any waste pile greater than ~30 cubic meters (m^3) was deemed a target for sampling, however larger waste piles were considered ideal. In Colorado, many of the larger (e.g., >~500,000 m^3) mine-related waste piles were remediated, included engineered caps on top of this material in many cases (making it difficult to collect surface samples), and are associated with federal and/or state regulated remedial programs. Selection of sample sites was a trade-off between access, volume, location, etc., with property and physical access to the waste piles being the largest issues. Following this initial assessment, mine waste piles were either sampled as individual sampling units (SU) or divided into multiple SUs if discrete portions of the waste pile appeared to be deposited during separate events or based on field observations including color, geological/mineralogical characteristics, height, shape, and morphology. Field observations of each sampling unit were recorded on the field data sheets included as **Appendix A**.

Each SU was divided into a minimum of 30 subsample points in a generally equal spaced grid based on the morphology of the waste pile. Although the grid was not surveyed, flagging was used to approximate the grid and for reference points during sampling. The general grid was recorded on the field data sheets (**Appendix A**). Areas on steep slopes, or disturbed areas, were generally not sampled and are delineated on the field sheets. A durable plastic or stainless-steel trowel was used to collect material from a depth of 5 centimeters (cm) at each subsample location. Aliquots from each subsample location were of similar size, mixed and composited in a single plastic 5-gallon bucket with a total minimum weight of one kilogram. USGS representatives assisted the field team during the first sampling event and a few modifications were made to the USGS provided draft sampling protocol. This included the collection of both a fine and coarse sample fraction as well as the procedures for collecting field duplicate samples. Based on these modifications, the composite sample collected from each individual SU was sieved in the field using a clean, dry, stainless steel 2-millimeter (mm) sieve which created both a fine (<2 mm) and coarse (> 2 mm) fraction sample.

The fine and coarse samples were transferred to new plastic bags and labeled in the field. In some instances, when no significant coarse fraction remained on the sieve, only the fine fraction sample was collected as noted on the field data sheets. Also, when the sample was moist, the sample was sieved at the sample holding facility after it was allowed to dry. Sample names contained the two-digit year sampled, the site designation, the SU number, the sample type (e.g., composite or grab), the size fraction, and a designation if the sample was a duplicate (e.g., Sample name: 24-NG1-SU1-Composite-Fine = 2024, Northgate Site 1, sampling unit 1, composite sample, fine fraction). The laboratory results presented in the results section of this report are averages of the fine and coarse fraction results at each SU as the amount of each of these sized material in each waste pile is unknown. Photographs of the sampling process are included in **Figure 2.**

A few grab samples were collected at some of the SUs that included mineralized rock material from the SU. Also, two channel samples (delineated as “grab samples”) from the Mayflower tailings site, where limited portions of tailings were exposed, were collected along a ~0.3 to 1 meter (m) exposure along a ~0.3 m wide channel. The channel samples were <2 mm in size at these two locations, were collected directly into new plastic bags using a clean plastic trowel, and the samples were sealed and labeled in the field.

All sampling equipment (buckets, trowels, and sieves) was either plastic or stainless-steel. All samplers wore disposable nitrile gloves while collecting and handling the samples. All stainless-steel sieves and all sampling equipment were thoroughly cleaned, rinsed with de-ionized water, and dried between each site and SU. Sample duplicates were collected at a frequency of one per 10 samples or one per sampling event. Duplicate sample names were designated with a “Dup” or “Duplicate” in the sample name. A duplicate sample, in this case, was collected in the same manner as the original sample by retracing the original grid of sub-samples and collecting a new sub-sample in the same manner (e.g., same depth) immediately adjacent to the primary sub-sample location (e.g., the duplicate is not a split of the primary sample). The duplicate samples were processed using the same procedure used for the primary samples.

Mine waste pile volumes were calculated using field observations and ArcGIS. The area of the mine pile was traced and calculated using ArcGIS and the estimated height of the waste pile was used to calculate the general volume of material. These are rough estimates as many of the waste piles are located on steep slopes, contain steep slopes and drainages within them, and the heights are different at different locations within the pile. The estimated volumes presented here generally represent a maximum potential volume (e.g., assumes a uniform thickness or height).

Laboratory Methods

Samples were submitted to the laboratory and analyzed by several methods as documented by the USGS ACP (USGS ACP, 2025; see method summaries associated with this reference):

- Major elements by wavelength dispersive x-ray fluorescence (WDXRF);
- Minor elements by inductively coupled plasma (ICP) mass spectrometry (MS) or ICP optical emission spectrometry (ICP-MS/ICP-OES);
- Au, Pt, and Pd were measured by lead fusion fire assay;
- Ore grade Au by lead fusion fire assay and ICP-OES; and
- F was measured by digestion and measurement with a F ion selective electrode.

Although this investigation focuses on the critical mineral concentrations, many additional laboratory analyses were conducted by the USGS to provide a complete set of data for future evaluation. These laboratory results are provided in **Appendix B** but not analyzed herein. The USGS ACP (USGS ACP, 2025) has more information about these analyses and laboratory results.

Quality Assurance and Quality Control

All laboratory results were reviewed by the USGS ACP for this project. More information about the laboratory analytical QA/QC is available on the ACP website (USGS ACP, 2025) and is summarized here. QA/QC practices managed by the USGS include submission of analytical duplicates and standard reference materials as unknowns to the laboratory. Samples were reportedly analyzed with 20% submitted as analytical duplicates and reference materials (including blind samples to the analytical laboratory).

The laboratory reports and performance of the duplicates and reference material were provided by the USGS ACP (**Appendix B**). Generally, results of the analysis were deemed acceptable if recovery for all elements was ±15% at five times the Lower Limit of Determination (LOD), the calculated Relative Standard Deviation (RSD) of duplicate samples was no greater than 15% or otherwise deemed acceptable by the ACP as noted. Boron results are for informational purposes only as the results were not certified. Additionally, Re results are for informational purposes only as there is not yet an established preferred value for this analyte and there is insufficient data to calculate the averages for meaningful comparisons (**Appendix B**).

As previously discussed, duplicate samples were collected during this investigation that included fine and coarse duplicate samples from 9 locations. Again, these duplicate samples were not splits from the same composite sample, rather, the duplicates were collected in the same manner as the original sample, along the same grid, but in locations next to the original sample to test the repeatability and precision of the sampling protocol. The fine and coarse sample results from both the primary sample and duplicate samples were averaged and the results are presented in **Appendix C**.

A relative percent difference (RPD) was calculated for each analyte, and they were further evaluated if they exceeded a RPD over 25% (**Appendix C**). Of the 9 pairs of primary/duplicate sample results, the laboratory results of 71 elements were compared (639 comparisons). Of these, 81 comparisons (~12.6%) had RPDs over 25%. However, 45 (56%) of these elevated RPDs were associated with sample results that had low detections and the results are similar. Of the remaining 36 elevated RPDs, 12 of them had elevated RPDs but again, with similar results (e.g., similar orders-of-magnitude). Of the remaining 24 (yellow highlighted results in **Appendix C**): 9 of them occurred in a duplicate collected at the Ballard waste pile in Leadville and indicates that this pile may need to be resampled to obtain more precise results and: 14 of these elevated results were associated with duplicates collected across sites for Au, Mn, Pb, and Zn, indicating that the sampling methodology results in a lower precision result for these analytes. However, differences between the duplicate and primary sample results may also indicate that some waste piles are more heterogeneous than others and that additional samples (> 30 subsamples) may be needed to obtain more representative results.

INVESTIGATION

Initial waste pile sampling target areas were selected based on their location within focus areas and further refined based on accessibility (e.g., safety, and/or land ownership). Mine waste piles in several initial sample target areas were inaccessible and therefore, some areas were added to this investigation after further research. A site location map is presented in **Figure 1**. The field data sheets are included in **Appendix A**. The laboratory reports and a summary of these results are included in **Appendix B**. Chondrite- normalized rare earth element graphs are included within the laboratory results. A summary table for each site that includes more results (e.g., major elements) is included in **Appendix D**. Total REEs (TotalREE) reported here includes the REEs + Sc. Total light REE (TotalLREE) include La, Ce, Pr, Nd, Sm, Eu, and Gd while the total heavy REEs (TotalHREE) include Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y.

The following subsections present a brief history, investigation, and results for each site. An expanded discussion of the geology and mining history of each site is provided in **Appendix E**. A figure showing the SUs sampled is included in the laboratory result summary tables for each site. As presented previously, the results presented here are averages of the laboratory results from the fine and coarse samples collected at each SU. Laboratory results were compared to 5- to 10-times bulk continental crust concentrations. Detected concentrations below 5-times bulk continental crust concentrations are referred to here as “below background” and concentrations above this value are considered “elevated” or “above background”. Bulk continental crust concentrations as reported by Taylor and McLennan (2003) were used in this comparison. Other bulk continental crust concentrations are from McDonough (1995; for Te) and Rudnick and Gao (2003; Pt, F). Elevated concentrations are in reference to these values and are included on the laboratory result summary tables for each site presented below. Upper continental crust averages are also included on these tables for reference purposes as well as for the major elements (Rudnick and Gao, 2003) which are included in the tables presented in **Appendix D**.

Although this report focuses on critical minerals, other metals such as Au, Ag, and Pb were also evaluated with respect to these background concentrations as potential future recovery scenarios may include other elements. Although all these sites are associated with critical mineral focus areas, and mineral systems/deposit types, they are summarized here by mining district as much of the literature and history is based on these names (although the boundaries of mining districts are somewhat arbitrary) (Burnell, 2015).

Perigo Mining District

The Tip Top/Golden Flint Mine (Tip Top) is located ~5 km north of Central City in Gilpin County (**Figure 1**). Although some existing documents associated with this site (EPA, 2019) refer to it as the Tip Top, several reports indicate that this mine is known as the Golden Flint (Lovering and Goddard, 1950, see the northern part of Plate 3; USGS, 1944; Sares and others, 2002; USGS, 2011). Although there is some discrepancy, the Tip Top name is used herein. The mine is located within the Perigo Mining District which is within the larger Northern Gilpin mining district (Lovering and Goddard, 1950; Koschmann and Bergendahl, 1968; Burnell, 2015) and is associated with the Central City-Idaho Springs polymetallic veins focus area (**Table 2**). Placer Au was first discovered in the area in 1859 and the lode deposits shortly after (1860) (Koschmann and Bergendahl, 1968). Generally, as summarized by Koschmann and Bergendahl (1968; page 101), veins in fractures contained Au, Ag, chalcopyrite with galena and sphalerite in places. Bastin and Hill (1917; page 159) report the presence of a mill at the Golden Flint - the original mill was abandoned in 1912, and a new mill was operational by 1913 (Bastin and Hill, 1917; page 159). Metals mined at the property included Au, Ag, and Cu (State of Colorado Bureau of Mines, 1916).

Sampling and Results

Composite samples from three SUs at one waste pile were collected at the Tip Top site on U.S. Forest Service (USFS) property. A portion of SU1 was not sampled as it was too steep to access, and another portion was not sampled as it is on private property. A summary of the laboratory results and estimated volumes are included as **Table 3**. The waste rock piles typically consisted of rock fragments (e.g., granite, schist, and other rock types) and included visible pyrite (oxidized in places) and minor sulfide minerals. Most of the critical minerals were detected at concentrations below 5-times background concentrations. The following critical minerals were detected at elevated concentrations: Bi (4.25 to 9.95 parts per million [ppm]) Te (1.6 to 1.65 ppm), and W (63 to 117 ppm). The TotalREEs (all below background) ranged from 222.8 to 245.2 ppm. Additional elements with elevated concentrations included: Au (1.44 to 3.3 ppm), Ag (1.2 to 1.89 ppm), Mo (11.5 and 14 ppm at SU1 and SU3, respectively), and Pb (135 to 308.5 ppm).

Peru-Argentine Mining District

Three mine waste piles were sampled in the Peru-Argentine mining district (Burnell, 2015) on the eastern side of McClellan Mountain in Clear Creek County on USFS property. These sites are associated with the Montezuma-Breckenridge polymetallic district focus area (**Table 2**). Mine waste was sampled near the Sidney Tunnel and waste rock piles associated with peripheral openings (one shaft and one adit) of the Santiago Mine. The Peru-Argentine district deposits occur in veins and may be related to other deposits in the neighboring Montezuma mining district to the west (see discussion in the Montezuma mining district section below).

Wood and others (2007) give a detailed description of the Sidney Tunnel and associated waste piles. The Sidney Tunnel was constructed beginning in 1902 to target veins beneath other workings in the area around Pendleton Mountain. This mine primarily produced Ag-ore (USFS, 2004; Widmann and Miersemann, 2002; Wood and others, 2007). According to the Mine Reporter (25 July 1907: page 87), mineralization included Pb-ore with Ag. In 1921, about 257 tons of high-grade Ag ore from one of the veins contained Ag with small amounts of Au and Cu. Production from several lodes in the area contained Ag, Au, Pb, and Zn (Wood and others, 2007). Other mine waste sampled in this area included piles associated with a shaft and adit peripheral to the Santiago Mine. The Santiago Mine produced Au, Ag, Pb, Cu, and Zn between

1901 and 1927 (Lovering, 1935). Ore minerals include galena, chalcopyrite, pyrite, and sphalerite (**Table 2**).

Sampling and Results

Composite samples were collected from 2, 1, and 1 SUs at the Santiago 1, Santiago 2, and Sidney waste piles, respectively. Portions of the Santiago 2 and Sidney waste piles were too steep to sample. Rock fragments, quartz, and minor amounts of pyrite were observed at all these sites. A summary of the laboratory results and estimated volumes for the Santiago area and Sidney sites are included as **Table 4** and **Table 5**, respectively. The following critical minerals were detected at elevated concentrations at the Santiago 1 and 2 (most were 10-times above background except for Cs, Rb, and Zn): As (12.5 ppm at the Santiago 2), Bi (0.7 to 26 ppm), Cs (8.05 to 9.4 ppm), In (0.5 to 1.05 ppm), Rb (188 ppm at Santiago SU1), Sb (2.0 to 4.0 ppm), Te (11.4 to 23.35 ppm at Santiago 1), W (16.5 ppm at Santiago 2) and Zn (478 to 682 ppm at Santiago 1). The TotalREE concentration ranged from 224.6 and 286 ppm and most REEs were below background. Additional elements with elevated concentrations at the Santiago 1 and 2 included: Au (0.068 to 0.119 ppm), Ag (7.22 to 152.98 ppm), Cd (2.05 to 3.85 ppm), Pb (2,070 to 8,885 ppm), and Tl (2.5 ppm).

At the Sidney site, the following critical minerals were detected at elevated concentrations: As (31 ppm), Cs (7.55 ppm), Sb (46 ppm), Zn (1,455 ppm), Ce (167 ppm), and Pr (19.75 ppm). Although the REEs Ce and Pr are elevated, all the other REE concentrations are below background. The TotalREE concentration is 410.7 ppm with the TotalLREE comprising 86% of this total. Additional with elevated concentrations at the Sidney waste pile included: Au (0.114 ppm), Ag (151.8 ppm), Cd (7.95 ppm), Mo (7 ppm), Pb (4,060 ppm), Th (29.95 ppm), and Tl (2.5 ppm).

Montezuma Mining District

Mine waste samples were collected from USFS property near the Peruvian Mine and a few piles to the west, referred to here as the Peruvian West area, along the slopes of Ruby Mountain and the north side of Peru Creek, in the Montezuma mining district, Summit County. This area is part of the Montezuma-Breckenridge polymetallic district focus area (**Table 2**). The Peruvian Mine historically produced Ag, Pb, Cu, Zn, and a negligible amount of Au. Neuerburg and others (1974) indicate that the ore included Ag-Pb-Zn veins. Reportedly, ore closer to the surface contained “gray copper” (tetrahedrite and/or tennantite?), galena, sphalerite, and pyrite with a quartz-barite gangue. Deeper ore was higher in Zn content and galena was the most abundant sulfide (Lovering, 1939).

Sampling and Results

Composite samples were collected from 1, 1, and 2 sampling units at the Peruvian West area 1, area 2, and the Peruvian Mine waste piles, respectively, as shown in **Tables 6** and **7**, respectively. Portions of the Peruvian Mine SU2 were too steep to sample. A grab sample of mineralized rock was collected from the Peruvian Mine SU1. Minor amounts of pyrite and other sulfide minerals were observed at all these sites but mostly at the Peruvian Mine waste pile where quartz, barite, and other oxidized sulfides (unknown Mn mineral?) were observed. A summary of the laboratory results and estimated volumes for the Peruvian West and Peruvian Mine waste piles are included as **Table 6** and **Table 7**, respectively. The following critical minerals were detected at elevated concentrations at the Peruvian West sites: As (0 to 141.5 ppm), Ba (1,537 to >10,000 ppm), Bi (16.7 to 28 ppm), Cs (8.9 ppm at MZ1), In (0.5 to 3 ppm), Rb (236 to 277 ppm), Sb (8.6 to 88.25 ppm), Te (1.86 ppm at MZ2), and W (6.5 to 13 ppm), and Zn (6,173 ppm at MZ2). The TotalREEs ranged from 359.5 to 394 ppm with the TotalLREE comprising between 77 and 83% of the totals. Additional elements with elevated concentrations at the Peru West waste piles included: Au (0.034 to 0.1575 ppm), Ag (4.0 to 44.5 ppm), Cd (17.3 ppm at MZ2), Pb (702 to 22,550 ppm), and Tl (4.05 to 4.3 ppm).

The following critical minerals were detected at elevated concentrations in the two composite samples from the Peruvian Mine waste pile where more mineralization was observed compared to the Peruvian West sites: As (98.5 to 281 ppm), Ba (2,789 to >10,000 ppm), Bi (15.7 to 54.4 ppm), Cs (10.8 to 12.2 ppm), Cu (513.5 ppm at SU1), In (1.9 to 5.5 ppm), Rb (199 to 234.5 ppm), Sb (104.3 to 661.5 ppm), Te (1.62 ppm at SU2), and Zn (1,223 to 4,277 ppm). The TotalREEs (all below background) ranged from 376.4 and 397.4 ppm with the TotalLREE comprising between 86 and 87% of the totals. Additional elements with elevated concentrations at the Peruvian waste pile included: Au (0.18 ppm), Ag (26.5 to 175 ppm), Cd (4.75 to 21.2 ppm), Mo (9.5 ppm at SU1), Pb (5,204 to 20,350 ppm), and Tl (3.5 to 3.7 ppm). The Peruvian Mine SU1 mineralized rock grab sample contained similar elements but some were elevated compared to the composite samples including: Au (0.29 ppm), Ag (>200 ppm), As (838 ppm), Bi (80 ppm), Cu (5,026 ppm), In (60.5 ppm), Mn (51,239 ppm), Pb (80,020 ppm), Sb (1,977 ppm), Sr (1,845 ppm), and Zn (119,300 ppm).

Breckenridge Mining District

Mine waste samples were collected from private property with permission at the Extenuate adit area of the Wellington Mine, French Gulch area, Breckenridge, CO in the Breckenridge mining district (Burnell, 2015). This area is in the Montezuma-Breckenridge polymetallic district focus area (**Table 2)**. Lead-silver mining in the French Gulch area began between the late 1880s to the early 1890s. Output declined until 1910 when the Wellington-Oro (Wellington) mine became more active and supplied most of the Pb and Zn ore from the area until 1929 (Lovering and Goddard, 1950). The Wellington primarily produced Pb and Zn as well as some Au and Ag from veins between about 1887 and 1972 (TechLaw, 2021). It was the most productive mine in the Breckenridge mining district. As indicated by Ransome (1911), the veins in the mine consist predominantly of varying amounts of pyrite, sphalerite, and galena with some native Au and Ag whose form is unknown (Lovering and Goddard, 1950). Other gangue minerals included siderite and barite but reportedly were not abundant and occur as veinlets or vug linings (Ransome, 1911).

Sampling and Results

Composite samples were collected from six sampling units containing waste rock at the site as shown in **Table 8**. Portions of some of these sampling units were not sampled due to steep slopes. Additionally, the north side of the entire waste pile has been regraded, and riprap has been placed to the north, therefore, only the exposed slopes and upper portions of the slopes were sampled. Several of the sampling units contained abundant sulfide minerals (e.g., pyrite, sphalerite, galena), quartz, and rock fragments with sulfide veins/veinlets. Additionally, metal, wood, and other materials were observed in several of the SUs. SU3 contained abundant pyrite compared to the other areas. A summary of the laboratory results and estimated volumes are included in **Table 8**. The following critical minerals were detected at elevated concentrations: As (87 to 425 ppm), Ba (1,431 ppm at SU5), Bi (3.35 to 78.5 ppm), Cs (8.55 to 12.4 ppm), In (4.7 to 21.1 ppm), Sb (4.7 to 19.55 ppm), Sn (33 ppm at SU4), Te (2.27 at SU3), W (10 to 19.5 ppm), and Zn (3,277 to 22,550 ppm).

The REEs were detected at concentrations below background with the TotalREEs ranging from 130.7 to 302.7 ppm with the TotalLREE comprising between 81 and 86% of the totals. Additional elements with elevated concentrations included: Au (0.16 to 0.97 ppm), Ag (7 to 86.5 ppm), B (58.5 ppm at SU3), Cd (17.4 to 125.5 ppm), Pb (2,457 to 15,750 ppm), and Tl (2 to 2.95 ppm). Higher concentrations of Au, Ag, As, Bi, and Te were detected in the sample from SU3 where more pyrite was observed at the surface.

Alma Mining District

Mine waste samples were collected from the Orphan Boy Mine (Orphan Boy) in the Greater Alma/Buckskin/Mosquito mining district, located in Park County (Burnell, 2015), on private land with permission. A historic ore stockpile from milling operations at the Duquesne smelter site was also sampled on USFS property on the north side of Sacramento Creek (referred to here as the Sacramento site) (Widmann and others, 2007; see author’s notes, page 10, description of mine waste). Reportedly, this smelter received ore from nearby mines and operated for a short time between 1879 and 1881 (Park County, 2014). It is unknown exactly what mines supplied ore to this operation without more investigation. Both mine waste piles are in the Climax-Sweet Home and other associated focus areas (**Table 2**).

The Orphan Boy operated sporadically between about 1862 and 1950 (Pilcher, 1968) where the ore is composed of massive pyrite with variable amounts (up to 30% of veins) of galena, sphalerite and chalcopyrite with calcite gangue (Scarbrough, 2001). The mine produced Au, Ag, Cu, Pb, and Zn (Scarbrough, 2001). Au is generally not visible and, at the nearby Buckskin Joe mines to the north, is associated with pyrite while a portion of the Au at the Orphan Boy is associated with galena (Pilcher, 1968). Pilcher (1968) reports that the ore is primarily pyrite and sphalerite in a dolomite with the vein filling varying from solid dolomite to nearly solid pyrite. Other minerals include minor amounts of chalcopyrite with smaller amounts of galena, quartz, and barite (Pilcher, 1968). Trace amounts of matildite, aikinite, one or more Au or Au-Ag tellurides, and potentially native Au also occur at the Orphan Boy (Pilcher, 1968).

Sampling and Results

A composite sample (fine and coarse fractions) was collected from the Orphan Boy waste pile and a summary of the laboratory results and estimated volume is included in **Table 9**. The side slopes of this pile were too steep and were not sampled. Abundant unknown sulfide minerals as well as rock fragments were observed in the waste pile. A grab sample of mineralized rock was also collected from this waste pile. The following critical minerals were detected at elevated concentrations in the composite sample: Bi (93.7 ppm), Cu (411.5 ppm), In 6.25 ppm), Sn (75 ppm), Te (11.85 ppm), and Zn (5,250 ppm). TotalREEs (all below background) from SU1 were detected at 100.5 ppm. Elevated concentrations of other elements included Au (2.135 ppm), Ag (93.49 ppm), Cd (31.5), and Pb (3,045 ppm). The grab sample contained some of the same elements at elevated concentrations, although most concentrations were lower, exceptions included Cd, Cu, In, and Sn.

Composite samples were collected from two SUs at the Sacramento site as shown in **Table 10**. A summary of the laboratory results and estimated volumes are also included as **Table 10**. The waste rock piles typically consisted of broken rock and abundant visible sulfide minerals including pyrite and other unknown minerals. A grab sample of mineralized rock was also collected from SU1. The following critical minerals were detected at elevated concentrations in the composite samples: Bi (48.25 to 68.4 ppm), Cu (418 to 669 ppm), In (14.1 to 18.25 ppm), Sb (2 ppm in one sample), Te (2.4 to 3.8 ppm), W (9 to 9.5 ppm), and Zn (9,765 to 15,500 ppm). TotalREE concentrations were relatively low and ranged from 67.8 to 83.7 ppm in the composite samples. Other elements detected at elevated concentrations include Au (5.7 to 6.7 ppm), Ag (37.6 to 44.6 ppm), Cd (61.95 to 101.5 ppm), and Pb (4,715 to 5,850 ppm). The grab sample contained elevated concentrations of similar elements as well as F, As, and Ge.

Leadville Mining District

Mine waste samples were collected from the Penn Group of mines located on the northwest slope of Breece Hill east of Leadville on private land with permission. Specifically, mine waste samples were collected from piles associated with the Penn 3 Mine, Little Prince Mine, Ballard Mine, and President shafts (within the Penn Group of mines on Breece Hill) in the Leadville mining district (Burnell, 2015). This area is in the Central COMB carbonate-replacement deposits focus area (**Table 2**). The geology and ore deposits in the area are complex and are summarized here. More information is included in **Appendix E**. Historically, the district produced Ag, Au, Cu, Pb, Zn and Fe-Mn ore. Bi was also produced as a byproduct of smelting in the district. Galena, or other Pb minerals, from the Leadville district contain up to 6,200 ppm Sb, up to 2,000 ppm Te, up to 1,200 ppm As, and up to 5.5 to -11 weight percent Bi (Chapman and Stevens, 1933; Foord and Shaw, 1989). Bismuthinite, associated with argentite in inclusions with galena is common at Leadville in both primary and secondary ores (Eckel, 1961; Streufert and Cappa, 1994).

The major ore deposits in the district are zoned around the Breece Hill stock and reportedly, this stock was the thermal center of the Leadville mining district (Emmons and others, 1927; Thompson and Arehart, 1990; Wallace, 1993). The Penn was historically known as the Breece Iron mine (Emmons and others, 1927; Cappa and Bartos, 2007). The mines of the Penn Group targeted contact metamorphic-(carbonate) related magnetite-serpentinite-(carbonate) deposits around the Breece Hill stock as well as other deposit types (Emmons and others, 1927;

Thompson and Arehart, 1990; Wallace, 1993). The magnetite-serpentinite deposits, mined for smelter flux between 1880 and 1930, locally also contain Ag and Au, are relatively smaller than other deposit types in the district, and occur locally within 200 meters of the Breece Hill stock (Emmons and others, 1927; Thompson and Arehart, 1990; Wallace, 1993). The iron deposits are composed primarily of magnetite and specularite (80%) but, in places, contain hematite and pyrite with minor chalcopyrite and a little Zn-blende and galena (Emmons and others, 1927). Emmons and others (1927; as summarized by Thompson and Arehart, 1990) indicate that the contact metamorphic bodies contained ~2 to 5.8 ppm Au and ~68.5 to 137 ppm Ag.

Numerous quartz-pyrite-Au veins and veinlets cut the Breece Hill stock (Wallace, 1993). A vein mined at the Penn Group of mines contained a narrow seam of Au and pyrite with chalcocite at depth (reportedly, Cu was mined from the lower levels of the Penn Mine) (Emmons and others, 1927). As indicated by Behre (1953), some mines at Breece Hill contained Au ore that abruptly changed in deeper workings to sulfide deposits that contained lower precious metal concentrations. Several other minerals have been reported from the mines on Breece Hill including argentite, bismutite, bismuthite, and lillianite. Also, as reported by Henderson (1926), most of the galena from the Leadville district contains Sb. Reportedly, Bi is generally rare in other portions of the Leadville district but occurs as intergrowths in galena with argentite and in the oxidized ore at Breece Hill (Henderson, 1926). Other minerals associated with Bi include tellurides (hessite, altaite, tennantite and chalcopyrite), galeno-bismutite, argentite, and native Ag (Behre, 1953). Bi ore was produced from mines on Breece Hill including the Ballard, Big Six, and Penn group mines (bismuth minerals were also found at the Little Prince) (Henderson, 1926). This ore, reportedly (Henderson, 1926; page 155) contains a mixture of Bi-carbonate and oxide and ranges from 2 to 40% Bi and 1.5 ppm Au (Henderson, 1926). The Balllard Mine and others produced over ~6.8 metric tons of Bi between 1904 and 1906 (Henderson, 1926).

Sampling and Results

Ten composite samples were collected from 4 waste piles including the Little Prince, President, Penn 3, and the Ballard waste piles. Sampling locations, a summary of the laboratory results, and estimated volumes are included in **Table 11**. One composite sample was collected from the Little Prince waste pile that contained rock fragments (altered siliceous carbonate?) and minor sulfides (oxidized pyrite) (**Table 11**). Critical minerals detected at elevated concentrations at the Little Prince included: As (122.5 ppm), Bi (91.2 ppm), Cu (416.5 ppm), In (3.6 ppm), Sb (47.9 ppm), Sn (17.5 ppm), Te (4.01 ppm), W (15.5 ppm), and Zn (677 ppm). REEs were all below background (TotalREE = 169.2 ppm). Other elements detected at elevated concentrations included: Au (0.95 ppm), Ag (29 ppm), Cd (3.25 ppm), Mo (5 ppm), Pb (857.5 ppm), and Tl (4.3 ppm).

Three SUs were collected from the President waste pile (**Table 11**). The waste piles contained rock fragments (altered rock) and minor sulfides (mostly oxidized pyrite) with some quartz. SU2 had less visible mineralization but also contained altered rock fragments as well as porphyritic rock material. A portion of SU3 was not sampled as the slopes were too steep. SU3 also contained several old building ruins that were avoided during sampling. Critical minerals detected at elevated concentrations in the three SUs at the President waste pile included: As (77.5 to 137.5 ppm), Ba (1,529 ppm at SU2), Bi (69.5 to 182 ppm), Cu (714.5 to 930.5 ppm), In (4.7 to 7.25 ppm), Sb (10.5 to 28.75 ppm), Te (28.84 to 36.67 ppm), W (25 to 43 ppm), and Zn (532 at SU1). REEs were mostly below background levels, with TotalREEs ranging from 147.4 to 224.9 ppm. Other elements detected at elevated concentrations included: Au (1.379 to 2.62 ppm), Ag (12 to 22 ppm), Cd (0.75 to 1.3 ppm), Mo (5.5 to 8 ppm), and Tl (2.2 to 2.3 at SU2 and SU3, respectively).

Three SUs were collected from the Penn 3 waste pile (**Table 11**). The three SUs contained altered rock fragments and minor sulfide minerals (oxidized pyrite). Portions of SU1 and SU2 could not be sampled due to steep slopes. Critical minerals were detected at elevated concentrations in the three SUs at the Penn 3 waste pile included: As (504 to 936.5 ppm), Ba (1,561 and 2,065 at SU1 and SU3, respectively), Bi (373.5 to 490.5 ppm), Cu (885 to 1,997 ppm), In (7.45 to 20.25 ppm), Sb (145 to 181 ppm), Sn (34.5 to 57.5 ppm), Te (26.79 to 36.72 ppm), and W (39.5 to 54 ppm). REEs were mostly below background levels, with TotalREEs ranging from 155.9 to 204.7

ppm. Other elements detected at elevated concentrations included: Au (2.365 to 5.22 ppm), Ag (39 to 39.5 ppm), B (62 and 63 ppm at SU1 and SU3, respectively), Cd (2.1 to 3.8 ppm), Mo (6.5 to 11.5 ppm), Pb (1,407 to 3,210 ppm), and Tl (5.8 to 9.9 ppm).

Three SUs were collected from the Ballard waste pile (**Table 11**). These contained altered rock fragments and very little visible mineralization (minor pyrite was observed at SU3). Critical minerals detected at elevated concentrations in the three SUs at the Ballard included: As (679.5 to 1,571 ppm), Bi (343.5 to 1,795 ppm), Cu (876.5 to 1,368 ppm), In (7.35 to 10.4 ppm), Sb (116.75 to 357 ppm), Sn (15.5 and 18.5 ppm at SU1 and SU2, respectively), Te (15.09 to 23.62 ppm), W (19 to 43.5 ppm), and Zn (1,008 to 1,699 ppm). REE concentrations were all below background and the TotalREEs ranged from 126.5 to 155.9 ppm. Other elements detected at elevated concentrations included: Au (1.465 to 3.75 ppm), Ag (28.5 to 55.5 ppm), B (50.5 ppm at SU2), Cd (10.3 to 15.65 ppm), Pb (4,884 to 6,921 ppm), and Tl (9.7 to 31.55 ppm).

Eureka/San Juan Mining District area

All the sites sampled are in the Eureka/San Juan mining districts (Burnell, 2015) (**Figure 1**). They are all associated with the Central Colorado epithermal Au-Ag and Silverton focus areas (**Table 2**).

Highland Mary Mill

The Highland Mary mill tailings are in the South Silverton mining area, Cunningham Gulch, near Silverton, Colorado. A composite sample was collected from the tailings associated with this historic mill on Bureau of Land Management (BLM) property, with permission, and a portion of the pile (to the south) was not sampled as it is located on private land. The tailings are processed material from the historic Highland Mary Mine located ~366 m from the mill and ~200 m higher (King and Allsman, 1950). The mine produced ore from fracture zone veins within the Shenandoah-Dives vein system (Varnes, 1963). The Highland Mary ore primarily consisted of galena, chalcopyrite, and pyrite with other minerals including sphalerite, tetrahedrite, and native Au with quartz and calcite gangue. Ore minerals reported by King and Allsman (1950) indicate the same as above but include tennantite and these authors indicate that the precious metals are (p. 104) "*usually associated with the gray copper minerals but also with the galena.*" Between 1901 and 1957, the Highland Mary and Trilby Tunnel mines produced Au, Ag, Cu, Pb, and Zn (Varnes, 1963).

Sampling and Results

One composite sample (only a fine fraction sample as no material over > 2mm existed in the sample) was collected from the Highland Mary tailings pile. The location of the SU and a summary of the laboratory results are provided in **Table 12**. The sample was moist, collected in the field, and then later sieved after it dried. Material in the waste pile was fine grained, mostly quartz and other silicate minerals, and no mineralization was visible (e.g., sulfide minerals). The top of this pile was reworked, appeared to be revegetated, and therefore was not sampled. Critical minerals detected at elevated concentrations included: As (42 ppm), Cs (13.8 ppm), Li (101 ppm), Rb (207 ppm), Sb (53.3 ppm), W (10 ppm), and Zn (470 ppm). REEs were below background and the TotalREE concentration is 111 ppm. Other elements detected at elevated concentrations included: Au (0.905 ppm), Ag (31 ppm), Cd (2.6 ppm), Mo (84 ppm), Pb (1,536 ppm), and Tl (3.8 ppm).

<u>Mayflower Mill</u>

Several samples were collected from the Mayflower tailings pile 4 (Pile 4) located on the east side of Silverton, Colorado. This area is part of Operable Unit 2 of the EPA Region 8 Bonita Peak Mining District Superfund Site (Bonita Peak) (EPA, 2024a). During this investigation, the EPA was regrading this area to use as a disposal location for additional mine waste from the Bonita Peak Superfund Site. The Bonita Peak area includes a large portion of the San Juan Mining District which historically produced Au, Ag, Pb, Cu, and Zn (though Zn was often left unrecovered). Ore material included mainly banded quartz and pyrite, but some ores contained galena, sphalerite, chalcopyrite, and various Ag minerals (Burbank and Luedke, 1969).

The Mayflower Mill (also known as the Shenandoah-Dives Mill) was built in 1929, started production in 1930, and processed ore from the region (Jones, 2007). The mill operated until 1991 and processed between 300 and 1,200 tons per day using flotation, concentrator, and amalgamation milling methods during its lifetime (Jones, 2007; EPA, 2022). Pile 4 (or TP-4) was constructed in 1976 and reclaimed between 1989 and 2006 (SGC, 2020). The Sunnyside Gold Corporation (SGC) reportedly processed ore from the Sunnyside Mine for 5 years and the tailings from this processing were placed in the upper level of Pile 4 (Knight Piesold, 2018). SGC also relocated ~80,000 tons of mostly historic mine waste and tails to TP-4 and performed remedial activities (e.g., regrading, reseeding, etc.) at this mine waste pile (Knight Piesold, 2018).

Due to the complex history of Pile 4, this report does not attempt to determine the precise source of the tails in this pile. However, the Sunnyside group is located ~11.2 km northeast of Silverton and includes the Gold King, American Tunnel, and Mogul mines. These mines accounted for >50% of the Au, Ag, Cu, Pb, and Zn production from San Juan County. Some of the main ore minerals include galena, sphalerite, chalcopyrite, and tetrahedrite. Gangue minerals include rhodonite and rhodochrosite (Blood, 1968).

Sampling and Results

The SU locations, a summary of the laboratory results, and estimated volume are included in **Table 13**. Only portions of the Mayflower tailings pile were exposed, therefore only 2 composite samples were collected in these exposed areas and likely do not represent the concentrations in the entire pile. SU1-comp1 was collected in an area being regraded, including some material from the old tailing pile cap (e.g., gravel), and the finer fraction was mostly quartz, feldspar, other unknown black minerals, and pyrite. SU2-comp2 was collected from a regraded area where mostly tailings were exposed that contained ~20 to 25% pyrite, quartz, feldspar, and other unknown minerals. Two channel grab samples were collected: Grab 1 was collected in a small (~0.3 meter) cut at the base of the tailings pile (fine to coarse sand, well sorted, yellowish tan with iron oxides); Grab 2 was collected at the top of the tailings pile adjacent to SU2-comp1 where grading activities had exposed tailings (~1 meter exposure, mostly quartz, feldspar, and other unknown minerals).

Critical minerals detected at elevated concentrations in the two composite samples (SU1-comp1 and SU2-comp2) included: F (0.293% at SU1-comp1), As (34 to 35.5 ppm), Bi (12.1 to 14.25 ppm), Cu (944.5 to 993.5 ppm), In (3.8 to 4.55 ppm), Mn (9,072 to 33,135 ppm), Sb (16.7 to 20.25 ppm), Te (6.17 to 8.01 ppm), W (56.5 to 90.5 ppm), and Zn (7,504 to 7,941 ppm). REEs were detected below background and the TotalREE concentrations ranged between 119.8 to 139.6 ppm. Other elements detected at elevated concentrations included: Au (0.93 and 1.49 ppm), Ag (17.5 and 29.5 ppm), Cd (31.55 and 36.65 ppm), Mo (9 and 11.5 ppm), Pb (4,138 and 5,555 ppm), and Tl (2.35 ppm).

Elevated concentrations of critical minerals detected in the two grab samples were similar to the composite samples and included: F (2.359% in Grab2), As (10 to 32 ppm), Bi (13.7 to 17.7 ppm), Cu (266 to 2,041 ppm), In (1.2 to 5.3 ppm), Mn (7,196 to 80,280 ppm), Sb (22 to 47.4 ppm), Te (2.97 to 6.6 ppm), and Zn (2,196 to 28,700 ppm). REEs were below background with TotalREEs ranging from 40.1 to 72.1 ppm. Other elevated element concentrations include Au (1.33 to 2.03 ppm), Ag (17 to 99 ppm), Cd (7.6 to 105 ppm), Mo (10 to 13 ppm), Pb (1,986 to 11,900 ppm), and Tl (3.2 ppm in Grab 1).

Brookyln Mine

The Brookyln Mine is located near the western boundary of the Silverton caldera, in the south portion of the Red Mountain mining district, San Juan County. Samples were collected from the waste pile associated with Level 1 of the Brooklyn Mine. Access to sample was obtained by Colorado Division of Reclamation, Mining and Safety (DRMS) representatives. The Brooklyn Mine targeted a quartz-pyrite vein containing native Au, sphalerite, galena, and chalcopyrite (Burbank and others, 1972; Neubert and others, 1992; Rosemeyer, 2002). Rosemeyer (2002) reports other minor or trace minerals. Along portions of the vein, narrow fissures contain native Au associated with minor manganiferous carbonate and pyrite (Burbank and others, 1972). The main Brooklyn vein cuts several faults and narrow veins that contain lower Au and Ag concentrations and consist of quartz, pyrite, sphalerite, and galena (Rosemeyer, 2002). The Brooklyn Mine produced Au, Ag, Cu, Pb, and Zn (Neubert and others, 1992).

Sampling and Results

One composite sample was collected from the Brooklyn waste pile and a summary of the laboratory results and estimated volume is included in **Table 14**. The top of the pile includes a flat area with a road and several abandoned buildings and debris and therefore, was not sampled. The waste rock material included altered rock fragments, quartz, abundant sulfide minerals (pyrite). Additionally, wood, metal, nails, coal, and potentially slag was observed in the pile. The composite sample was moist due to recent rains, collected on-site, and then sieved later after it dried. Elevated concentrations of critical minerals included: As (75 ppm), Bi (26.1 ppm), Cs (8.15 ppm), In (2 ppm), Rb (213.5 ppm), Sb (29.6 ppm), Te (10.2 ppm), and W (6 ppm). REEs were generally below background and the TotalREE concentration is 244.8 ppm. Other elements detected at elevated concentrations include Au (5.19 ppm), Ag (28.5 ppm), Cd (1.05 ppm), Mo (7 ppm), Pb (2,706 ppm), and Tl (5.15 ppm).

North Star Mine

The North Star mine waste piles sampled during this investigation are located about 0.8 km west of downtown Silverton, Colorado. Piles sampled are located just below the Level 5 adit to the historic mine. Larger piles on this property are associated with the lower portions of the mine (Level 6 and 7) and were placed near the historic North Star mill, adjacent to Mineral Creek and lower in elevation, but were not sampled due to safety concerns (e.g., steep slopes) and remedial activities (EPA, 2024b). The sample is located on private property and access was obtained from the property owner.

Musgrave and Thompson (1991) report that major vein minerals in the north end of the Sultan Mountain Stock area (where the North Star is located) include quartz, sulfides, carbonates, and barite (in some locations) (Musgrave and Thompson, 1991). They included 25 additional minerals from the nearby Pittsburg level (to the south) including, by estimated abundance of total vein volume: quartz (30-95%), pyrite (10-15%), chalcopyrite (5%), rhodochrosite-siderite (2%), tetrahedrite (2%), galena (1-2%), and sphalerite (1-2%). Other minerals less than 0.5% include Au and several others (Musgrave and Thompson, 1991). Sulfide content of the vein material at the North Star Level 7 (~40%) may be greater than the Pittsburg level (~20%) based on their preliminary inspection (Musgrave and Thompson, 1991). As reported by other authors (King and Allsman, 1950; p. 66), principal ore minerals associated with the vein system include galena, sphalerite, and chalcopyrite. Native Au and Ag may also be contained in the sulfide minerals. Ransome (1901) reports that the veins at the North Star contained abundant quartz, with some barite, and sulfide mineralization that included galena, tetrahedrite, pyrite (reportedly containing some Au), sphalerite, chalcopyrite, as well as some native Au.

Sampling and Results

Two composite samples and one mineralized rock grab sample were collected from the North Star Mine waste pile. The location and laboratory results are summarized in **Table 15**. The samples were moist when collected due to recent rains and then sieved later in the laboratory after they dried. The waste rock piles contained altered rock fragments, quartz vein material, pyrite, and other unknown minerals. Elevated concentrations of critical minerals detected in the composite samples included: As (262 to 286 ppm), Bi (19.05 to 41.25 ppm), Cs (24.3 to 28.75 ppm), In (0.6 ppm), Rb (279.5 to 293 ppm), Sb (371 to 659.5 ppm), Te (2.63 to 4.08 ppm), W (61 to 89 ppm), and Zn (956.5 ppm in SU1). REE concentrations were below background and ranged from 199.6 to 227.6 ppm. Other elements detected at elevated concentrations included: Au (0.523 to 0.66 ppm), Ag (31 to 89 ppm), B (111.5 to 140.5 ppm), Cd (1.45 to 4.5 ppm), Mo (8.5 to 18.5 ppm), Pb (2,133 to 13,700 ppm), and Tl (5.25 to 5.8 ppm). Analysis of the mineralized rock grab sample from SU2 generally detected elevated concentrations of similar critical minerals but also included Cu (2,329 ppm) as well as elevated concentrations of Au (13.13 ppm) and Ag (>200 ppm).

La Plata Mining District

The mine waste sampling areas are included in the La Plata polymetallic district focus area (**Table 2**) and are discussed below. DRMS obtained access to sample these sites.

<u>*Columbus Mine*</u>

Veins at the Columbus Mine are within a pyrite-rich shear zone and the ore material contains quartz, pyrite, calcite, and possible Au tellurides (Neubert and others, 1992; Eckel, 1949). Recorded production from the Columbus Mine included Au, Ag, Cu, and Pb (Neubert and others, 1992). Additional geochemical sampling results for many mine waste piles in the La Plata mining district are available in Neubert and others (1992).

Sampling and Results

Three composite samples from the Columbus waste rock were collected from 3 SUs. The location and summary of the laboratory results are included in **Table 16**. SU3 appeared to contain more tailings (e.g., finer grained, processed material) than the other SUs. The waste rock piles typically consisted of rock fragments (quartzite, silicified siltstone/mudstone, and syenite?), massive quartz vein material, and minor sulfide minerals (pyrite and potentially other sulfides). Elevated concentrations of critical minerals detected in these samples included: As (394.5 to 699.5 ppm), Ba (1,361 to 5,840 ppm), Cs (17.45 to 37.4 ppm), Ge (8 to 8.5 ppm at SU3 and SU1, respectively), Sb (43 to 90 ppm), Te (3.7 ppm at SU1 and SU3), and W (40 to 107.5 ppm). REEs were generally below background and the TotalREE concentrations ranged between 117.8 and 151.5 ppm. Other elements detected at elevated concentrations included Au (0.312 to 3.195 ppm), Ag (1.29 to 6.92 ppm), B (57 to 164.5 ppm), Mo (5 to 34 ppm), Pb (65.5 to 119 ppm), and Tl (2.5 to 9 ppm).

Doyle Group area

The Doyle Group consists of several historic mines located on the north side of the East Mancos River in the La Plata Mountains, Montezuma County. Waste piles associated with the Doyle 2 (Northstar), Doyle 3 (Northstar/Sundown shared portal), and Thunder mines were sampled during this investigation. The Doyle Group deposits include Au-bearing replacement and pyrite vein deposits (Eckel, 1949). Per Eckel (1949), ore includes fine to coarse granular pyrite containing Au and a little chalcopyrite as well as veins with pyrite and quartz. Some areas contain massive Au-bearing pyrite with abundant quartz (Eckel, 1949). Per Neubert and others (1992), although records from this area are incomplete, production from the area included Au, Ag, and Cu. Most of the production was from the North Star-Sundown mine. Although pyrite was the only sulfide identified by Neubert and others (1992), they also report free Au, malachite staining, and the potential for Au-Te minerals based on their laboratory analysis of samples collected from within the North Star-Sundown mine. They also report that Ag and most of the base metals are absent and that Co concentrations were elevated (> 100 ppm) in many of the samples which was often higher than Cu, Pb, and Zn concentrations. Lower Au concentrations (generally less than 1,000 ppb) were detected in samples collected from the silicified sedimentary rocks in this area which contains varying quantities of disseminated pyrite and/or limonite (Neubert and others, 1992).

A mine waste pile of the Thunder Mine was also sampled during this investigation. According to Eckel (1949), Au and Ag occur in the ore deposit. The lower adit of the Thunder Mine follows a vein that intersects a fracture zone containing limonite gouge and pyritized breccia (Eckel, 1949; Neubert and others, 1992). An upper adit contains more pyrite, brecciated sandstone, gouge, quartz, and galena (Eckel, 1949). Historic analyses of samples from this area contained a maximum of 0.140 ppm Au and 1,500 ppm Zn with anomalous concentrations of As (3,190 ppm) in an ore-bin sample (Neubert and others, 1992).

Sampling and Results

Two composite samples were collected from two SUs at the Doyle Group waste rock piles and one sample was collected from the Thunder waste rock pile. The location and results are included in **Tables 17** and **18,** respectively**.** Additionally, one mineralized rock grab sample was collected from SU2 at the Doyle Group. Portions of SU1 at the Doyle Group and SU1 at the Thunder were not sampled as they were too steep in areas. The Doyle Group piles contained rock fragments (primarily fine to very fine crystalline limestone) and abundant amounts of pyrite. The Thunder waste pile contained rock fragments (dominantly sandstone) with abundant sulfides (pyrite, arsenopyrite, and other potential sulfide minerals). Elevated critical minerals detected at the Doyle Group waste piles included: As (44.5 to 59.5 ppm), Bi (17.4 to 24.1 ppm), In (0.4 to 1.6 ppm), Sb (7.5 to 11 ppm), Sn (16.5 ppm at SU1), Te (5 to 9.15 ppm), and W (19 to 56 ppm). REEs were detected at low concentrations and ranged between 69.1 and 116.7 ppm. Additional elements detected at elevated concentrations included: Au (4.145 and 4.354 ppm), Ag (2.12 and 4.11 ppm), Mo (6 and 10 ppm), Pb (82 and 286.5 ppm), and Tl (2 ppm at SU1). Analysis of the mineralized rock grab sample from SU2 detected similar critical minerals (As, In, and Sb were not detected at elevated concentrations) as well as Co (378 ppm), Re (0.02 ppm) and lower concentrations of other elements (e.g., Au at 0.447 ppm).

Elevated concentrations of the following critical minerals were detected at the Thunder waste pile: As (344.5), Bi (3 ppm), Sb (28 ppm), and W (23.5 ppm). REE concentrations were low and the TotalREE concentration is 45 ppm. Other elevated element concentrations detected at the Thunder included: Au (0.3 ppm), Ag (5.06 ppm), Mo (5 ppm), Pb (126.5), and Tl (86 ppm).

Northgate Mining District

Mine waste samples were collected from a tailing disposal area and waste piles near the Gero Tunnel and Penber fluorspar mines in northern Jackson County about 21.7 km north of Walden and 7.2 km north-northeast of Cowdrey (**Figure 1**). DRMS obtained access to sample these waste piles. The Northgate mining district is within the Northgate district focus area. About 32% of the total fluorspar production in Colorado (before 1975) was mined from this district (Brady, 1975).

The largest deposits of fluorspar in the Northgate mining district occur along faults on Pinkham Mountain and are associated with vein zones (Steven, 1960). Samples were collected from the mine tailings and waste piles associated with this vein zone at the historic Gero and Penber Mine. The fluorspar in this area occurs as veins and breccia filling where the former contains (Steven, 1960: p. 393) "*greenish, yellowish, or colorless fluorite which occurs in botryoidal layers with finely granular to columnar structure…..In the Northgate district, the fluorspar consists largely of fluorite intermixed with finely granular quartz, chalcedony, wallrock fragments, and other minor impurities."* General grades of fluorite in the Fluorspar-Gero-Penber vein zone range between 40 and 80% CaF_2 (Steven, 1960). Sulfide minerals are rare in vein zones (Steven, 1960). Minor quantities of quartz, pyrite, barite, and Mn oxides occur in some of the deposits in the Northgate district (Brady, 1975; Shawe and others, 1976). Mo was detected in anomalous amounts in the wallrock next to the fluorspar veins (up to 800 ppm in wallrock and decreasing away from the vein) where (USGS, 1970; p. A5) "*dark-gray veinlets are pervasive through the rock, even along mineral cleavage planes, and are composed of a fine mixture or intergrowth of fluorite, chalcedonic quartz, pyrite, and in one place, molybdenite.*" Pure fluorite from vein systems in the area contain trace Ba, Mn, Sr, and Y while trace amounts of Zn, Cu, and Ag occur in Mn oxide zones (Shawe and others, 1976).

Sampling and Results

Three SUs were sampled at Northgate waste piles and two mineralized rock grab samples were collected. The locations and a summary of the sampling results are provided in **Table 19**. SU1 contained waste rock and SU2 and SU3 contained tailings. Portions of SU1 were not sampled as some areas were too steep. Additionally, portions of SU2 and SU3 were not sampled due to water and vegetation. SU1 contained abundant fluorite while the material at SU2 and SU3 was too fine/altered to identify. Elevated concentrations of critical minerals in the composite samples included F (1.25 to 5.14%), As (126 to 282 ppm), Bi (0.45 ppm at SU1), Cs (8.4 to 9.6 ppm), Rb (224 and 288 ppm at SU3 and SU2, respectively), Sb (2.0 to 7.0 ppm), Ta (5.2 at SU3), and W (13 to 21 ppm). REE concentrations were generally low with TotalREE concentrations ranging from 110.7 to 174. 3 ppm. Other elements detected at elevated concentrations include Mo (31 to 164 ppm) and Tl (4 to 8 ppm).

The mineralized grab samples contained some elevated concentrations of critical minerals including: F (18% in Grab1), As (36 to 923 ppm), Sb (4 ppm in Grab2), and Y (209 in Grab 1). The Grab 1 sample was dominantly fluorite. Other elements detected at elevated concentrations included: Mo (9 to 290 ppm) and Tl (21 ppm in Grab2). TotalREE concentrations ranged from 312.2 ppm (dominantly Y) in Grab 1 to 49.6 ppm in Grab2.

DISCUSSION

During this reconnaissance investigation, several critical minerals and other elements were detected in surface samples from historic mine-related waste at concentrations 5- to 10-times above bulk continental crust estimates provided by others (Taylor and McLennan, 2003; Rudnick and Gao, 2003; McDonough, 2003). Elevated detections (above 5-times bulk continental crust) of critical minerals for all the sites are summarized in **Table 20**. Other elements (currently not critical minerals) (e.g., Au, Ag) are shown as the potential for future extraction of many of the critical minerals may be based on the primary recovery of these other elements. Fine (< 2 mm) and coarse (> 2 mm) samples were collected at most of the sites (from a depth of ~5 cm) and averaged for this evaluation as the amount of each in the waste pile is unknown. **Figure 3** compares the fine and coarse sample results for select critical minerals (Bi, In, Sb, Te, Zn, and Cu) as well as Au and Ag. As shown in **Figure 3**, higher concentrations of Bi, In, Sb, Te, Au, and Ag were generally detected in the fine sample fractions. Generally, fine and coarse fraction concentrations of Cu and Zn were similar across most of the sites.

Generally, the concentrations of Bi, In, Sb, Te, and Zn were elevated at many sites above 10-times bulk crustal composition (**Table 20**). Based on these elevated concentrations, a few sites that contained higher concentrations of several critical minerals and other elements, as well as higher volumes of material, are discussed here especially in areas where other waste piles exist and where additional sampling could be conducted.

Laboratory results from the samples collected from the Leadville mining district (Little Prince, President, Penn 3, and Ballard) detected some of the highest concentrations for several critical minerals including: As (77.5 to 1,571 ppm), Bi (69.2 to 1,795 ppm), Cu (416.5 to 1,997 ppm), In (3.6 to 20.25 ppm), Sb (10.5 to 357 ppm), and Te (4.01 to 36.72 ppm) (**Table 20**). These piles also contained elevated Au (0.95 to 5.22 ppm), Pb (721 to 6,921), and lower concentrations of Ag, Sn, W, and other elements with a combined estimated volume of 118,000 m^3. Bi was mined in this area in the past and Te, Sb, and Ag related mineralization are known to occur in this area. There are several other waste piles in the Breece Hill area, as well as many others throughout the

Leadville district. Therefore, additional investigation is recommended if and where access can be obtained.

Although the sampling at the Mayflower site in the Eureka Mining District may not be representative of the pile (e.g., two small areas and two grab channel samples were collected), it is of interest with regard to critical minerals due to its volume and due to the elevated concentrations of Bi (12.1 to 17.7 ppm), Cu (266 to 2,041 ppm), In (1.2 to 5.3 ppm), Mn (7,196 to 80,280 ppm), Sb (16.7 to 47.4 ppm), Te (2.97 to 8.01 ppm), W (63 to 139 ppm), and Zn (2,196 to 28,700 ppm) detected in the samples. The concentration of other elements, such as Au (1.93 to 2.03 ppm) and Pb (1,986 to 11,900 ppm), were also elevated (**Table 20**). Again, additional investigation, especially at depth, would be required to verify these results as well as volumes. Some of the higher concentrations detected here were associated with a grab sample while much of the pile was unexposed and covered with fill during this investigation (see the Results section of this report for more information).

Many of the large piles at the North Star site were inaccessible due to very steep slopes. Analysis of samples from limited areas at this location detected elevated concentrations of several critical minerals including Bi (19.05 to 41.25 ppm), Cs (24.3 to 28.75 ppm), In (0.6 ppm), Rb (279.5 to 293 ppm), Sb (371 to 659.5 ppm), and Te (2.63 to 4.08 ppm) (**Table 20**). Other elements detected at elevated concentrations included Au (0.52 to 0.66 ppm). A mineralized rock sample analyzed from this pile detected Au at 13.13 ppm (the highest Au concentration detected during this investigation) and Ag at >200 ppm. Although the estimated volume was relatively small (16,000 m^3), the other large piles in this area may make this site more interesting with regard to critical minerals as well as precious metals.

The Wellington site in the Breckenridge Mining District contained elevated concentrations of critical minerals including Bi (3.35 to 78.5 ppm), Cs (8.55 to 12.4 ppm), In (4.7 to 20.85 ppm), Sb (4.7 to 19.55 ppm), Sn (33 ppm), and Zn (3,277 to 22,500 ppm) (**Table 20**). Elevated concentrations of Au (0.16 to 0.97 ppm), Ag (7 to 86.5 ppm), Pb (2,457 to 15,750 ppm) and other elements were also detected. Although still relatively small, the volume of the entire waste pile in this area was over 110,000 m^3 but could be larger as the backside of the pile was not included in this estimate. Additionally, there are several other mine waste piles in this area and therefore, additional investigation is recommended to verify the results and to find additional sampling opportunities.

Laboratory analysis of samples collected in the Alma area at the Sacramento and Orphan Boy sites detected elevated concentrations of several critical minerals including Bi (48.25 to 93.7 ppm), Cu (411.5 to 669 ppm), In (6.25 to 18.25 ppm), Te (2.4 to 11.85 ppm), and Zn (5,250 to 15,500 ppm) (**Table 20**). Additional elements with elevated concentrations included: Au (2.14 to 6.73 ppm), Ag (44.59 to 93.49 ppm), and Pb (3,045 to 5,850 ppm). Although one of the piles was relatively small (~3,600 m^3) and historically known as an ore stockpile, many other mine waste piles exist in the surrounding area.

The samples from the Northgate tailings, a historical fluorite mining site, contained between 1.25 to 3.26% fluoride and had a combined estimated volume of over 3 million m^3 (**Table 19** and **20**). However, this was a very rough estimate as much of the tailings were unexposed, and the depth is unknown. A grab mineralized fluorite sample from this area had an elevated detection of Y (~200 ppm) and a few other critical minerals were elevated at this site including Ce. If F is of interest to future assessments, additional investigation at this site would be required to obtain more precise estimates.

Most of the TotalREE laboratory results were below 200 ppm. The laboratory analysis of samples from the Sidney (Peru-Argentine mining district) and Peruvian (Montezuma mining district) sites were over 300 ppm TotalREE. The two elevated concentrations of the REEs from composite samples were for Ce and Pr at the Sidney site. Both were elevated in the Montezuma mining district samples but below 5-times bulk continental crust concentrations.

This investigation focused on composite surface samples (~5 cm). More investigation, especially at depth, would be needed to verify these results, and to more precisely estimate the volume and concentration of these critical minerals and other elements, as well as verify the precision of the sampling methods. Waste rock and tailing piles could be stratified depending on the source of the material, when it was placed, remobilization of elements, and many other factors. Additionally, bulk density measurements (tonnage factors) of the waste pile material are needed to calculate estimated endowments of these waste piles. This is an important factor regarding mineral economic assessments. However, the concentrations and estimated volumes are provided if future evaluations necessitate the need to estimate bulk density and provide estimated potential mineral endowments.

Colorado contains an abundance of historic mine waste piles, and it would take an indefinite period to obtain access to these sites and characterize them all for critical minerals. Several inventories of historic mine features, including waste piles, have been conducted in Colorado (O'Keeffe and others, 2019; Sares and others, 2011) but as most people working at these sites know, the only way to determine how many waste piles are at a site is to perform a survey in the field. As mentioned previously, many of the relatively large mine-related waste piles are associated with federal and state remediation activities where waste rock and/or tailings have been consolidated, capped with liners or vegetation cover, and where subsurface investigations would be required as the tailings are not exposed on the surface. These sites include additional areas of the Mayflower tailings pile sampled during this investigation, the consolidated tailings pile at the Eagle Mine located near Minturn, CO, the Summitville Mine waste piles, and many more. Additionally, mine waste piles from active mines could also be sampled if access could be obtained in the future.

CONCLUSIONS AND RECOMMENDATIONS

All the waste piles sampled during this investigation contained elevated concentrations of critical minerals above 5- to 10-times bulk continental crust concentrations (**Table 20**). Laboratory analysis of samples from most of the sites detected critical minerals above 10-times bulk continental crust concentrations especially for As, Bi, In, Sb, Te, W, and Zn. Other critical minerals detected at several sites generally above 5-times bulk continental crust concentrations included Ba and Cu with a few sites where elevated concentrations of Mn, Cs, Rb, and Sn were detected. Other elements were detected at most of the sites above 10-times bulk continental crust concentrations including Au, Ag, Cd, and Pb. Lower concentrations (5-times bulk continental crust) of Mo and Tl were detected at some of the waste pile sites. Generally, TotalREEs were below 300 ppm at many sites, and Pr and Ce were detected above 5-times bulk continental crust at one site (Sidney).

The geochemical information from several sites warrants additional investigation as many of them are within large mining districts that contain several additional waste piles. This includes the Leadville, Eureka, Alma, and Breckenridge mining districts as the piles sampled in these areas contained elevated concentrations of critical minerals, as well as other elements, and have areas with several larger waste piles. However, as observed during this investigation, obtaining access to some sites may be difficult in Colorado due to land ownership and the substantial number of patented claims in many areas in and around historic mining districts.

This investigation utilized near-surface (~5 cm depth) composite sampling of fine and coarse fractions at field designated SUs. Analysis of primary and duplicate samples collected and processed independently revealed element concentrations that differed by more than 25% RPD in some cases. These discrepancies may reflect heterogeneity in the waste material or limitations in the sampling protocol, indicating a need for more robust field procedures. Additionally, the designation of SUs in the field is somewhat arbitrary (e.g., based on general composition, if the waste pile appears to have been deposited at different time, varying material). Future investigations should adopt standardized SU designation criteria and consider the potential cost implications of increased sample numbers and laboratory analyses.

Although the composite sampling protocol may provide some information about critical mineral concentrations in the waste piles, many are likely not homogenous, especially at depth, and therefore additional sampling at depth would be required to provide a more precise assessment of potential critical mineral endowments. The collection of samples at depth for general grain size analysis may also assist with determining future reprocessing methods.

Field conditions posed significant challenges for sampling. Many waste piles contained areas of cemented material, with intermixed fines and coarse fragments, resulting in steep and slippery conditions and increased fall hazards. Steep slopes also limited access for sampling activities at several waste piles. Future investigations should incorporate comprehensive health and safety plans tailored to site-specific risks. Given the remote locations and high elevations of many sites. Field reconnaissance is essential, as satellite imagery and LiDAR may not adequately reveal hazardous conditions.

The estimated volumes of the waste piles sampled during this investigation ranged between 399 and over 3 million m^3. These are estimated volumes based on estimated heights and the general footprint of the waste pile. Due to topography of both the land surface and the waste pile, additional standardized methods for determining waste pile volumes in the field should be established and provided nationwide for future evaluations. Additionally, site-specific bulk density information should be collected during future investigations to better determine potential waste pile critical mineral and other element endowments as the material is different from site to site. Although there were no general restrictions with regards to volume when assessing targets for sampling, larger piles (potentially larger than 100,000 m^3) may provide a more lucrative target for future assessments and potential reprocessing. The precious metals as well as other non-critical minerals should be included in the calculation of potential endowments as potential future recovery scenarios may include these elements.

Several larger (e.g., likely >~500,000 m^3) waste piles in Colorado exist at sites that are currently managed by federal and/or state remediation programs. These sites likely contain large volumes of material with elevated concentrations of critical minerals and other elements. Additionally, many of these sites are located near rivers at lower elevations and are relatively accessible. However, as many of these waste piles have engineered cap material, subsurface investigations would be required, making it difficult to obtain access without the assistance of several stakeholders.

REFERENCES

Arbogast, B.F., Knepper, D.H., Langer, Jr., W.H., Cappa, J.A., Keller, J.W., Widmann, B.L., Ellefsen, K.J., Klein, T.L., Lucius, J.E., and Dersch, J.S., 2011, Development of industrial minerals in Colorado: U.S. Geological Survey Circular 1368, 87 p.

Bastin, E.A. and Hill, J.M., 1917, Economic geology of Gilpin County and adjacent parts of Clear Creek and Boulder counties: U.S. Professional Paper 94, 379 p.

Behre, Jr., C.H., 1953, Geology and ore deposits of the West Slope of the Mosquito Range: U.S. Geological Survey Professional Paper 235, 176 p.

Blood, W.A., 1968, Geology, history, and economics of the Sunnyside Mine, Eureka Mining District, San Juan County, Colorado: Colorado School of Mines thesis, 339 p.

Brady, B.T., 1975, Fluorspar deposits of Colorado: U.S. Geological Survey Mineral Investigations Resource Map MR-70, Colorado Geological Survey Miscellaneous Investigations 12, 1:500K-scale map, 20 p.

Burbank, W.S. and Luedke, R.G., 1969, Geology and ore deposits of the Eureka and adjoining districts, San Juan Mountains, Colorado: U.S. Geological Survey Professional Paper 535, 73 p.

Burnell, J.R., 2015, Historic metal mining districts of Colorado: Colorado Geological Survey Online Map ON-007-08M.

Cappa, J.A., and Bartos, P.J., 2007, Geology and mineral resources of Lake County, Colorado: Colorado Geological Survey Resource Series 42, 123 p.

Chapman, E.P. and Stevens, R.E., 1933, Silver and bismuth-bearing galena from Leadville: Economic Geology, v. 28, p. 678–685.

Chapin, C.E., 2012, Origin of the Colorado Mineral Belt: Geosphere, February 2012, v. 8, no. 1, p. 28-43, https://doi.org/10.1130/GES00694.1.

Cunningham, C.G., Naeser, C.W., Marvin, R.F., Luedke, R.G., and Wallace, A.R., 1994, Ages of selected intrusive rocks and associated ore deposits in the Colorado Mineral Belt: U.S. Geological Survey Bulletin 2109, 31 p.

Dicken, C.L., Woodruff, L.G., Hammarstrom, J.M., and Crocker, K.E., 2022, GIS, supplemental data table, and references for focus areas of potential domestic resources of critical minerals and related commodities in the United States and Puerto Rico: U.S. Geological Survey data release, 29 April 24, v. 2.0, https://doi.org/10.5066/P9DIZ9N8.

Dold, B., 2020; Sourcing of critical elements and industrial minerals from mine waste – The final evolutionary step back to sustainability of humankind?; Journal of Geochemical Exploration, Volume 219.

Eckel, E.B., 1949, Geology and Ore Deposits of the La Plata District, Colorado, with sections by Williams, J.S., Galbraith, F.W., and others, U.S. Geological Survey Professional Paper 219, 179 p.

Eckel, E.B., 1961, Minerals of Colorado: A 100-Year Record: U.S. Geological Survey Bulletin 1114, 399 p.

Emmons, S.F., Irving, J.D., and Loughlin, G.F., 1927, Geology and ore deposits of the Leadville mining district, Colorado: U.S. Professional Paper 148, 368 p.

EPA, 2019, Interim record of decision for Bonita Peak Mining District Superfund site, Operable Unit 1, Sand Juan County, Colorado: U.S. Environmental Protection Agency, document 100006405, https://semspub.epa.gov/work/08/100006405.pdf.

EPA, 2022, Final field sampling plan, Mayflower impoundment areas, 2022 winter sampling events, Bonita Peak Mining District, San Juan County, Colorado: EPA Region 8, dated March 2022, document DCN 83145-1-45-F026-IN-0193, https://semspub.epa.gov/work/08/100011708.pdf.

EPA, 2024a, Bonita Peak Mining District Superfund Site: EPA Region 8 website, https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0802497, accessed July 2024.

EPA, 2024b, North Star Mine: EPA Region 8 website, accessed July 2024, https://response.epa.gov/site/site_profile.aspx?site_id=14877.

Foord, E.E. and Shawe, D.R., 1989, The Pb-Bi-Ag-Cu-(Hg) chemistry of galena and some associated sulfosalts: A review and some new data from Colorado, California, and Pasadena: Canadian Mineralogist, v. 27, part 3, p. 363-382.

Fortier, S.M., Nassar, N.T., Lederer, G.W., Brainard, Jamie, Gambogi, Joseph, and McCullough, E.A., 2018, Draft critical mineral list—Summary of methodology and background information—U.S. Geological Survey technical input document in response to Secretarial Order No. 3359: U.S. Geological Survey Open-File Report 2018–1021, 15 p., https://doi.org/10.3133/ofr20181021.

Hammarstrom, J.M., Kreiner, D.C., Dicken, C.L., and Woodruff, L.G., 2023, National map of focus areas for potential critical mineral resources in the United States: U.S. Geological Survey Fact Sheet 2023–3007, 4 p., https://doi.org/10.3133/fs20233007.

Henderson, C.W., 1926, Mining in Colorado, a history of discovery, development and production: U.S. Geological Survey Professional Paper 138, 263 p.

Hofstra, A.H., and Kreiner, D.C., 2020, Systems-deposits-commodities critical minerals table for the Earth Mapping Resources Initiative (ver. 1.1, May 2021): U.S. Geological Survey Open-File Report 2020–1042, 26 p., https://doi.org/10.3133/ofr20201042.

Jones, W.R., 2007, History of mining and milling practices and production in San Juan County, Colorado, 1871-1991, in Chapter C of Integrated investigations of environmental effects of historical mining in the Animas River watershed, San Juan County, Colorado, by Church S.E., von Guerard, P., and Finger, S.E.: U.S. Geological Survey Professional Paper 1651, p. 43-86.

Kellogg, K.S., Shorba, R.R., Bryant, B., and Premo, W.R., 2008, Geologic map of the Denver West 30' x 60' quadrangle, north-central Colorado: U.S. Geological Survey Scientific Investigations Map SIM-3000, 1:100K-scale.

King, W.H., and Allsman, P.T., 1950, Reconnaissance of metal mining in the San Juan Region, Ouray, San Juan, and San Miguel Counties, Colo.: U.S. Bureau of Mines, Information Circular 7554, March 1950, 109 p.

Knight Piesold Consulting, 2018, SGC mining and reclamation activities and metals loading in the Animas River: Knight Piesold Consulting, by Lange, S., January 2018, 24 p., https://www.knightpiesold.com/en/news/publications/sgc-mining-and-reclamation-activities-and-metals-loading-in-the-animas-river/#:~:text=Sunnyside%20Gold%20Corporation%20(SGC)%20was,remediation%20in%20the%20Silverton%20Caldera.

Koschmann, A.H. and Bergendahl, M.H., 1968, Principal gold-producing districts of the United States: U.S. Geological Survey Professional Paper 610, 283 p.

Loughlin, G.F., 1926, Guides to ore in the Leadville district, Colorado: U.S. Geological Survey Bulletin 779, 37 p.

Lovering, T.S., 1935, Geology and ore deposits of the Montezuma quadrangle, Colorado: U.S. Geological Survey Professional Paper 178, 119 p.

Lovering, T.S. and Goddard, E.N., 1950, Geology and ore deposits of the Front Range, Colorado: U.S. Geological Survey Professional Paper 223, 319 p.

Luedke, R.G., and Burbank, W.S., 2000, Geologic map of the Silverton and Howardsville Quadrangles, Southwestern Colorado: 1:24K-scale.

Luedke, R.G., and Burbank, W.S., 2000, Geologic map of the Silverton and Howardsville quadrangles, southwestern Colorado: U.S. Geological Survey, Geologic Investigations Series Map I-2681, 1:24K-scale.

McDonough, W.F., 2003, Compositional model for the Earth's core: in Carlson, R.W., ed., The mantle and core, v. 2 of Holland, H.D., and Turekian, K.K., eds., Treatise on geochemistry: Oxford, United Kingdom, Elsevier-Pergamon, p. 547–568.

Musgrave, J.A. and Thompson, T.B., 1991, Sultan Mountain mine, Western San Juan Mountains, Colorado: a fluid inclusion and stable isotope study: Economic Geology, v. 86, p. 768-779.

Nassar, N.T., Graedel, T.E., and Harper, E.M., 2015, By-product metals are technologically essential but have problematic supply: Science Advances, 1, e1400180, dated 3 April 2015, 10 p.

Neubert, J.T., Ellis, C.E., Hannigan, B.J., Jeske, T.E., Martin, C.M., Thompson, J.R., Tuftin, R.H.W., II, Zelten, J.E., and Raby, A.G., 1992, Mineral appraisal of San Juan National Forest, Colorado: U.S. Bureau of Mines Mineral Land Assessment, Open-File Report MLA 2-92, 311 p.

Neuerburg, G.J., Botinelly, T., and Watterson, J.R., 1974, Molybdenite in the Montezuma district of Central Colorado: U.S. Geological Survey Circular 704, 21 p.

O'Keeffe, M.K., Barkmann, P., Fitzgerald, S., and Lovekin, J., 2019, Colorado abandoned mine land inventory and information hub: report on the development and data sources: Colorado Geological Survey Open-File Report OF-19-12, 44 p.

Park County, 2014, Park County local historic landmark nomination form, Alma Branch of the Boston and Colorado Smelting Company: Park County Colorado website, posted 31 March 2014, 12 p., https://www.parkcountyco.gov/DocumentCenter/View/1590/B-and-C-Nomination-Presentation_BOCC_Web.

Pilcher, S.H., 1968, Geology and geochemistry of the Orphan Boy Mine, Park County, Colorado: Colorado School of Mines Ph.D. dissertation T1063, 158 p.

Ransome, F.L., 1901, A report on the economic geology of the Silverton Quadrangle, Colorado: U.S. Geological Survey Bulletin 182, Series A, Economic Geology, 12, 265 p.

Ransome, F.L., 1911, Geology and ore deposits of the Breckenridge district, Colorado: U.S. Geological Survey Professional Paper 75, 187 p., doi: 10.3133/pp75.

Rosemeyer, T., 2002, History, geology, and mineralogy of the Brooklyn Mine, San Juan County, Colorado: Rocks and Minerals, v. 77, n. 3, p. 154-167.

Rosera, J.M., Gaynor, S.P., and Coleman, D.S., 2021, Spatio-temporal shifts in magmatism and mineralization in Northern Colorado beginning in the Late Eocene: Economic Geology, v. 116, no. 4, p. 987-1010.

Rudnick, R.L. and Gao, S., 2003, The composition of the continental crust: in Holland, H.D. and Turekian, K.K., Eds., Treatise on Geochemistry, Vol. 3, The Crust, Elsevier-Pergamon, Oxford, p. 1-64. http://dx.doi.org/10.1016/b0-08-043751-6/03016-4.

Sares, M.A., Phillips, R.C., Neubert, J.T., Wood II, R.H., Lovekin, J.R., Kirkham, R.M., and Benson, R.G., and others, 2011, U.S. Forest Service abandoned mine land inventory project: Colorado Geological Survey On-Line Map (with accompanying data) ON-008-04M, https://coloradogeologicalsurvey.org/publications/colorado-usfs-aml-map/.

Scarbrough, Jr., L.A., 2001, Geology and mineral resources of Park County, Colorado: Colorado Geological Survey Resource Series 40, 89 p.

SGC, 2020, SGC The Mayflower: Presentation by SGC to the Bonita Peak Mining District Community Advisory Group, dated 28 May 2020, https://www.bonitapeakcag.org/wp-content/uploads/2020/07/SGC-Mayflower-for-CAG-5.2020.pdf.

Shawe, D.R., 1990, Gold in the Alma mining district, Colorado: U.S. Geological Survey Bulletin 1857-F, p. 19-31.

Shawe, D.R., Van Alstine, R.E., Worl, R.G., Heyl, A.V., Trace, R.D., Parker, R.L., Griffitts, W.R., Sainsbury, C.L., and Cathcart, J.B., 1976, Geology and resources of fluorine in the United States: edited by Shawe, D.R., U.S. Professional Paper 933, 99 p.

Sims, P.K., 1964, Geology of the Central City quadrangle, Colorado: U.S. Geological Survey Map GQ-267, 1:24K-scale.

State of Colorado Bureau of Mines, 1914, Thirteenth biennial report for the years 1913 and 1914: Colorado Bureau of Mines, 228 p.

State of Colorado Bureau of Mines, 1916, Fourteenth biennial report for the years 1915 and 1916: Colorado Bureau of Mines, 116 p.

Steven, T.A., 1960, Geology and fluorspar deposits, Northgate District, Colorado: U.S. Geological Survey Bulletin 1082-F, p. 323-422.

Streufert, R.K. and Cappa, J.A., 1994, Location Map and Descriptions of Metal Occurrences in Colorado with Notes on Economic Potential: Colorado Geological Survey Map Series 28, 35 p.

Taylor, S.R. and McLennan, S.M. (2003), Chemical composition and element distribution in the Earth's Crust: Encyclopedia of Physical Science and Technology, Academic Press, p. 697-719.

TechLaw, 2021, French Gulch, Wellington-Oro Mine Site, Sampling Activities Report, Breckenridge, Colorado, 2020 Sampling Events Final: prepared for the U.S. EPA Region 8, March 2021, 10 p.

Thompson, T.B., and Arehart, G.B., 1990, Geology and the origin of ore deposits in the Leadville district, Colorado: Part 1. Geologic studies of orebodies and wall rocks: in editors Beaty, D.W., Landis, G.P., and Thompson, T.B., Carbonate-hosted sulfide deposits of the central Colorado mineral belt: Economic Geology Monograph n. 7, p. 130-155.

Tweto, O. and Sims, P.K., 1963, Precambrian ancestry of the Colorado mineral belt: Geological Society of America Bulletin, v. 74, n. 8, p. 991-1014, https://doi.org/10.1130/0016-7606(1963)74[991:PAOTCM]2.0.CO;2.

U.S. Department of Energy (DOE), 2023, Critical materials assessment: U.S. Department of Energy, July 2023, https://www.energy.gov/sites/default/files/2023-07/doe-critical-material-assessment_07312023.pdf.

U.S. Forest Service (USFS), 2004, Removal action memorandum for the Dibbens Mill and Sydney Tunnel mine site: U.S. Forest Service, supplied by the USFS and not available online.

U.S. Geological Survey (USGS), 1944, Central City, CO, topographic map: U.S. Geological Survey, 1944 Edition, N3945-W10530/7.5, 1:31,680-scale, one online version has penciled in mine names, https://ngmdb.usgs.gov/ht-bin/tv_browse.pl?id=00a012eb64371fd7b06e5eb3d43c8ecb.

USGS, 1970, Geological research 1970 – Chapter A: U.S. Geological Survey Professional Paper 700-A, as reported by Worl, R.G. (page A5), 426 p.

USGS, 2011, Mineral resources data system (MRDS): U.S. Geological Survey, https://mrdata.usgs.gov/mrds/.

USGS, 2022, 2022 final list of critical minerals: Department of the Interior, U.S. Geological Survey, online document: https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/2022%20Final%20List%20of%20Critical%20Minerals%20Federal%20Register%20Notice_2222022-F.pdf.

USGS, 2024, Mineral commodity summaries: U.S. Geological Survey, 212 p.

U.S. Geological Survey Analytical Chemistry Project (ACP), 2025, Analytical chemistry: U.S. Geological Survey website: https://www.usgs.gov/centers/gggsc/science/analytical-chemistry.

U.S. Geological Survey, 2025a, Geochemical data generated by projects funded by the USGS Earth Mapping Resources Initiative: U.S. Geological Survey data release, v. 11, dated January 2025, https://www.sciencebase.gov/catalog/item/601963c6d34edf5c66f0d0e5.

U.S. Geological Survey, 2025b, Earth mapping resources initiative (EarthMRI) website: https://www.usgs.gov/special-topics/earth-mri.

Varnes, D.J., 1963, Geology and ore deposits of the South Silverton Mining Area, San Juan County, Colorado: U.S. Geological Survey Professional Paper 378-A, 56 p.

Wallace, A.R., 1993, Geologic setting of the Leadville mining district, Lake County, Colorado: U.S. Geological Survey Open-File Report 93-343, 20 p.

White House, 2017, A Federal strategy to ensure secure and reliable supplies of critical minerals—Executive Order 13817 of December 20, 2017: Federal Register, v. 82, no. 246, document 2017–27899, p. 60835–60837, https://www.federalregister.gov/documents/2017/12/26/2017- 27899/a-federal-strategy-to-ensure-secure-and-reliable-supplies-ofcritical-minerals.

Widmann, B.L., and Miersemann, U., 2002, Geologic map of the Georgetown quadrangle, Clear Creek County, Colorado: Colorado Geological Survey Open-File Report OF-01-03, 1:24K-scale.

Widmann, B.L., Kirkham, R.M., Houck, K.J., and Lindsay, N.R., 2007, Geologic map of the Fairplay West Quadrangle, Park County, Colorado: Colorado Geological Survey Open-File Report 06-7, 1:24K-scale geologic map and description of map units, 68 p.

Wilson, Anna Burack and Sims, P.K., 2003, Colorado mineral belt revisited – an analysis of old new data: U.S. Geological Survey Open-File Report 03-046, 7 p.

Wood II, R.H., Bird, D.A., and Oerter, E.J., 2007, History, geology, and environmental setting of the Sidney Tunnel, Argentine mining district, Arapaho/Roosevelt National Forest, Clear Creek County, Colorado: Colorado Geological Survey Unpublished Draft Open-File Report, 58 p.

FIGURES

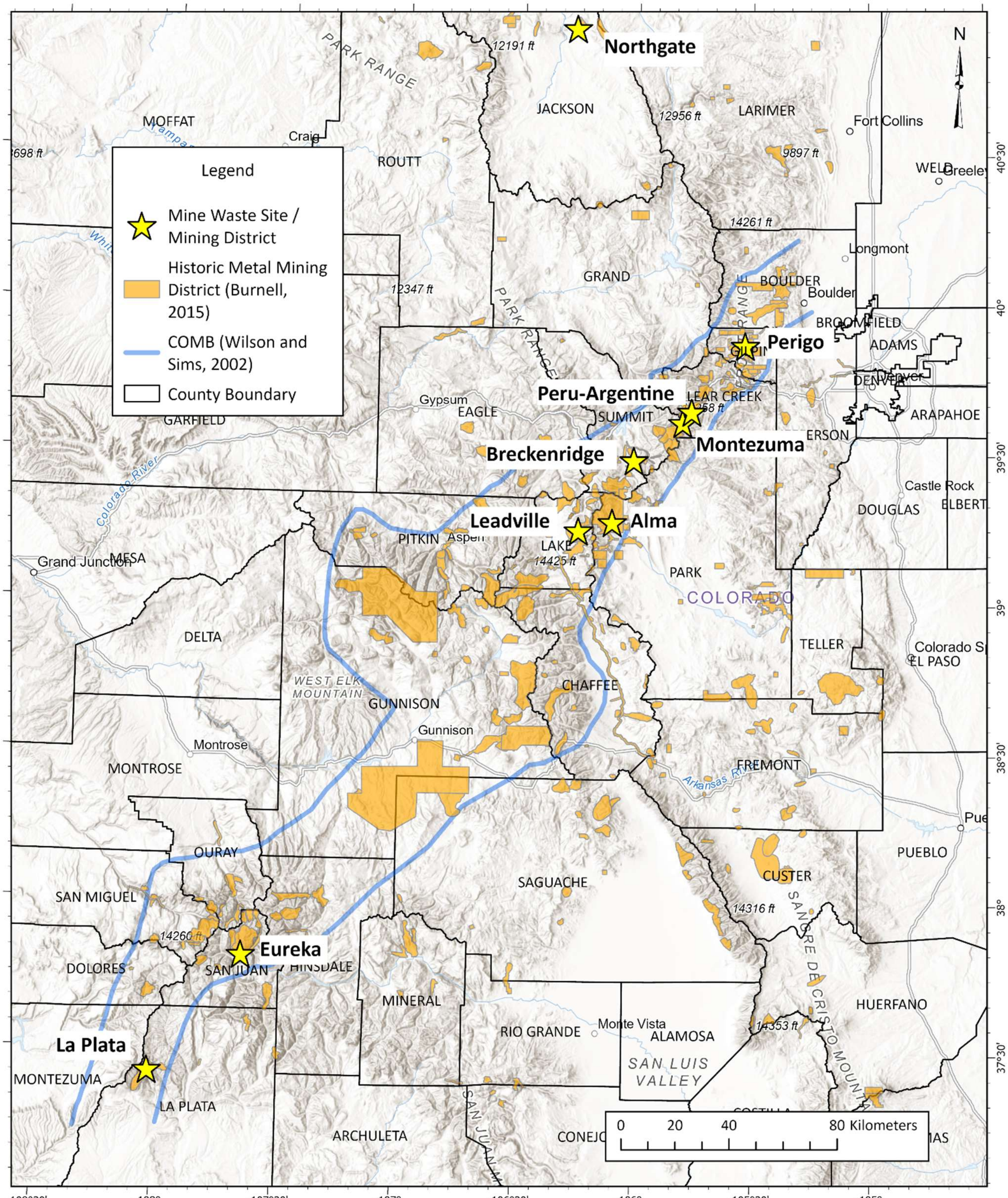


Figure 1 – Mine waste sampling site location map. COMB – Colorado mineral belt. Mining district names are shown where samples were collected.

Figure 2 – Photographs showing the mine waste sampling procedure. Upper left and right – mine waste pile at Breckenridge, CO (Wellington Mine, Extenuate Adit). Middle left and right – mine waste pile grid sampling, compositing, and sieving (2 mm stainless steel sieve). Bottom left and right – fine (<2 mm) and coarse (> 2mm) composite samples.

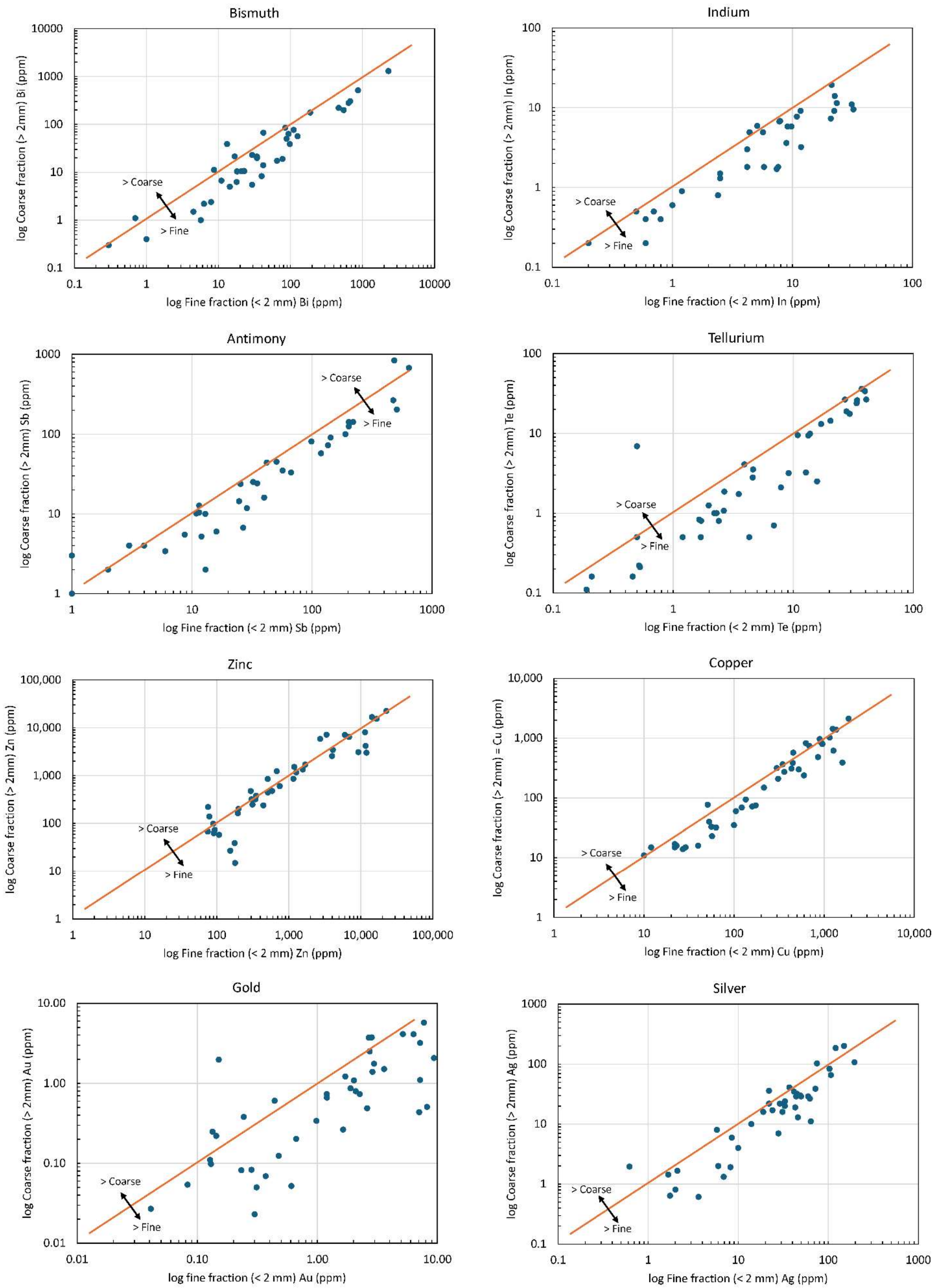


Figure 3 – Comparison of mine waste fine and coarse sample fraction concentrations for select elements. Line represents equal concentrations in both the fine and coarse fractions.

TABLES

Table 1 - Critical minerals, apparent consumption, and net import reliance.

Element/Material	Abbreviation	USGS Critical Mineral (Fortier and others, 2018)	DOE (DOE, 2023) Medium-term criticality (2025-2035)			Estimated apparent consumption (metric tons)*	Estimated net import reliance as a percentage of apparent consumption*
			Critical	Near critical	Not critical		
Aluminum (bauxite/alumina)	Al	*		*		1,800,000	>75
Antimony	Sb	*				22,000	82
Arsenic	Ar	*				6,400	100
Barite	$BaSO_4$	*				na	>75
Beryllium	Be	*				150	0
Bismuth	Bi	*				1,400	94
Cesium	Cs	*				na	100
Chromium	Cr	*				380,000	74
Cobalt	Co	*	*			6,400	67
Copper	Cu			*		1,800,000	46
Electrical Steel				*		na	na
Fluorine	F			*		na	na
Fluorspar	CaF_2	*				370,000	100
Gallium	Ga	*	*			19	100
Germanium	Ge	*				na	>50
Graphite	C	*	*			76,000	100
Hafnium	Hf	*				na	na
Indium	In	*				300	100
Iridium	Ir		*			na	na
Lithium	Li	*	*			na	>25
Magnesium	Mg	*	*			55,000	>50
Manganese	Mn	*			*	690,000	100
Nickel	Ni	*	*			190,000	57
Niobium	Nb	*				8,400	100
Palladium	Pd	*				82	37
Phosphorus	P				*	na	na
Platinum	Pt	*	*			70	83
Rhodium	Rh	*				na	na
Rubidium	Rb	*				na	100
Ruthenium	Ru	*				na	na
Scandium	Sc	*				na	100
Silicon	Si			*		na	<50
Silicon Carbide	SiC		*			na	na
Tantalum	Ta	*				370	100
Tellurium	Te	*			*	na	>25
Tin	Sn	*				39,000	74
Titanium	Ti	*			*	42,000	>95
Tungsten	W	*				na	>50
Uranium	U			*		na	na
Vanadium	V	*				14,000	58
Zinc	Zn	*				970,000	77
Zirconium	Zr	*				<100,000	<25
Rare Earth Elements (REE)						8,800	>95
Light REEs							
Lanthanum	La	*				na	na
Cerium	Ce	*				na	na
Praseodymium	Pr	*	*			na	na
Neodymium	Nd	*	*			na	na
Samarium	Sm	*				na	na
Europium	Eu	*				na	na
Gadolinium	Gd	*				na	na
Heavy REEs							
Terbium	Tb	*	*			na	na
Dysprosium	Dy	*	*			na	na
Holmium	Ho	*				na	na
Erbium	Er	*				na	na
Thulium	Tm	*				na	na
Ytterbium	Yb	*				na	na
Lutetium	Lu	*				na	na
Yttrium	Y	*				200	100

Notes

* from USGS, 2024 (see Table 5, page 23).

na - not applicable or not available

Values for cesium, hafnium, iridium, rhodium, rubidium, and ruthenium are not shown because available information is insufficient to make estimates of U.S. or world production.

Apparent consumption is a USGS calculated value (general formula is the production + imports - exports +/- stock change). In some cases, when data was unavailable or withheld, these were esimated by the USGS. For more on the how these values are calculated see the following link:

https://www.usgs.gov/centers/national-minerals-information-center/historical-statistics-mineral-and-material-commoditie.

Additionally, apparent consumption for several commodities measures more than one form of the commodity (metal, ferroalloys, ore, etc.).

Table 2 - Summary of the mining history, minerals, mineral systems, and other information associated with each site.

Mining district	Historic production	Dominant ore and other minerals	USGS critical mineral focus area[1]	Mineral system/deposit types[1]	Potential critical minerals in deposit[1]	Other potential commodities in deposit[1]	General mine/waste pile sample location	Sampling units	Number of primary samples[2]
Perigo	gold, silver, copper (?)	pyrite, galena, sphalerite	Central City-Idaho Springs polymetallic veins	Alkalic porphyry/Polymetallic sulfide S-R-V-IS	bismuth, gallium, germanium, indium, tellurium, zinc	copper, gold, lead, silver, uranium	Tip Top/Golden Flint	3	6
Peru-Argentine	silver, gold, lead, copper, zinc	pyrite, galena, chalcopyrite, sphalerite	Montezuma-Breckenridge polymetallic districts	Porphyry Cu-Mo-Au/polymetallic sulfide S-R-V-IS	antimony, arsenic, bismuth, gallium, germanium, indium, manganese, tellurium, tungsten, zinc	cadmium, copper, gold, lead, silver	Sidney, Santiago peripherials	4	8
Montezuma	silver, lead, copper, zinc, gold (minor)	galena, pyrite, sphalerite, "gray copper" (tetrahedrite and or tennantite?)	Montezuma-Breckenridge polymetallic districts	Porphyry Cu-Mo-Au/polymetallic sulfide S-R-V-IS	antimony, arsenic, bismuth, gallium, germanium, indium, manganese, tellurium, tungsten, zinc	cadmium, copper, gold, lead, silver	Peruvian, other peripherials	4	8
Breckenridge	lead, zinc, gold, silver	galena, sphalerite, pyrite, native Au/Ag	Montezuma-Breckenridge polymetallic districts	Porphyry Cu-Mo-Au/polymetallic sulfide S-R-V-IS	antimony, arsenic, bismuth, gallium, germanium, indium, manganese, tellurium, tungsten, zinc	cadmium, copper, gold, lead, silver	Wellington, Extenuate adit	6	12
Alma	gold, silver, copper, zinc.	galena, sphalerite, chalcopyrite, pyrite	Climax-Sweet Home	Climax-Type/Greisen; Polymetallic sulfide S-R-V-IS; Porphyry molybdenum	antimony, arsenic, beryllium, bismuth, fluorspar, gallium, germanium, indium, manganese, REE, rhenium, scandium, tin, tungsten, zinc	copper, gold, lead, molybdenum, silver	Orphan Boy, Ore stockpile north side of Sacramento Creek	3	6
Leadville	lead, zinc, copper, silver, gold, iron, manganese, bismuth	pyrite, sphalerite, galena, chalcopyrite, tetrahedrite	Central Colorado Mineral Belt carbonate-replacement deposits	Porphyry Cu-Mo-Au/Polymetallic sulfide S-R-V-IS	bismuth, manganese, zinc, antimony, arsenic, gallium, germanium, indium, manganese, tellurium, tungsten	copper, gold, iron, lead, silver	Breece Hill, Penn Group, Little Prince, President, Penn 3, Ballard	10	20
Eureka	gold, silver, lead, copper, zinc, gold	pyrite, galena, sphalerite, chalcopyrite, tetrahedrite	Central Colorado epithermal Au-Ag/Silverton	Alkalic porphyry; Climax-type/Low sulfidation, high sulfidation, polymetallic sulfide S-R-V-IS	zinc, fluorspar, arsenic, antimony, bismuth, germanium, indium, manganese, tellurium, tungsten, vanadium.	copper, gold, lead, silver	Mayflower mill tailings, Highland Mary mill tailings, North Star, Brooklyn	5	11
La Plata	gold, silver, copper, gold	pyrite, galena	La Plata polymetallic district	Distal disseminated silver-gold; Polymetallic sulfide S-R-V-IS; Porphyry/skarn copper-gold	antimony, arsenic, bismuth, gallium, germanium, indium, PGE, tellurium, zinc	gold, copper, silver	Columbus, Doyle Group (Northstar, Sundown), Thunder	6	12
Northgate	fluorspar	fluorspar	Northgate district	Climax-type	fluorspar	fluorspar	Northgate, near the Gero Tunnel and Penber	3	4

NOTES:

[1] - Based on Dicken and others (2022) and Hofstra and Kreiner (2020) .

[2] - Does not include grab samples or duplicates, includes fine (< 2mm) and coarse (> 2 mm) composite samples..

Ore minerals also include native gold and silver in many of these deposits.

IS - intermediate sulfidation

na - not applicable

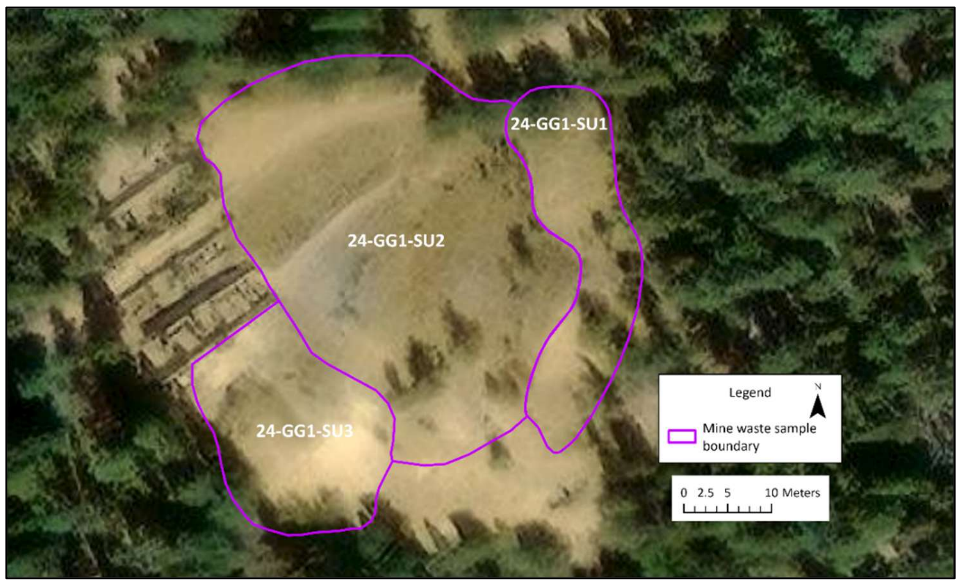
R - replacement

REE - rare earth elements

S - skarn

USGS - U.S. Geological Survey

V - vein



Sample Name	24-GG1-SU1	24-GG1-SU2	24-GG1-SU3				
Sample Type	Waste Rock	Waste Rock	Waste Rock				
Area	Tip Top	Tip Top	Tip Top	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1	SU2	SU3				
Volume (m^3) Est.[2]	1,328	7,894	1,861				
Au (ppb)	3,295	1,544	1,444		30	3	1.8
Au (ppm)	3.30	1.54	1.44	0.02	0.03	0.003	0.0018
Ag (ppm)	1.89	1.20	1.41	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	63,850	61,750	62,900	420,500	841,000	84,100	80,400
F (%)	0.122	0.132	0.143	0.28	0.553	0.0553	na
Fe (%)	4.68	4.37	4.39	35.35	70.7	7.07	3.5
Mg (ppm)	3,020	3,650	3,205	160,000	320,000	32,000	13,300
Ti (%)	0.169	0.152	0.186	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	<10	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	750.5	463.5	679.5	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	9.95	4.25	5.15	0.3	0.6	0.06	0.127
Cd (ppm)	<0.2	<0.2	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	3	3.5	3	145	290	29	17
Cr (ppm)	16	10	15	925	1,850	185	85
Cs (ppm)	0.7	0.75	0.95	7.5	15	1.5	4.8
Cu (ppm)	47.5	46.5	40	375	750	75	25
Ga (ppm)	22	21	21	90	180	18	17
Ge (ppm)	2	1	1.5	8	16	1.6	1.6
Hf (ppm)	8	9.5	7.5	15	30	3.0	5.8
In (ppm)	0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	<10	<10	<10	65	130	13	20
Mn (ppm)	101	131.5	84	7,000	14,000	1,400	600
Mo (ppm)	11.5	4.5	14	5	10	1.0	1.5
Nb (ppm)	8.5	8	9.5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	308.5	135	204.5	40	80	8.0	16
Rb (ppm)	96.5	80.5	90.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	<1	<1	1	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	6.5	6.5	10.5	13	25	2.5	5.5
Sr (ppm)	158.5	76	184.5	1,300	2,600	260	350
Ta (ppm)	0.65	0.55	0.7	5	10	1.0	1.1
Te (ppm)	1.6	1.65	1.6	1.50	3	0.3	0.003
Th (ppm)	4.85	5.5	5.3	21	42	4.2	10.7
Tl (ppm)	<1	<1	<1	1.8	3.6	0.36	0.75
U (ppm)	2	2.5	2.5	5.5	11	1.1	2.8
V (ppm)	30.5	27	42	1,150	2,300	230	110
W (ppm)	83.5	177	63	5	10	1	2
Zn (ppm)	77	83.5	83	400	800	80	71
Zr (ppm)	301	342	272.5	500	1,000	100	190
Sc (ppm)	5	<5	5.5	150	300	30	13
La (ppm)	34.5	36.5	34.5	80	160	16	30
Ce (ppm)	76.5	74	71.5	165	330	33	64
Pr (ppm)	8.2	8.7	8.5	19.5	39	3.9	7.1
Nd (ppm)	32	34	32.5	80	160	16	26
Sm (ppm)	7.8	7.25	5.9	17.5	35	3.5	4.5
Eu (ppm)	1.65	1.35	1.35	5.5	11	1.1	0.88
Gd (ppm)	6.6	7.25	5.95	16.5	33	3.3	3.8
Tb (ppm)	1.35	1.25	0.9	3	6	0.6	0.64
Dy (ppm)	7	8.35	6.4	18.5	37	3.7	3.5
Ho (ppm)	1.52	1.76	1.42	3.9	7.8	0.78	0.8
Er (ppm)	4.6	5.4	4.45	11	22	2.2	2.3
Tm (ppm)	0.70	0.77	0.625	1.6	3.2	0.32	0.33
Yb (ppm)	4.7	5.3	4.3	11	22	2.2	2.2
Lu (ppm)	0.7	0.8	0.7	1.5	3	0.3	0.32
Y (ppm)	42.65	47.5	38.35	100	200	20	22
TotalREE	235.5	245.2	222.8				
TotalLREE	167.3	169.05	160.2				
TotalHREE	63.2	71.13	57.14				
%LREE	71	69	72				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

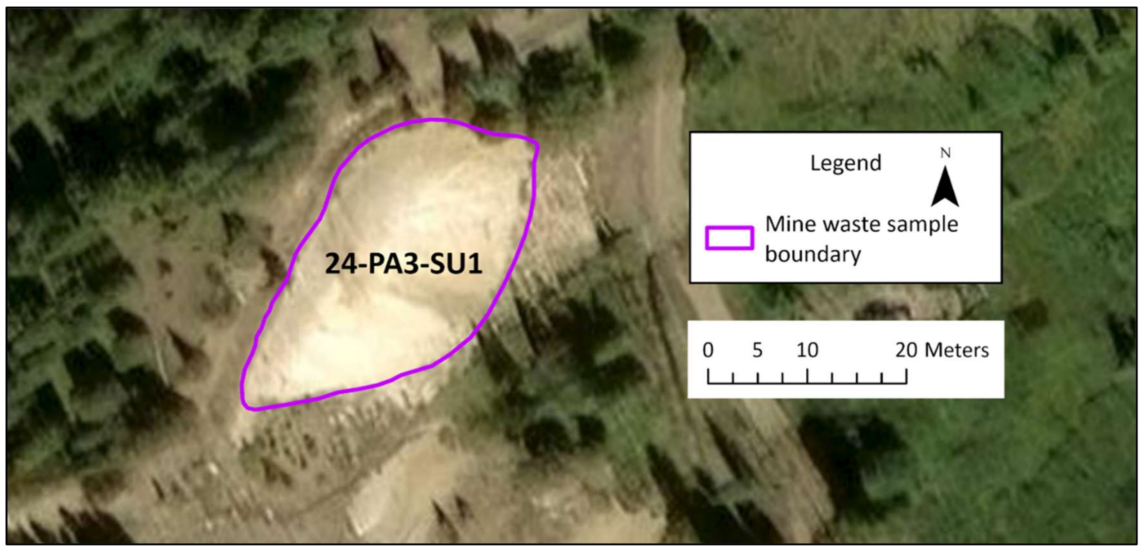
Table 3 – Tip Top site sampling units and summary of laboratory results.

Sample Name	24-PA1-SU1	24-PA1-SU2	24-PA2-SU1	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Waste Rock				
Area	Santiago 1	Santiago 1	Santiago 2				
Sample Unit	SU1	SU2	SU1				
Volume (m^3) Est.[2]	1,500	3,525	1,737				
Au (ppm)	0.0685	0.1915	0.119	0.02	0.03	0.003	0.0018
Ag (ppm)	38.22	152.98	7.22	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	73,000	75,650	69,050	420,500	841,000	84,100	80,400
F (%)	0.119	0.119	0.142	0.28	0.553	0.0553	na
Fe (%)	2.86	3.095	2.26	35.35	70.7	7.07	3.5
Mg (ppm)	3,380	2,810	2,265	160,000	320,000	32,000	13,300
Ti (%)	0.300	0.315	0.219	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	12.5	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	674	655.5	654	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	0.9	26	0.7	0.3	0.6	0.06	0.127
Cd (ppm)	3.85	2.05	2.15	0.49	0.98	0.098	0.098
Co (ppm)	2.5	<2	4.5	145	290	29	17
Cr (ppm)	60.5	53.5	23.5	925	1,850	185	85
Cs (ppm)	9.4	7.45	8.05	7.5	15	1.5	4.8
Cu (ppm)	19.5	19.5	20.5	375	750	75	25
Ga (ppm)	18.5	18	17.5	90	180	18	17
Ge (ppm)	2	2	2.5	8	16	1.6	1.6
Hf (ppm)	5.5	5.5	4.5	15	30	3.0	5.8
In (ppm)	0.5	0.8	1.05	0.25	0.5	0.05	0.05
Li (ppm)	10.5	<10	<10	65	130	13	20
Mn (ppm)	643	1,070	1,245	7,000	14,000	1,400	600
Mo (ppm)	3	<2	4	5	10	1.0	1.5
Nb (ppm)	13.5	15	19	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	2,575	8,885	2,070	40	80	8.0	16
Rb (ppm)	188	180.5	163.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	2	3.5	4	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	59.5	61.5	42.5	1,300	2,600	260	350
Ta (ppm)	0.85	0.85	0.9	5	10	1.0	1.1
Te (ppm)	11.4	23.35	<0.5	1.50	3	0.3	0.003
Th (ppm)	17.1	13.9	12.7	21	42	4.2	10.7
Tl (ppm)	2.5	2.5	2.5	1.8	3.6	0.36	0.75
U (ppm)	4.5	4	3.5	5.5	11	1.1	2.8
V (ppm)	56.5	59.5	61.5	1,150	2,300	230	110
W (ppm)	2.5	2.5	16.5	5	10	1	2
Zn (ppm)	682	478	365.5	400	800	80	71
Zr (ppm)	239.5	206.5	166.5	500	1,000	100	190
Sc (ppm)	9	9.5	7	150	300	30	13
La (ppm)	57.5	44.5	47.5	80	160	16	30
Ce (ppm)	109.5	90.5	91	165	330	33	64
Pr (ppm)	12.8	10.1	10.05	19.5	39	3.9	7.1
Nd (ppm)	45.5	36.5	35.5	80	160	16	26
Sm (ppm)	7.7	6.5	5.65	17.5	35	3.5	4.5
Eu (ppm)	1.25	1	1.1	5.5	11	1.1	0.88
Gd (ppm)	5.6	4.8	3.55	16.5	33	3.3	3.8
Tb (ppm)	0.8	0.7	0.45	3	6	0.6	0.64
Dy (ppm)	4.65	4.4	2.95	18.5	37	3.7	3.5
Ho (ppm)	0.905	0.875	0.565	3.9	7.8	0.78	0.8
Er (ppm)	2.6	2.6	1.6	11	22	2.2	2.3
Tm (ppm)	0.385	0.36	0.225	1.6	3.2	0.32	0.33
Yb (ppm)	2.5	2.45	1.6	11	22	2.2	2.2
Lu (ppm)	0.4	0.35	0.25	1.5	3	0.3	0.32
Y (ppm)	24.9	23.7	15.65	100	200	20	22
TotalREE	286.0	238.8	224.6				
TotalLREE	239.9	193.9	194.4				
TotalHREE	37.1	35.4	23.3				
%LREE	84	81	87				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 4 – Santiago Area site sampling units and summary of laboratory results.



Sample Name	24-PA3-SU1				
Sample Type	Waste Rock				
Area	Sidney	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1				
Volume (m^3) Est.[2]	6,566				
Au (ppb)	114		30	3	1.8
Au (ppm)	0.114	0.02	0.03	0.003	0.0018
Ag (ppm)	151.80	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	68,700	420,500	841,000	84,100	80,400
F (%)	0.166	0.28	0.553	0.0553	na
Fe (%)	2.07	35.35	70.7	7.07	3.5
Mg (ppm)	2,525	160,000	320,000	32,000	13,300
Ti (%)	0.291	2.7	5.4	0.5	0.39
As (ppm)	31	5.0	10	1	1.5
B (ppm)	<20	50	100	10	15
Ba (ppm)	625.5	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	7.95	0.49	0.98	0.098	0.098
Co (ppm)	<2	145	290	29	17
Cr (ppm)	34.5	925	1,850	185	85
Cs (ppm)	7.55	7.5	15	1.5	4.8
Cu (ppm)	64	375	750	75	25
Ga (ppm)	18	90	180	18	17
Ge (ppm)	2	8	16	1.6	1.6
Hf (ppm)	8	15	30	3.0	5.8
In (ppm)	0.2	0.25	0.5	0.05	0.05
Li (ppm)	13.5	65	130	13	20
Mn (ppm)	140.5	7,000	14,000	1,400	600
Mo (ppm)	7	5	10	1.0	1.5
Nb (ppm)	13.5	55	110	11	12.5
Ni (ppm)	<20	640	1,280	128	50
Pb (ppm)	4,060	40	80	8.0	16
Rb (ppm)	174	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	46	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<5	13	25	2.5	5.5
Sr (ppm)	79	1,300	2,600	260	350
Ta (ppm)	0.55	5	10	1.0	1.1
Te (ppm)	<0.5	1.50	3	0.3	0.003
Th (ppm)	29.95	21	42	4.2	10.7
Tl (ppm)	2.5	1.8	3.6	0.36	0.75
U (ppm)	3.5	5.5	11	1.1	2.8
V (ppm)	48	1,150	2,300	230	110
W (ppm)	2.5	5	10	1	2
Zn (ppm)	1,455	400	800	80	71
Zr (ppm)	272	500	1,000	100	190
Sc (ppm)	8	150	300	30	13
La (ppm)	74	80	160	16	30
Ce (ppm)	167	165	330	33	64
Pr (ppm)	19.75	19.5	39	3.9	7.1
Nd (ppm)	72.5	80	160	16	26
Sm (ppm)	11.7	17.5	35	3.5	4.5
Eu (ppm)	1.3	5.5	11	1.1	0.88
Gd (ppm)	7.55	16.5	33	3.3	3.8
Tb (ppm)	1.1	3	6	0.6	0.64
Dy (ppm)	6.4	18.5	37	3.7	3.5
Ho (ppm)	1.22	3.9	7.8	0.78	0.8
Er (ppm)	3.45	11	22	2.2	2.3
Tm (ppm)	0.46	1.6	3.2	0.32	0.33
Yb (ppm)	3	11	22	2.2	2.2
Lu (ppm)	0.4	1.5	3	0.3	0.32
Y (ppm)	32.85	100	200	20	22
TotalREE	410.7				
TotalLREE	353.8				
TotalHREE	48.9				
%LREE	86				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

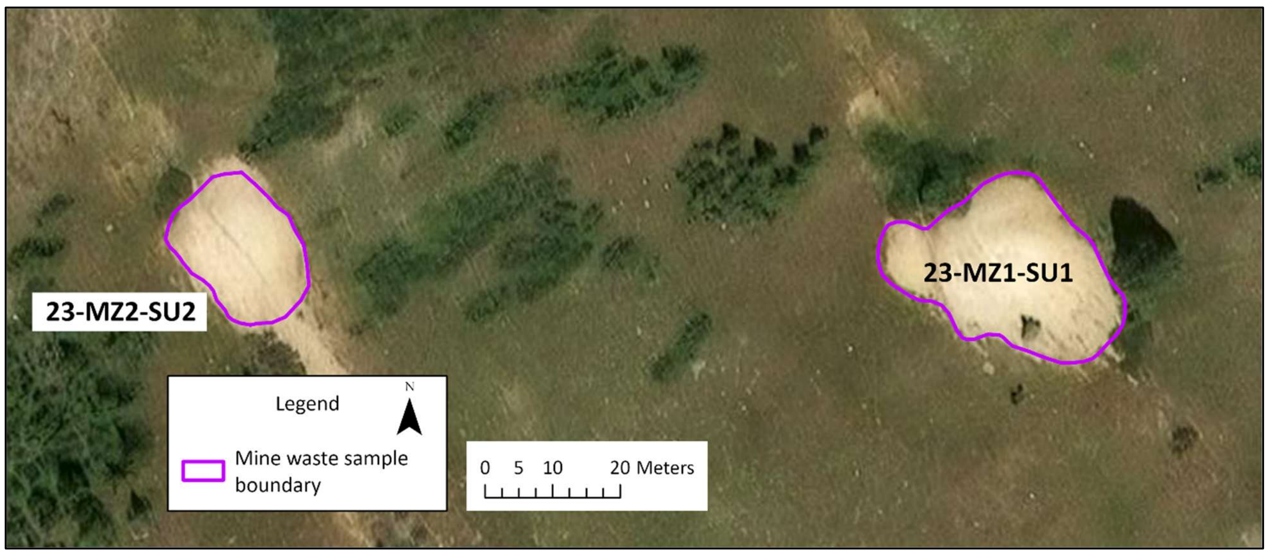
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 5 – Sidney site sampling units and summary of laboratory results.

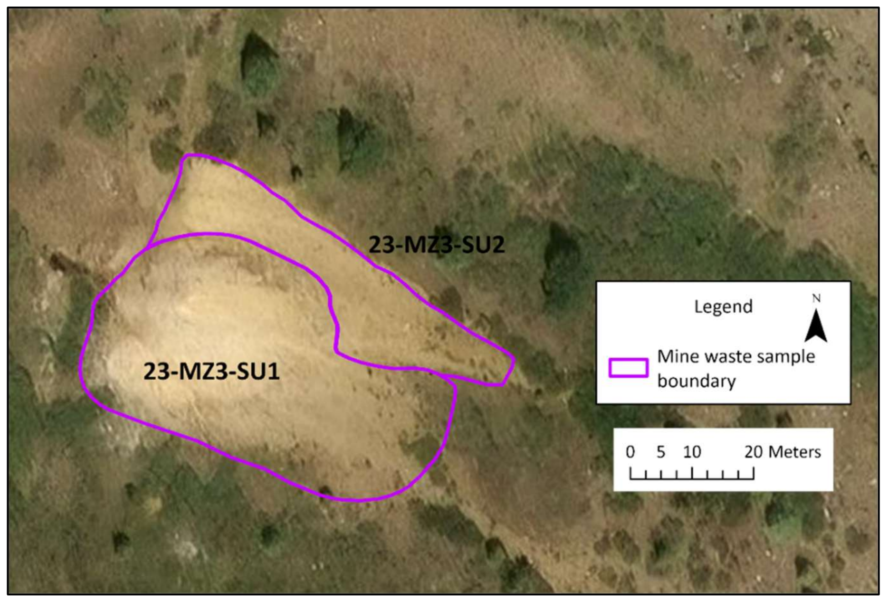


Sample Name	23-MZ1-SU1	23-MZ2-SU1				
Sample Type	Waste Rock	Waste Rock				
Area	Peruvian West area (MZ1)	Peruvian West area (MZ2)	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1	SU1				
Volume (m^3) Est.[2]	2,908	1,444				
Au (ppm)	0.034	0.1575	0.02	0.03	0.003	0.0018
Ag (ppm)	4.0	44.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	2.5	5	0.5	0.5
Al (ppm)	84,250	89,050	420,500	841,000	84,100	80,400
F (%)	0.135	0.202	0.28	0.553	0.0553	na
Fe (%)	1.82	2.72	35.35	70.7	7.07	3.5
Mg (ppm)	4,650	4,950	160,000	320,000	32,000	13,300
Ti (%)	0.395	0.42	2.7	5.4	0.5	0.39
As (ppm)	19	141.5	5.0	10	1	1.5
B (ppm)	30.5	30.5	50	100	10	15
Ba (ppm)	1,537	>10,000	1,250	2,500	250	550
Be (ppm)	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	16.7	28.0	0.3	0.6	0.06	0.127
Cd (ppm)	0.2	17.3	0.49	0.98	0.098	0.098
Co (ppm)	2.0	1.7	145	290	29	17
Cr (ppm)	76	100	925	1,850	185	85
Cs (ppm)	8.9	7.4	7.5	15	1.5	4.8
Cu (ppm)	22	44.5	375	750	75	25
Ga (ppm)	20.5	27	90	180	18	17
Ge (ppm)	2.0	2.0	8	16	1.6	1.6
Hf (ppm)	8.5	8.0	15	30	3.0	5.8
In (ppm)	0.5	3	0.25	0.5	0.05	0.05
Li (ppm)	11	<10	65	130	13	20
Mn (ppm)	420.5	225	7,000	14,000	1,400	600
Mo (ppm)	2.5	4.0	5	10	1.0	1.5
Nb (ppm)	16	17	55	110	11	12.5
Ni (ppm)	7.5	9.0	640	1,280	128	50
Pb (ppm)	702	22,550	40	80	8.0	16
Rb (ppm)	236	277	185	370	37	112
Re (ppm)	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	8.6	88.25	1	2	0.2	0.2
Se (ppm)	<1	1.0	250	500	50	50
Sn (ppm)	5.0	8.0	13	25	2.5	5.5
Sr (ppm)	157	661.5	1,300	2,600	260	350
Ta (ppm)	0.9	1.15	5	10	1.0	1.1
Te (ppm)	1.26	1.86	1.50	3	0.3	0.003
Th (ppm)	13	16.3	21	42	4.2	10.7
Tl (ppm)	4.05	4.3	1.8	3.6	0.36	0.75
U (ppm)	2.8	3.6	5.5	11	1.1	2.8
V (ppm)	66.5	81	1,150	2,300	230	110
W (ppm)	6.5	13	5	10	1	2
Zn (ppm)	71.5	6,173	400	800	80	71
Zr (ppm)	283.5	275	500	1,000	100	190
Sc (ppm)	13	16	150	300	30	13
La (ppm)	67	67.8	80	160	16	30
Ce (ppm)	136	138	165	330	33	64
Pr (ppm)	16.49	17.03	19.5	39	3.9	7.1
Nd (ppm)	61.6	60.3	80	160	16	26
Sm (ppm)	10.1	11.35	17.5	35	3.5	4.5
Eu (ppm)	1.65	1.68	5.5	11	1.1	0.88
Gd (ppm)	7.09	9.00	16.5	33	3.3	3.8
Tb (ppm)	1.03	1.29	3	6.0	0.6	0.64
Dy (ppm)	5.77	7.8	18.5	37	3.7	3.5
Ho (ppm)	1.15	1.65	3.9	7.8	0.78	0.8
Er (ppm)	3.37	4.96	11	22	2.2	2.3
Tm (ppm)	0.49	0.78	1.6	3.2	0.32	0.33
Yb (ppm)	3.25	5.2	11	22	2.2	2.2
Lu (ppm)	0.51	0.80	1.5	3	0.3	0.32
Y (ppm)	31	50.45	100	200	20	22
TotalREE	359.5	394.0				
TotalLREE	299.9	305.1				
TotalHREE	46.6	72.9				
%LREE	83	77				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 6 – Peruvian West site sampling units and summary of laboratory results.

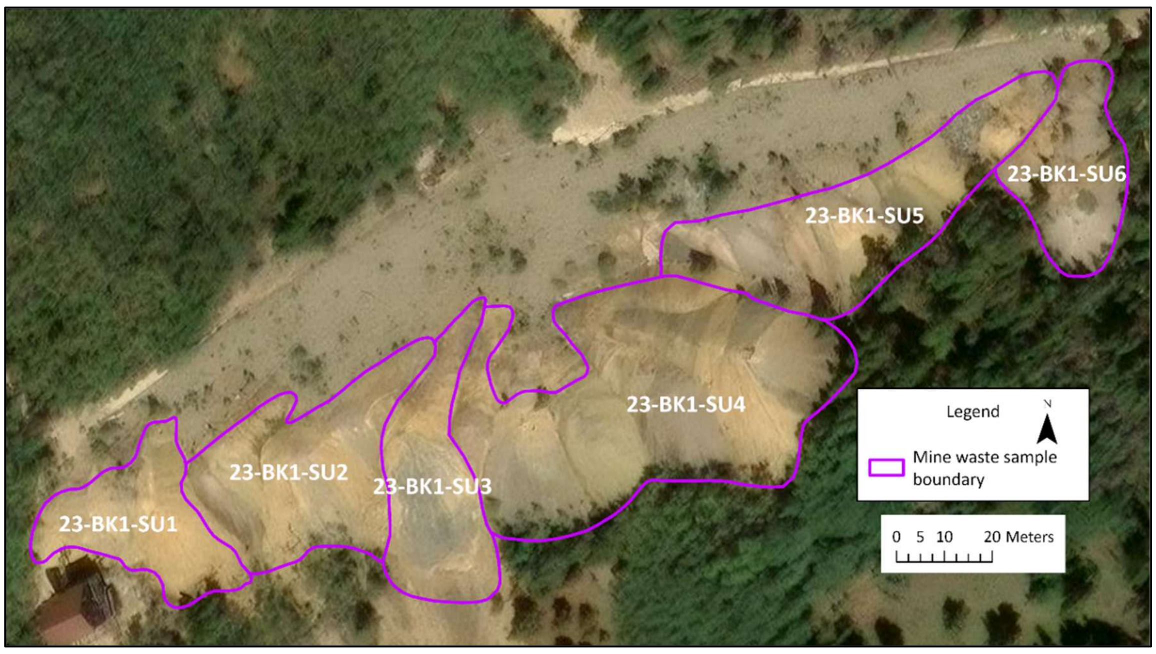


Sample Name	23-MZ3-SU1	23-MZ3-SU2	23-MZ3-SU1-Grab	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample				
Area	Peruvian	Peruvian	Peruvian				
Sample Unit	SU1	SU2	SU1				
Volume (m^3) Est.[2]	9,900	3,847	na				
Au (ppm)	0.182	0.181	0.29	0.02	0.03	0.003	0.0018
Ag (ppm)	175	26.5	>200	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	58,500	71,900	6,400	420,500	841,000	84,100	80,400
F (%)	0.177	0.206	0.020	0.28	0.553	0.0553	na
Fe (%)	4.09	3.62	9.06	35.35	70.7	7.07	3.5
Mg (ppm)	3,900	4,900	1,200	160,000	320,000	32,000	13,300
Ti (%)	0.31	0.385	0.03	2.7	5.4	0.5	0.39
As (ppm)	281	98.5	838	5.0	10	1	1.5
B (ppm)	33	34.5	21	50	100	10	15
Ba (ppm)	>10,000	2,789	5,444	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	54.4	15.7	80	0.3	0.6	0.06	0.127
Cd (ppm)	21.2	4.75	366	0.49	0.98	0.098	0.098
Co (ppm)	1.05	1.55	1.1	145	290	29	17
Cr (ppm)	33.5	42.5	<10	925	1,850	185	85
Cs (ppm)	10.8	12.2	2	7.5	15	1.5	4.8
Cu (ppm)	513.5	124.5	5,026	375	750	75	25
Ga (ppm)	16.5	21	9	90	180	18	17
Ge (ppm)	3.5	3	6	8	16	1.6	1.6
Hf (ppm)	7.5	8	<1	15	30	3.0	5.8
In (ppm)	5.5	1.9	60.5	0.25	0.5	0.05	0.05
Li (ppm)	14	14.5	12	65	130	13	20
Mn (ppm)	427	385	51,239	7,000	14,000	1,400	600
Mo (ppm)	9.5	3	5	5	10	1.0	1.5
Nb (ppm)	14.5	17.5	2	55	110	11	12.5
Ni (ppm)	9.5	9	8	640	1,280	128	50
Pb (ppm)	20,350	5,204	80,020	40	80	8.0	16
Rb (ppm)	199	234.5	21.1	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	661.5	104.3	1,977	1	2	0.2	0.2
Se (ppm)	<1	<1	3	250	500	50	50
Sn (ppm)	11.5	10	1	13	25	2.5	5.5
Sr (ppm)	892	364.5	1,845	1,300	2,600	260	350
Ta (ppm)	0.85	0.95	<0.5	5	10	1.0	1.1
Te (ppm)	1.24	1.62	0.46	1.50	3	0.3	0.003
Th (ppm)	18.75	16.45	4.1	21	42	4.2	10.7
Tl (ppm)	3.5	3.7	2.1	1.8	3.6	0.36	0.75
U (ppm)	2.12	2.57	1.16	5.5	11	1.1	2.8
V (ppm)	45.5	59	<5	1,150	2,300	230	110
W (ppm)	4	4	1	5	10	1	2
Zn (ppm)	4,277	1,223	119,300	400	800	80	71
Zr (ppm)	266.5	293	33.2	500	1,000	100	190
Sc (ppm)	8	11	<5	150	300	30	13
La (ppm)	74.6	78.5	14.2	80	160	16	30
Ce (ppm)	154.5	159.5	28.8	165	330	33	64
Pr (ppm)	18.93	19.19	3.51	19.5	39	3.9	7.1
Nd (ppm)	63.3	65.9	12.2	80	160	16	26
Sm (ppm)	9.65	10.25	1.9	17.5	35	3.5	4.5
Eu (ppm)	1.27	1.65	0.25	5.5	11	1.1	0.88
Gd (ppm)	6.46	7.29	1.26	16.5	33	3.3	3.8
Tb (ppm)	0.84	0.94	0.12	3	6.0	0.6	0.64
Dy (ppm)	4.72	5.36	0.65	18.5	37	3.7	3.5
Ho (ppm)	0.95	1.04	0.1	3.9	7.8	0.78	0.8
Er (ppm)	2.66	2.90	0.29	11	22	2.2	2.3
Tm (ppm)	0.40	0.4	<0.05	1.6	3.2	0.32	0.33
Yb (ppm)	2.45	2.6	0.3	11	22	2.2	2.2
Lu (ppm)	0.39	0.41	<0.05	1.5	3	0.3	0.32
Y (ppm)	27.3	30.45	3.0	100	200	20	22
TotalREE	376.4	397.4	66.6				
TotalLREE	328.7	342.3	62.1				
TotalHREE	39.7	44.1	4.5				
%LREE	87	86	93				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 7 – Peruvian site sampling units and summary of laboratory results.



Sample Name	23-BK1-SU1	23-BK1-SU2	23-BK1-SU3	23-BK1-SU4	23-BK1-SU5	23-BK1-SU6				
Sample Type	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Area	Wellington	Wellington	Wellington	Wellington	Wellington	Wellington				
Sample Unit	SU1	SU2	SU3	SU4	SU5	SU6				
Volume (m^3) Est.[2]	9,949	16,203	14,188	36,222	14,393	6,959				
Au (ppm)	0.2205	0.33	0.967	0.434	0.183	0.1615	0.02	0.03	0.003	0.0018
Ag (ppm)	36.5	23.5	86.5	25.5	20.5	7	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	64,700	68,600	39,600	63,200	63,250	75,400	420,500	841,000	84,100	80,400
F (%)	0.065	0.077	0.040	0.066	0.073	0.083	0.28	0.553	0.0553	na
Fe (ppm)	72,350	65,200	184,500	85,750	81,150	66,800	353,500	707,000	70,700	35,000
Fe (%)	7.24	6.52	18.45	8.58	8.12	6.68	35.35	70.7	7.07	3.5
Mg (ppm)	2,900	6,000	1,750	5,550	4,750	6,600	160,000	320,000	32,000	13,300
Ti (ppm)	3,250	3,300	2,100	3,450	3,700	4,500	27,000	54,000	5,400	3,900
Ti (%)	0.33	0.33	0.21	0.35	0.37	0.45	2.7	5.4	0.5	0.39
As (ppm)	128.5	106	425	161	151	87	5.0	10	1	1.5
B (ppm)	39.5	37.5	58.5	45	43.5	35.5	50	100	10	15
Ba (ppm)	483.5	740.5	294	667	1,431	1,190	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	27.75	27	78.5	8.85	9.7	3.35	0.3	0.6	0.06	0.127
Cd (ppm)	32	96.5	20.55	125.5	33.2	17.4	0.49	0.98	0.098	0.098
Co (ppm)	4.65	6.85	19.65	8.9	5	10.2	145	290	29	17
Cr (ppm)	28	38.5	17.5	32.5	32	26.5	925	1,850	185	85
Cs (ppm)	10.25	8.55	5.85	10.6	10.95	12.4	7.5	15	1.5	4.8
Cu (ppm)	316.5	356.5	114.5	372.5	182	67.5	375	750	75	25
Ga (ppm)	17.5	18	11	16.5	16.5	20	90	180	18	17
Ge (ppm)	2	2	2	2	2	2	8	16	1.6	1.6
Hf (ppm)	5	4.5	3	4.5	4.5	5.5	15	30	3.0	5.8
In (ppm)	20.85	21.1	17.4	15.7	7.5	4.7	0.25	0.5	0.05	0.05
Li (ppm)	36	33	29	28.5	25	26.5	65	130	13	20
Mn (ppm)	1,055	1,988	434.5	3,019	1,948	1,984	7,000	14,000	1,400	600
Mo (ppm)	3.5	4.5	2.5	3.5	4	2	5	10	1.0	1.5
Nb (ppm)	16.5	16.5	11	14	14.5	20.5	55	110	11	12.5
Ni (ppm)	10	12.5	11	17.5	11.5	16	640	1,280	128	50
Pb (ppm)	10,593	4,291	6,271	15,750	13,800	2,457	40	80	8.0	16
Rb (ppm)	124	127.5	87.65	109	132.5	141.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	10.95	7.1	11.45	19.55	12.1	4.7	1	2	0.2	0.2
Se (ppm)	1	1.5	2.5	1.5	1	<1	250	500	50	50
Sn (ppm)	7	5.5	11	32.5	7	5.5	13	25	2.5	5.5
Sr (ppm)	77	184	87	153.5	136	198	1,300	2,600	260	350
Ta (ppm)	1	1	0.6	0.8	0.85	1.05	5	10	1.0	1.1
Te (ppm)	0.37	0.31	2.27	0.19	0.37	0.15	1.50	3	0.3	0.003
Th (ppm)	11.85	12.6	5.95	12.25	10.85	14.95	21	42	4.2	10.7
Tl (ppm)	2.95	2.75	2.55	2.7	2.3	2	1.8	3.6	0.36	0.75
U (ppm)	3.55	4.56	2.04	4.34	3.59	4.16	5.5	11	1.1	2.8
V (ppm)	91	122	48	118.5	147	144.5	1,150	2,300	230	110
W (ppm)	12	13	8.5	12	10	19.5	5	10	1	2
Zn (ppm)	6,639	15,950	3,774	22,550	6,565	3,277	400	800	80	71
Zr (ppm)	167.5	152.5	106.3	155.5	151	197.5	500	1,000	100	190
Sc (ppm)	8.5	10	5.5	12	11.5	13.5	150	300	30	13
La (ppm)	47.9	46.6	28.3	43.75	46.15	64.35	80	160	16	30
Ce (ppm)	84.9	82.45	50	77.35	83	115.5	165	330	33	64
Pr (ppm)	9.67	9.64	5.77	9.15	9.64	13.48	19.5	39	3.9	7.1
Nd (ppm)	34.65	35.2	20.75	33.45	35.15	49.7	80	160	16	26
Sm (ppm)	5.45	5.65	3.35	5.55	5.6	7.85	17.5	35	3.5	4.5
Eu (ppm)	0.97	1.2	0.58	1.14	1.09	1.69	5.5	11	1.1	0.88
Gd (ppm)	3.74	4.01	2.24	4.26	3.84	5.68	16.5	33	3.3	3.8
Tb (ppm)	0.51	0.56	0.32	0.61	0.54	0.75	3	6	0.6	0.64
Dy (ppm)	2.84	3.06	1.80	3.53	2.97	3.97	18.5	37	3.7	3.5
Ho (ppm)	0.57	0.61	0.34	0.71	0.58	0.77	3.9	7.8	0.78	0.8
Er (ppm)	1.61	1.71	0.96	2.10	1.7	2.17	11	22	2.2	2.3
Tm (ppm)	0.24	0.25	0.14	0.29	0.26	0.31	1.6	3.2	0.32	0.33
Yb (ppm)	1.6	1.7	1	2.05	1.7	2	11	22	2.2	2.2
Lu (ppm)	0.26	0.26	0.16	0.31	0.26	0.3	1.5	3	0.3	0.32
Y (ppm)	15.4	16.15	9.5	19.5	15.65	20.7	100	200	20	22
TotalREE	218.8	219.0	130.7	215.7	219.6	302.7				
TotalLREE	187.3	184.7	111.0	174.7	184.5	258.3				
TotalHREE	23.0	24.3	14.2	29.1	23.6	31.0				
%LREE	86	84	85	81	84	85				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

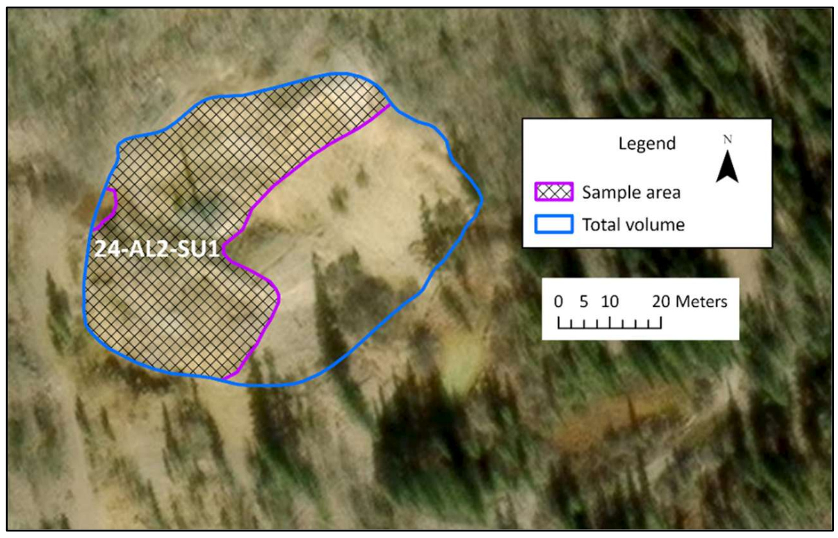
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 8 – Wellington site sampling units and summary of laboratory results.

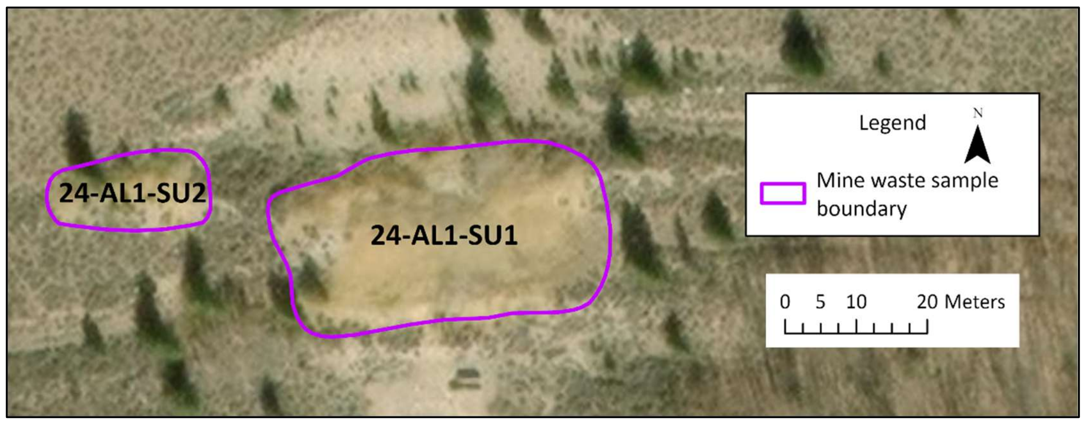


Sample Name	24-AL2-SU1	24-AL2-SU1-GRAB	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Rock Grab Sample				
Area	Orphan Boy	Orphan Boy				
Sample Unit	SU1	SU1				
Volume (m^3) Est.[2]	31,190	na				
Au (ppm)	2.135	0.198	0.02	0.03	0.003	0.0018
Ag (ppm)	93.49	42.56	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	2.5	5	0.5	0.5
Al (ppm)	46,400	2,340	420,500	841,000	84,100	80,400
F (%)	0.0865	0.0071	0.28	0.553	0.0553	na
Fe (%)	7.26	23	35.35	70.7	7.07	3.5
Mg (ppm)	6,605	217	160,000	320,000	32,000	13,300
Ti (%)	0.141	0.014	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	5.0	10	1	1.5
B (ppm)	<20	<20	50	100	10	15
Ba (ppm)	493.5	12	1,250	2,500	250	550
Be (ppm)	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	93.7	31.8	0.3	0.6	0.06	0.127
Cd (ppm)	31.5	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	7	78	145	290	29	17
Cr (ppm)	10	<10	925	1,850	185	85
Cs (ppm)	3.3	<0.5	7.5	15	1.5	4.8
Cu (ppm)	411.5	<10	375	750	75	25
Ga (ppm)	12	<1	90	180	18	17
Ge (ppm)	2	<1	8	16	1.6	1.6
Hf (ppm)	4	<2	15	30	3.0	5.8
In (ppm)	6.25	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	10	<10	65	130	13	20
Mn (ppm)	778	56	7,000	14,000	1,400	600
Mo (ppm)	4.5	3	5	10	1.0	1.5
Nb (ppm)	6.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	640	1,280	128	50
Pb (ppm)	3,045	450	40	80	8.0	16
Rb (ppm)	115.5	4	185	370	37	112
Re (ppm)	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	<1	<1	1	2	0.2	0.2
Se (ppm)	<1	2	250	500	50	50
Sn (ppm)	75	<5	13	25	2.5	5.5
Sr (ppm)	68.5	<10	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	11.85	9	1.50	3	0.3	0.003
Th (ppm)	4.25	0.5	21	42	4.2	10.7
Tl (ppm)	1	<1	1.8	3.6	0.36	0.75
U (ppm)	1.5	<1	5.5	11	1.1	2.8
V (ppm)	35.5	<10	1,150	2,300	230	110
W (ppm)	3	2	5	10	1	2
Zn (ppm)	5,250	21	400	800	80	71
Zr (ppm)	148	<100	500	1,000	100	190
Sc (ppm)	<5	<5	150	300	30	13
La (ppm)	18.5	<4	80	160	16	30
Ce (ppm)	39	<3	165	330	33	64
Pr (ppm)	4.4	<0.5	19.5	39	3.9	7.1
Nd (ppm)	17	<1	80	160	16	26
Sm (ppm)	2.9	<0.5	17.5	35	3.5	4.5
Eu (ppm)	0.55	<0.3	5.5	11	1.1	0.88
Gd (ppm)	2.35	<0.5	16.5	33	3.3	3.8
Tb (ppm)	0.25	<0.2	3	6	0.6	0.64
Dy (ppm)	1.9	<0.2	18.5	37	3.7	3.5
Ho (ppm)	0.38	<0.05	3.9	7.8	0.78	0.8
Er (ppm)	1.1	<0.2	11	22	2.2	2.3
Tm (ppm)	0.16	<0.05	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	<0.2	11	22	2.2	2.2
Lu (ppm)	0.15	<0.1	1.5	3	0.3	0.32
Y (ppm)	10.65	1.2	100	200	20	22
TotalREE	100.5	1.2				
TotalLREE	84.7	na				
TotalHREE	15.8	1.2				
%LREE	84	na				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - esimated volume, estimated volumes include the entire waste pile (only a portion was sampled).
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 9 – Orphan Boy site sampling units and summary of laboratory results.



Sample Name	24-AL1-SU1	24-AL1-SU2	24-AL1-SU1-GRAB				
Sample Type	Waste Rock / Ore Stockpile	Waste Rock / Ore Stockpile	Rock Grab Sample				
Area	Sacramento	Sacramento	Sacramento	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1	SU2	SU1				
Volume (m^3) Est.[2]	3,200	399	na				
Au (ppm)	6.725	5.735	0.672	0.02	0.03	0.003	0.0018
Ag (ppm)	44.59	37.56	78.07	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	21,250	26,650	24,600	420,500	841,000	84,100	80,400
F (%)	0.092	0.104	1.69	0.28	0.553	0.0553	na
Fe (%)	10.01	8.63	8.43	35.35	70.7	7.07	3.5
Mg (ppm)	20,800	28,250	9,370	160,000	320,000	32,000	13,300
Ti (%)	0.124	0.162	0.05	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	30	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	300.5	380.5	41	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	68.4	48.25	98.1	0.3	0.6	0.06	0.127
Cd (ppm)	101.5	61.95	24	0.49	0.98	0.098	0.098
Co (ppm)	5	4.5	3	145	290	29	17
Cr (ppm)	15	16	<10	925	1,850	185	85
Cs (ppm)	1.45	1.75	0.8	7.5	15	1.5	4.8
Cu (ppm)	669	418	31	375	750	75	25
Ga (ppm)	7.5	9	<1	90	180	18	17
Ge (ppm)	1.5	2	24	8	16	1.6	1.6
Hf (ppm)	4.5	5.5	3	15	30	3.0	5.8
In (ppm)	18.25	14.1	1	0.25	0.5	0.05	0.05
Li (ppm)	15.5	18.5	<10	65	130	13	20
Mn (ppm)	4,015	3,030	2,590	7,000	14,000	1,400	600
Mo (ppm)	9	9	4	5	10	1.0	1.5
Nb (ppm)	5.5	5.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	5,850	4,715	8,470	40	80	8.0	16
Rb (ppm)	42	59	31	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	2	<1	3	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	49	51	28	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	2.4	3.8	1	1.50	3	0.3	0.003
Th (ppm)	4.55	4.95	4	21	42	4.2	10.7
Tl (ppm)	<1	<1	<1	1.8	3.6	0.36	0.75
U (ppm)	2	2	<1	5.5	11	1.1	2.8
V (ppm)	29.5	38.5	<10	1,150	2,300	230	110
W (ppm)	9	9.5	170	5	10	1	2
Zn (ppm)	15,500	9,765	2,730	400	800	80	71
Zr (ppm)	170.5	220.5	128	500	1,000	100	190
Sc (ppm)	<5	<5	<5	150	300	30	13
La (ppm)	11	14.5	21	80	160	16	30
Ce (ppm)	26.5	32.5	40	165	330	33	64
Pr (ppm)	2.65	3.4	4.8	19.5	39	3.9	7.1
Nd (ppm)	10	12.5	18	80	160	16	26
Sm (ppm)	2	2.3	3.4	17.5	35	3.5	4.5
Eu (ppm)	0.35	0.35	0.7	5.5	11	1.1	0.88
Gd (ppm)	1.55	1.7	1.9	16.5	33	3.3	3.8
Tb (ppm)	0.25	0.25	0.2	3	6	0.6	0.64
Dy (ppm)	1.5	1.8	1.3	18.5	37	3.7	3.5
Ho (ppm)	0.33	0.41	0.24	3.9	7.8	0.78	0.8
Er (ppm)	1	1.3	0.6	11	22	2.2	2.3
Tm (ppm)	0.17	0.20	0.08	1.6	3.2	0.32	0.33
Yb (ppm)	1.25	1.5	0.6	11	22	2.2	2.2
Lu (ppm)	0.2	0.2	<0.1	1.5	3	0.3	0.32
Y (ppm)	9.05	10.8	6	100	200	20	22
TotalREE	67.8	83.7	98.8				
TotalLREE	54.1	67.3	89.8				
TotalHREE	13.8	16.5	9.0				
%LREE	80	80	91				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

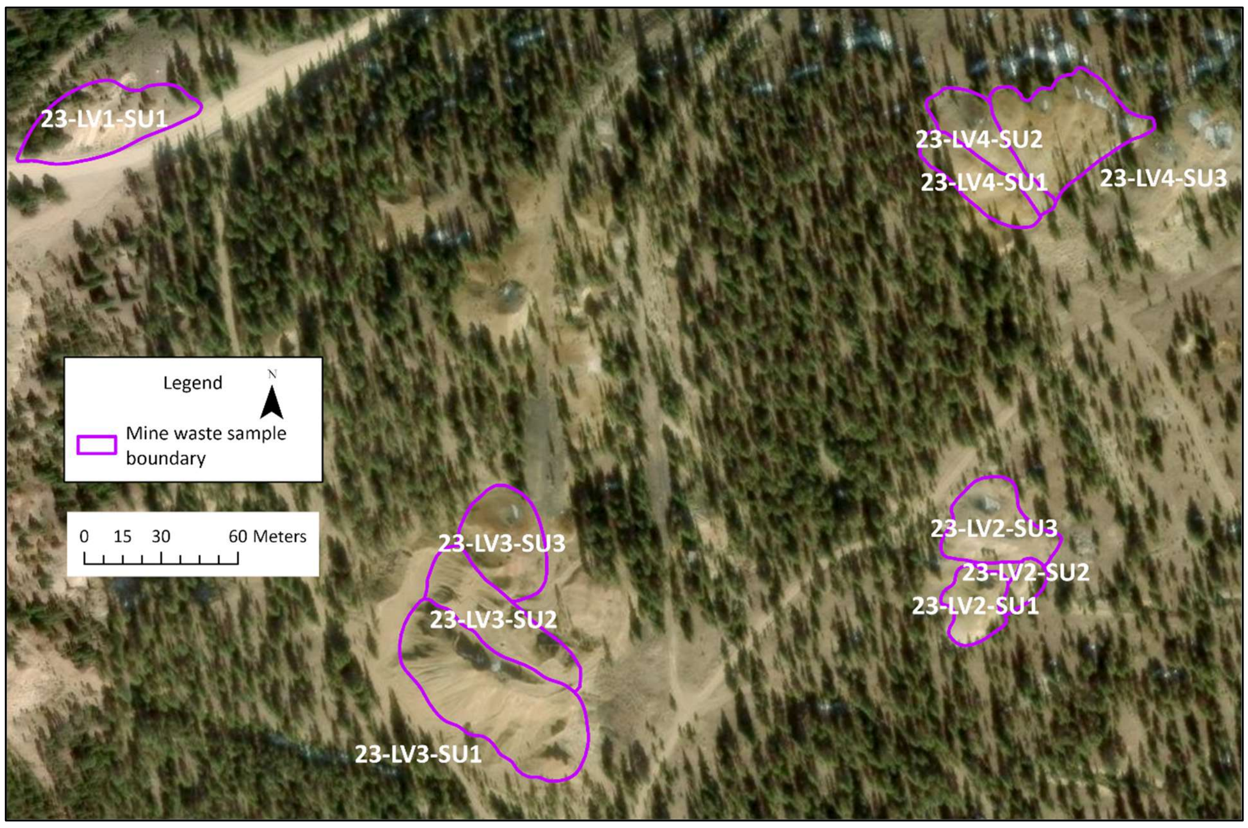
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 10 – Sacramento site sampling units and summary of laboratory results.



Sample Name	23-LV1-SU1	23-LV2-SU1	23-LV2-SU2	23-LV2-SU3	23-LV3-SU1	23-LV3-SU2	23-LV3-SU3	23-LV4-SU1	23-LV4-SU2	23-LV4-SU3	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock				
Area	Little Prince	President	President	President	Penn 3	Penn 3	Penn 3	Ballard	Ballard	Ballard				
Sample Unit	SU1	SU1	SU2	SU3	SU1	SU2	SU3	SU1	SU2	SU3				
Volume (m^3) Est.[2]	6,552	3,511	704	7,887	41,224	19,263	13,521	5,852	5,707	13,274				
Au (ppm)	0.952	1.555	2.62	1.379	5.22	4.64	2.365	1.465	3.748	2.555	0.02	0.03	0.003	0.0018
Ag (ppm)	29	12	22	17.5	39.5	39.5	39	38.5	28.5	55.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	1	1.5	1	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	68,150	71,950	79,100	77,850	58,200	62,700	49,750	54,400	54,800	38,800	420,500	841,000	84,100	80,400
F (%)	0.069	0.127	0.124	0.114	0.082	0.113	0.078	0.073	0.072	0.055	0.28	0.553	0.0553	na
Fe (%)	7.94	8.21	5.92	12.09	17.67	13.30	22.84	13	11.87	14.22	35.35	70.7	7.07	3.5
Mg (ppm)	1,550	9,250	3,250	3,100	1,900	3,700	3,050	1,050	1,200	1,150	160,000	320,000	32,000	13,300
Ti (%)	0.10	0.22	0.17	0.22	0.22	0.23	0.18	0.18	0.21	0.20	2.7	5.4	0.5	0.39
As (ppm)	122.5	77.5	100	137.5	751.5	504	936.5	1,073	679.5	1,571	5.0	10	1	1.5
B (ppm)	29	30	23.5	37.5	62	47.5	63	45	50.5	48	50	100	10	15
Ba (ppm)	659.5	1,149	1,529	1,013	1,561	1,120	2,065	852.5	649	782.5	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	91.2	69.25	84.8	182	462	490.5	373.5	691	343.5	1,795	0.3	0.6	0.06	0.127
Cd (ppm)	3.25	0.95	0.75	1.3	2.25	2.1	3.8	10.3	12.6	15.65	0.49	0.98	0.098	0.098
Co (ppm)	1.95	1.95	1.45	2.3	1.15	1.65	3.3	8.4	9.55	2.3	145	290	29	17
Cr (ppm)	<10	10	16	12.5	26.5	21.5	28	32	35.5	25	925	1,850	185	85
Cs (ppm)	5.25	4.8	3.85	3.85	4.4	4.85	4.05	3.45	3.55	4	7.5	15	1.5	4.8
Cu (ppm)	416.5	726	714.5	930.5	1,088	885	1,997	1,340	1,368	876.5	375	750	75	25
Ga (ppm)	23	28.5	34	34.5	40	38	43.5	18.5	22.5	25	90	180	18	17
Ge (ppm)	3	2	3	3	4	4	4	5	4.5	6.5	8	16	1.6	1.6
Hf (ppm)	3.5	6.5	5	4.5	4	5	3	4.5	4.5	5	15	30	3.0	5.8
In (ppm)	3.6	4.65	7.25	5.3	9.3	7.45	20.25	10.4	7.35	7.8	0.25	0.5	0.05	0.05
Li (ppm)	29	15	21	18	21	22.5	22	36.5	41.5	37	65	130	13	20
Mn (ppm)	443.5	267.5	157.5	404.5	164.5	275	462	1,781	3,034	204.5	7,000	14,000	1,400	600
Mo (ppm)	5	6.5	5.5	8	9	11.5	6.5	15.5	12	26.5	5	10	1.0	1.5
Nb (ppm)	24	15	16	14	12.5	13	7.5	9	9	9	55	110	11	12.5
Ni (ppm)	7	6.5	18.5	7.5	8.5	7.5	11.5	20.5	16.5	11	640	1,280	128	50
Pb (ppm)	857.5	721	1,316	1,203	3,210	2,967	1,407	6,660	4,884	6,921	40	80	8.0	16
Rb (ppm)	108.5	128.5	103.4	112.5	75.6	89.0	56	40.6	39.7	36.8	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	47.9	10.5	24.6	28.75	181	145	172.5	164	116.75	357	1	2	0.2	0.2
Se (ppm)	1	2	1.5	1	<1	2	1	1.5	1	1.5	250	500	50	50
Sn (ppm)	17.5	19	19.5	23	52	34.5	57.5	15.5	7.5	18.5	13	25	2.5	5.5
Sr (ppm)	152.5	397	382	327.5	240	317	257	415.5	436.5	356.5	1,300	2,600	260	350
Ta (ppm)	1.6	1	1.1	0.9	0.8	0.85	<0.5	0.55	0.55	0.55	5	10	1.0	1.1
Te (ppm)	4.01	30.06	36.67	28.84	36.72	33.62	26.79	17.40	15.09	23.62	1.50	3	0.3	0.003
Th (ppm)	15.4	12.9	11.05	12.8	10.1	12.3	9.3	6.7	7.4	7.35	21	42	4.2	10.7
Tl (ppm)	4.3	1.75	2.2	2.3	5.9	5.8	9.9	27.6	9.7	31.55	1.8	3.6	0.36	0.75
U (ppm)	12.9	12.2	9.2	10.1	13.3	13.5	15.3	20.3	19.9	12.1	5.5	11	1.1	2.8
V (ppm)	24	41	33	38.5	46	42	50	37	36	36.5	1,150	2,300	230	110
W (ppm)	15.5	32	25	43	51	39.5	54	22	19	43.5	5	10	1	2
Zn (ppm)	677	532	179.5	200.5	311.5	280.5	331.5	1,355	1,699	1,008	400	800	80	71
Zr (ppm)	90.7	206	153.5	148.5	129	157.5	101.7	159.5	162	185	500	1,000	100	190
Sc (ppm)	5	5.5	5.5	5.5	7.5	6.5	9	5.5	5	5	150	300	30	13
La (ppm)	29.1	39.55	32.1	26.95	29.3	40	27.3	21.15	23.2	29.7	80	160	16	30
Ce (ppm)	57.2	81.75	63.5	55.4	56.95	76.2	56.6	43.35	46.5	56.65	165	330	33	64
Pr (ppm)	7.16	9.34	7.22	6.41	6.74	8.87	6.23	5.13	5.42	6.61	19.5	39	3.9	7.1
Nd (ppm)	27.4	35.9	26.85	24.75	25.35	33.65	23.3	20.2	20.5	24.55	80	160	16	26
Sm (ppm)	5.55	6.45	4.75	4.65	4.85	6.3	4.4	3.8	4.1	4.6	17.5	35	3.5	4.5
Eu (ppm)	1.13	1.95	1.34	1.20	1.14	1.52	1.02	1.06	1.17	1.06	5.5	11	1.1	0.88
Gd (ppm)	4.77	5.86	4.66	3.85	4.30	5.43	3.99	3.93	4.52	4.11	16.5	33	3.3	3.8
Tb (ppm)	0.69	0.81	0.64	0.49	0.60	0.72	0.57	0.55	0.65	0.58	3	6	0.6	0.64
Dy (ppm)	3.91	4.52	3.44	2.44	3.12	3.56	3.06	3.04	3.55	3.18	18.5	37	3.7	3.5
Ho (ppm)	0.76	0.91	0.68	0.44	0.59	0.64	0.59	0.57	0.65	0.6	3.9	7.8	0.78	0.8
Er (ppm)	2.12	2.5	1.96	1.26	1.65	1.76	1.72	1.55	1.76	1.65	11	22	2.2	2.3
Tm (ppm)	0.31	0.37	0.29	0.19	0.25	0.25	0.25	0.24	0.27	0.24	1.6	3.2	0.32	0.33
Yb (ppm)	2.05	2.55	1.85	1.35	1.7	1.75	1.75	1.6	1.8	1.55	11	22	2.2	2.2
Lu (ppm)	0.30	0.37	0.28	0.22	0.25	0.26	0.25	0.24	0.27	0.25	1.5	3	0.3	0.32
Y (ppm)	21.8	26.6	20.2	12.3	15.4	17.3	15.9	14.7	17.3	15.6	100	200	20	22
TotalREE	169.2	224.9	175.2	147.4	159.7	204.7	155.9	126.5	136.6	155.9				
TotalLREE	132.3	180.8	140.4	123.2	128.6	172.0	122.8	98.6	105.4	127.3				
TotalHREE	31.9	38.6	29.3	18.7	23.5	26.2	24.0	22.4	26.2	23.6				
%LREE	78	80	80	84	81	84	79	78	77	82				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

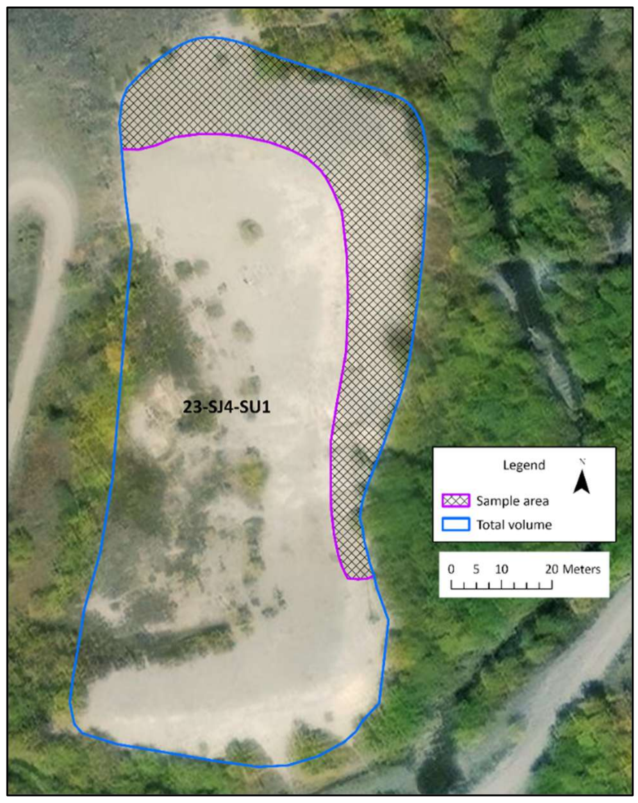
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 11 – Leadville site sampling units and summary of laboratory results.

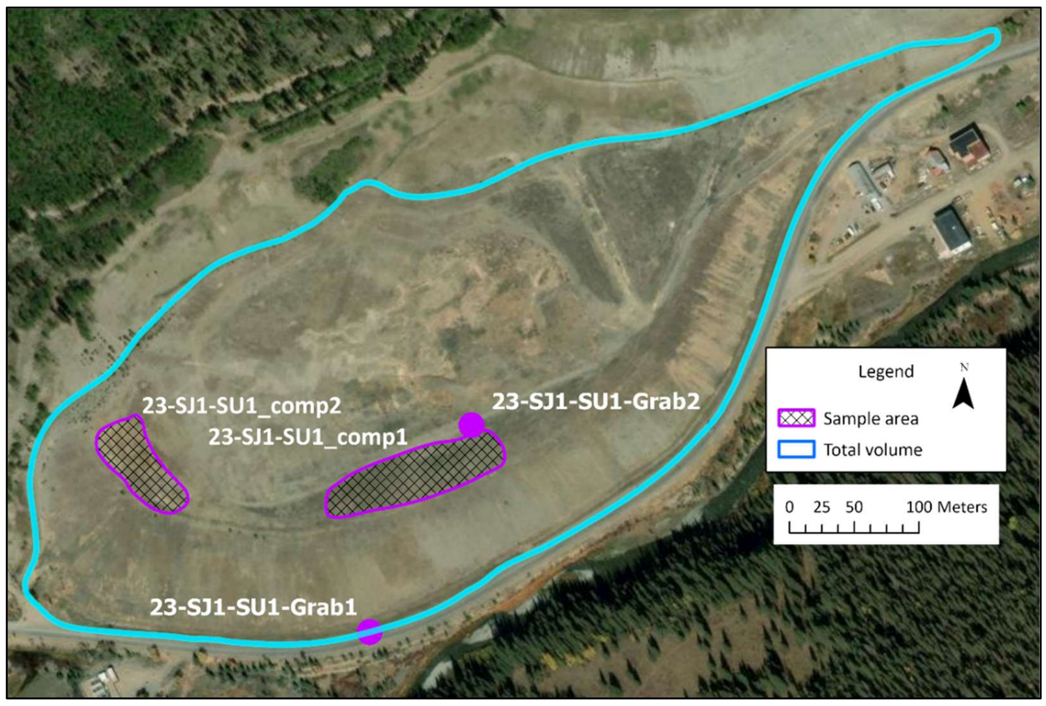


Sample Name	23-SJ4-SU1-Composite-Fine				
Sample Type	Tailings				
Area	Highland Mary	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1				
Volume (m^3) Est.[2]	47,616				
Au (ppm)	0.905	0.02	0.03	0.003	0.0018
Ag (ppm)	31	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	42,400	420,500	841,000	84,100	80,400
F (%)	0.072	0.28	0.553	0.0553	na
Fe (%)	1.54	35.35	70.7	7.07	3.5
Mg (ppm)	3,000	160,000	320,000	32,000	13,300
Ti (%)	0.2	2.7	5.4	0.5	0.39
As (ppm)	42	5.0	10	1	1.5
B (ppm)	35	50	100	10	15
Ba (ppm)	606	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	0.1	0.3	0.6	0.06	0.127
Cd (ppm)	2.6	0.49	0.98	0.098	0.098
Co (ppm)	5.9	145	290	29	17
Cr (ppm)	15	925	1,850	185	85
Cs (ppm)	13.8	7.5	15	1.5	4.8
Cu (ppm)	159	375	750	75	25
Ga (ppm)	10	90	180	18	17
Ge (ppm)	1	8	16	1.6	1.6
Hf (ppm)	3	15	30	3.0	5.8
In (ppm)	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	101	65	130	13	20
Mn (ppm)	1,475	7,000	14,000	1,400	600
Mo (ppm)	84	5	10	1.0	1.5
Nb (ppm)	8	55	110	11	12.5
Ni (ppm)	131	640	1,280	128	50
Pb (ppm)	1,536	40	80	8.0	16
Rb (ppm)	207	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	53.3	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<1	13	25	2.5	5.5
Sr (ppm)	38	1,300	2,600	260	350
Ta (ppm)	<0.5	5	10	1.0	1.1
Te (ppm)	0.25	1.50	3	0.3	0.003
Th (ppm)	8.6	21	42	4.2	10.7
Tl (ppm)	3.8	1.8	3.6	0.36	0.75
U (ppm)	2.98	5.5	11	1.1	2.8
V (ppm)	57	1,150	2,300	230	110
W (ppm)	10	5	10	1	2
Zn (ppm)	470	400	800	80	71
Zr (ppm)	130	500	1,000	100	190
Sc (ppm)	7	150	300	30	13
La (ppm)	21.1	80	160	16	30
Ce (ppm)	38.8	165	330	33	64
Pr (ppm)	4.51	19.5	39	3.9	7.1
Nd (ppm)	15.8	80	160	16	26
Sm (ppm)	2.9	17.5	35	3.5	4.5
Eu (ppm)	0.66	5.5	11	1.1	0.88
Gd (ppm)	2.54	16.5	33	3.3	3.8
Tb (ppm)	0.33	3	6.0	0.6	0.64
Dy (ppm)	2.1	18.5	37	3.7	3.5
Ho (ppm)	0.4	3.9	7.8	0.78	0.8
Er (ppm)	1.15	11	22	2.2	2.3
Tm (ppm)	0.19	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	11	22	2.2	2.2
Lu (ppm)	0.19	1.5	3	0.3	0.32
Y (ppm)	12.1	100	200	20	22
TotalREE	111.0				
TotalLREE	86.3				
TotalHREE	17.7				
%LREE	78				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 12 – Highland Mary site sampling units and summary of laboratory results.

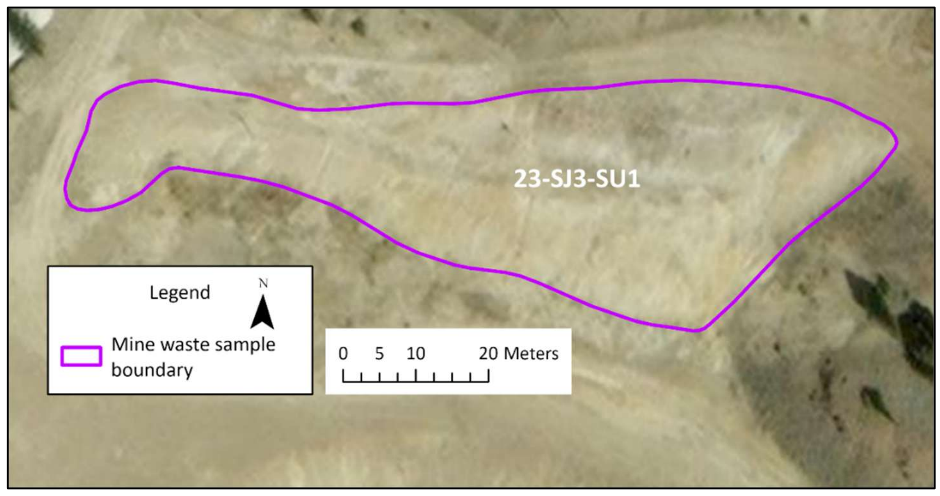


Sample Name	23-SJ1-SU1-comp1	23-SJ1-SU1-comp2	23-SJ1-SU1-Grab1	23-SJ1-SU1-Grab2				
Sample Type	Tailings/Fill	Tailings	Grab/Tailings	Grab/Tailings				
Area	Mayflower	Mayflower	Mayflower	Mayflower	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1	SU1	SU1	SU1				
Volume (m^3) Est.[2]	3,000,120	same waste pile	na	na				
Au (ppm)	0.9315	1.4975	1.33	2.03	0.02	0.03	0.003	0.0018
Ag (ppm)	29.5	17.5	17	99	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	43,950	49,500	36,200	13,400	420,500	841,000	84,100	80,400
F (%)	0.293	0.184	0.065	2.359	0.28	0.553	0.0553	na
Fe (%)	3.57	5.8	1.11	1.6	35.35	70.7	7.07	3.5
Mg (ppm)	5,900	5,550	2,200	1,900	160,000	320,000	32,000	13,300
Ti (%)	0.25	0.29	0.28	0.06	2.7	5.4	0.5	0.39
As (ppm)	34	35.5	10	32	5.0	10	1	1.5
B (ppm)	15	27	17	<10	50	100	10	15
Ba (ppm)	514.5	531	550	137	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	12.1	14.25	13.7	17.7	0.3	0.6	0.06	0.127
Cd (ppm)	36.65	31.55	7.6	105	0.49	0.98	0.098	0.098
Co (ppm)	7.7	13.6	0.6	2.4	145	290	29	17
Cr (ppm)	11	11	<10	<10	925	1,850	185	85
Cs (ppm)	4.9	5.25	4.9	2.7	7.5	15	1.5	4.8
Cu (ppm)	944.5	993.5	266	2,041	375	750	75	25
Ga (ppm)	18.5	15.5	12	20	90	180	18	17
Ge (ppm)	1	1	1	1	8	16	1.6	1.6
Hf (ppm)	3.5	3.5	3	<1	15	30	3.0	5.8
In (ppm)	3.8	4.55	1.2	5.3	0.25	0.5	0.05	0.05
Li (ppm)	41	37.5	36	42	65	130	13	20
Mn (ppm)	33,135	9,072	7,196	80,280	7,000	14,000	1,400	600
Mo (ppm)	11.5	9	10	13	5	10	1.0	1.5
Nb (ppm)	7.5	9	8	2	55	110	11	12.5
Ni (ppm)	8.5	14.5	6	<5	640	1,280	128	50
Pb (ppm)	5,555	4,138	1,986	11,900	40	80	8.0	16
Rb (ppm)	110.5	122.4	126	43.1	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	20.25	16.7	22	47.4	1	2	0.2	0.2
Se (ppm)	1.5	2	<1	2	250	500	50	50
Sn (ppm)	2	3	3	1	13	25	2.5	5.5
Sr (ppm)	142.5	193	73	37	1,300	2,600	260	350
Ta (ppm)	0.65	0.65	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	6.17	8.01	2.97	6.6	1.50	3	0.3	0.003
Th (ppm)	10.05	11.05	7.2	2.5	21	42	4.2	10.7
Tl (ppm)	2.35	2.35	3.2	1.1	1.8	3.6	0.36	0.75
U (ppm)	3.06	3.73	2.37	1.28	5.5	11	1.1	2.8
V (ppm)	69	73	68	21	1,150	2,300	230	110
W (ppm)	90.5	56.5	63	139	5	10	1	2
Zn (ppm)	7,941	7,504	2,196	28,700	400	800	80	71
Zr (ppm)	110.45	123.55	94.3	26	500	1,000	100	190
Sc (ppm)	8.5	9	8	<5	150	300	30	13
La (ppm)	21.35	26.15	12.7	6.7	80	160	16	30
Ce (ppm)	40.75	48.75	23.3	13	165	330	33	64
Pr (ppm)	4.9	5.89	2.69	1.67	19.5	39	3.9	7.1
Nd (ppm)	17.6	20.4	9.4	6.1	80	160	16	26
Sm (ppm)	3.4	3.75	1.6	1.2	17.5	35	3.5	4.5
Eu (ppm)	0.91	0.92	0.43	0.75	5.5	11	1.1	0.88
Gd (ppm)	2.8	3.15	1.26	1.27	16.5	33	3.3	3.8
Tb (ppm)	0.38	0.43	0.19	0.18	3	6.0	0.6	0.64
Dy (ppm)	2.27	2.45	1.3	1.11	18.5	37	3.7	3.5
Ho (ppm)	0.445	0.49	0.28	0.2	3.9	7.8	0.78	0.8
Er (ppm)	1.29	1.45	0.89	0.48	11	22	2.2	2.3
Tm (ppm)	0.2	0.21	0.15	0.06	1.6	3.2	0.32	0.33
Yb (ppm)	1.25	1.45	1	0.4	11	22	2.2	2.2
Lu (ppm)	0.19	0.22	0.16	0.06	1.5	3	0.3	0.32
Y (ppm)	13.55	14.95	8.7	6.9	100	200	20	22
TotalREE	119.8	139.6	72.1	40.1				
TotalLREE	91.7	109.0	51.4	30.7				
TotalHREE	19.6	21.6	12.7	9.4				
%LREE	77	78	71	77				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume, estimated volumes include the entire waste pile (only a portion was sampled).
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 13 – Mayflower site sampling units and summary of laboratory results.

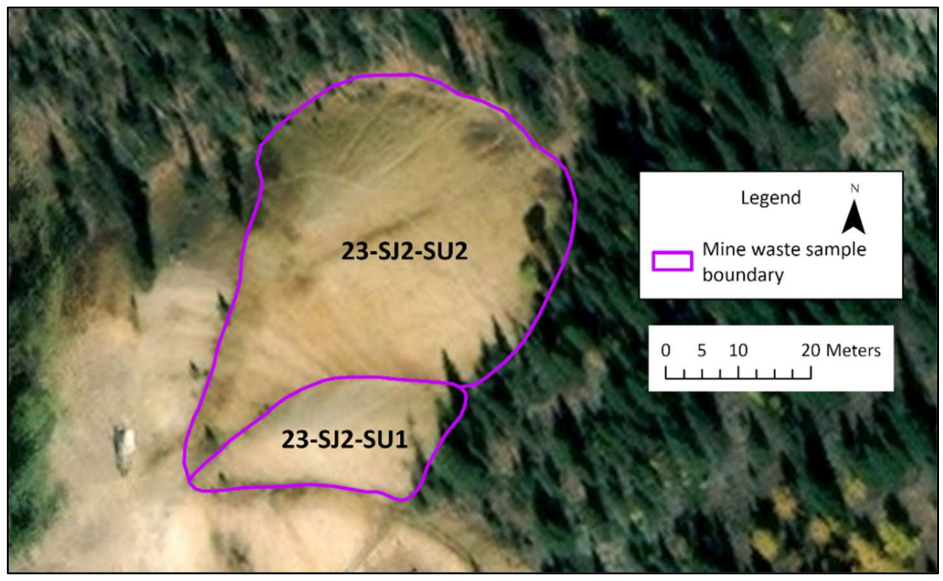


Sample Name	23-SJ3-SU1				
Sample Type	Waste Rock				
Area	Brooklyn	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1				
Volume (m^3) Est.[2]	34,458				
Au (ppm)	5.19	0.02	0.03	0.003	0.0018
Ag (ppm)	28.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	94,450	420,500	841,000	84,100	80,400
F (%)	0.078	0.28	0.553	0.0553	na
Fe (%)	4.05	35.35	70.7	7.07	3.5
Mg (ppm)	4,750	160,000	320,000	32,000	13,300
Ti (%)	0.64	2.7	5.4	0.5	0.39
As (ppm)	75	5.0	10	1	1.5
B (ppm)	47	50	100	10	15
Ba (ppm)	997	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	26.1	0.3	0.6	0.06	0.127
Cd (ppm)	1.05	0.49	0.98	0.098	0.098
Co (ppm)	2	145	290	29	17
Cr (ppm)	12.5	925	1,850	185	85
Cs (ppm)	8.15	7.5	15	1.5	4.8
Cu (ppm)	115.5	375	750	75	25
Ga (ppm)	24	90	180	18	17
Ge (ppm)	1	8	16	1.6	1.6
Hf (ppm)	6.5	15	30	3.0	5.8
In (ppm)	2	0.25	0.5	0.05	0.05
Li (ppm)	14.5	65	130	13	20
Mn (ppm)	410	7,000	14,000	1,400	600
Mo (ppm)	7	5	10	1.0	1.5
Nb (ppm)	19	55	110	11	12.5
Ni (ppm)	7	640	1,280	128	50
Pb (ppm)	2,706	40	80	8.0	16
Rb (ppm)	213.5	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	29.6	1	2	0.2	0.2
Se (ppm)	1	250	500	50	50
Sn (ppm)	7.5	13	25	2.5	5.5
Sr (ppm)	125	1,300	2,600	260	350
Ta (ppm)	1.3	5	10	1.0	1.1
Te (ppm)	10.2	1.50	3	0.3	0.003
Th (ppm)	19.35	21	42	4.2	10.7
Tl (ppm)	5.15	1.8	3.6	0.36	0.75
U (ppm)	6.02	5.5	11	1.1	2.8
V (ppm)	164	1,150	2,300	230	110
W (ppm)	6	5	10	1	2
Zn (ppm)	341.5	400	800	80	71
Zr (ppm)	230	500	1,000	100	190
Sc (ppm)	15.5	150	300	30	13
La (ppm)	48.15	80	160	16	30
Ce (ppm)	90.5	165	330	33	64
Pr (ppm)	10.69	19.5	39	3.9	7.1
Nd (ppm)	37.1	80	160	16	26
Sm (ppm)	6.05	17.5	35	3.5	4.5
Eu (ppm)	1.05	5.5	11	1.1	0.88
Gd (ppm)	4.24	16.5	33	3.3	3.8
Tb (ppm)	0.54	3	6.0	0.6	0.64
Dy (ppm)	3.49	18.5	37	3.7	3.5
Ho (ppm)	0.73	3.9	7.8	0.78	0.8
Er (ppm)	2.17	11	22	2.2	2.3
Tm (ppm)	0.34	1.6	3.2	0.32	0.33
Yb (ppm)	2.35	11	22	2.2	2.2
Lu (ppm)	0.38	1.5	3	0.3	0.32
Y (ppm)	21.55	100	200	20	22
TotalREE	244.8				
TotalLREE	197.8				
TotalHREE	31.5				
%LREE	81				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 14 – Brooklyn site sampling units and summary of laboratory results.



Sample Name	23-SJ2-SU1	23-SJ2-SU2	23-SJ2-SU2-Grab	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample				
Area	North Star	North Star	North Star				
Sample Unit	SU1	SU2	SU2				
Volume (m^3) Est.[2]	3,238	13,244	na				
Au (ppm)	0.5235	0.6605	13.13	0.02	0.03	0.003	0.0018
Ag (ppm)	89	31	>200	0.40	0.8	0.08	0.05
Pd (ppb)	<1	1	<0.01	5.0	10	1	0.5
Pt (ppb)	<10	<10	<0.01	2.5	5	0.5	0.5
Al (ppm)	79,300	79,200	25,900	420,500	841,000	84,100	80,400
F (%)	0.150	0.129	0.042	0.28	0.553	0.0553	na
Fe (%)	2.67	4.07	6.79	35.35	70.7	7.07	3.5
Mg (ppm)	3,700	4,300	1,200	160,000	320,000	32,000	13,300
Ti (%)	0.38	0.38	0.13	2.7	5.4	0.5	0.39
As (ppm)	262	286	1,196	5.0	10	1	1.5
B (ppm)	140.5	111.5	48	50	100	10	15
Ba (ppm)	862.5	919	230	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	19.05	41.25	45.2	0.3	0.6	0.06	0.127
Cd (ppm)	4.5	1.45	67	0.49	0.98	0.098	0.098
Co (ppm)	0.75	1.5	5	145	290	29	17
Cr (ppm)	11	15.5	<10	925	1,850	185	85
Cs (ppm)	28.75	24.3	4	7.5	15	1.5	4.8
Cu (ppm)	307.5	259	2,329	375	750	75	25
Ga (ppm)	20.5	20.5	8	90	180	18	17
Ge (ppm)	2	1.5	2	8	16	1.6	1.6
Hf (ppm)	6	6.5	2	15	30	3.0	5.8
In (ppm)	0.6	0.6	3.6	0.25	0.5	0.05	0.05
Li (ppm)	64.5	41.5	46	65	130	13	20
Mn (ppm)	214.5	442.5	1,491	7,000	14,000	1,400	600
Mo (ppm)	18.5	8.5	9	5	10	1.0	1.5
Nb (ppm)	14	15.5	4	55	110	11	12.5
Ni (ppm)	6	6	5	640	1,280	128	50
Pb (ppm)	13,700	3,133	107,200	40	80	8.0	16
Rb (ppm)	279.5	293	79.9	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	659.5	371	2,157	1	2	0.2	0.2
Se (ppm)	3.5	4	7	250	500	50	50
Sn (ppm)	2	2.5	1	13	25	2.5	5.5
Sr (ppm)	229	132	16	1,300	2,600	260	350
Ta (ppm)	0.95	0.95	<0.5	5	10	1.0	1.1
Te (ppm)	4.08	2.63	12.08	1.50	3	0.3	0.003
Th (ppm)	14.5	15.8	6.6	21	42	4.2	10.7
Tl (ppm)	5.8	5.25	1.7	1.8	3.6	0.36	0.75
U (ppm)	3.44	3.89	1.99	5.5	11	1.1	2.8
V (ppm)	90	97	39	1,150	2,300	230	110
W (ppm)	89	61	14	5	10	1	2
Zn (ppm)	956.5	386	11,800	400	800	80	71
Zr (ppm)	223	225.5	60.7	500	1,000	100	190
Sc (ppm)	8	9.5	<5	150	300	30	13
La (ppm)	41.7	45.85	18.2	80	160	16	30
Ce (ppm)	76.15	87.1	34.2	165	330	33	64
Pr (ppm)	8.85	10.21	4.06	19.5	39	3.9	7.1
Nd (ppm)	30.35	34.5	13.9	80	160	16	26
Sm (ppm)	5.1	5.85	3.5	17.5	35	3.5	4.5
Eu (ppm)	1.12	1.23	0.62	5.5	11	1.1	0.88
Gd (ppm)	3.37	4.15	1.85	16.5	33	3.3	3.8
Tb (ppm)	0.44	0.55	0.25	3	6.0	0.6	0.64
Dy (ppm)	2.77	3.25	1.48	18.5	37	3.7	3.5
Ho (ppm)	0.57	0.67	0.29	3.9	7.8	0.78	0.8
Er (ppm)	1.67	1.95	0.87	11	22	2.2	2.3
Tm (ppm)	0.26	0.29	0.12	1.6	3.2	0.32	0.33
Yb (ppm)	1.65	1.9	0.8	11	22	2.2	2.2
Lu (ppm)	0.26	0.29	0.11	1.5	3	0.3	0.32
Y (ppm)	17.35	20.3	9.2	100	200	20	22
TotalREE	199.6	227.6	89.5				
TotalLREE	166.6	188.9	76.3				
TotalHREE	25.0	29.2	13.1				
%LREE	83	83	85				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

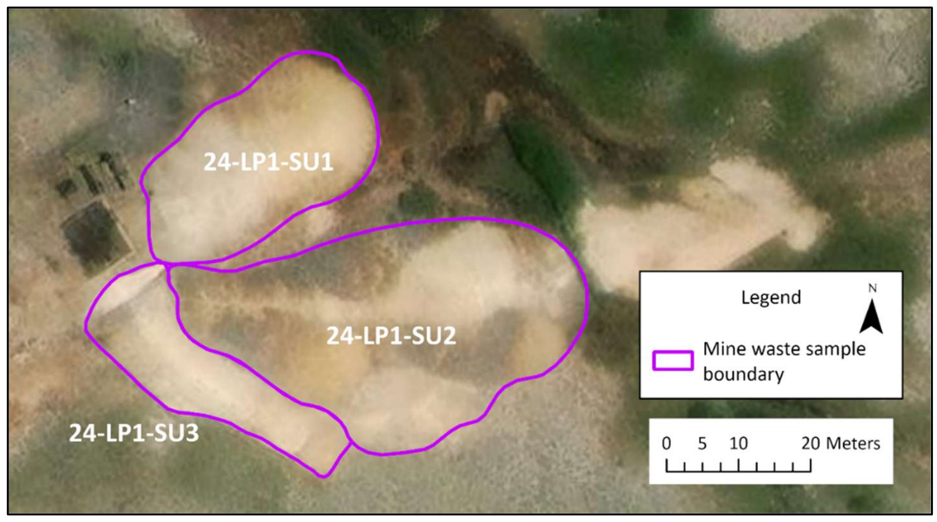
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 15 – North Star site sampling units and summary of laboratory results.



Sample Name	24-LP1-SU1	24-LP1-SU2	24-LP1-SU3				
Sample Type	Waste Rock	Waste Rock	Tailings(?)/Waste Rock				
Area	Columbus	Columbus	Columbus	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1	SU2	SU3				
Volume (m^3) Est.[2]	3,749	5,646	689				
Au (ppm)	3.195	0.312	1.0655	0.02	0.03	0.003	0.0018
Ag (ppm)	6.92	1.56	1.29	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	68,850	79,300	95,300	420,500	841,000	84,100	80,400
F (%)	0.202	0.152	0.265	0.28	0.553	0.0553	na
Fe (%)	2.18	3.66	3.35	35.35	70.7	7.07	3.5
Mg (ppm)	1,780	4,670	2,860	160,000	320,000	32,000	13,300
Ti (%)	0.362	0.408	0.479	2.7	5.4	0.5	0.39
As (ppm)	699.5	404.5	394.5	5.0	10	1	1.5
B (ppm)	88	57	164.5	50	100	10	15
Ba (ppm)	5,840	4,600	1,361	1,250	2,500	250	550
Be (ppm)	<5	<5	5.5	7.5	15	1.5	3.0
Bi (ppm)	<0.3	<0.3	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	0.4	<0.2	0.35	0.49	0.98	0.098	0.098
Co (ppm)	2	7	4.5	145	290	29	17
Cr (ppm)	<10	<10	<10	925	1,850	185	85
Cs (ppm)	20.7	17.45	37.4	7.5	15	1.5	4.8
Cu (ppm)	13.5	18.5	10.5	375	750	75	25
Ga (ppm)	17	17.5	20	90	180	18	17
Ge (ppm)	8.5	5.5	8	8	16	1.6	1.6
Hf (ppm)	3.5	3.5	3.5	15	30	3.0	5.8
In (ppm)	<0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	50	41	51	65	130	13	20
Mn (ppm)	60	524	400	7,000	14,000	1,400	600
Mo (ppm)	34	22.5	5	5	10	1.0	1.5
Nb (ppm)	8.5	10.5	9.5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	119	90.5	65.5	40	80	8.0	16
Rb (ppm)	92.5	85.5	133	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	90	50	43	1	2	0.2	0.2
Se (ppm)	1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	982.5	809	1,179	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	3.7	0.85	3.7	1.50	3	0.3	0.003
Th (ppm)	2.9	3.2	3.05	21	42	4.2	10.7
Tl (ppm)	9	7	2.5	1.8	3.6	0.36	0.75
U (ppm)	5.5	3.5	3	5.5	11	1.1	2.8
V (ppm)	254.5	163.5	191.5	1,150	2,300	230	110
W (ppm)	54.5	40	107.5	5	10	1	2
Zn (ppm)	148	93.5	109.5	400	800	80	71
Zr (ppm)	122	151	141.5	500	1,000	100	190
Sc (ppm)	5.5	7	8.5	150	300	30	13
La (ppm)	21.5	25	25.5	80	160	16	30
Ce (ppm)	41	49.5	52	165	330	33	64
Pr (ppm)	5	5.9	6.25	19.5	39	3.9	7.1
Nd (ppm)	19.5	23.5	25	80	160	16	26
Sm (ppm)	3.85	4.4	4.75	17.5	35	3.5	4.5
Eu (ppm)	1	1.2	1.4	5.5	11	1.1	0.88
Gd (ppm)	2.7	3.5	3.9	16.5	33	3.3	3.8
Tb (ppm)	0.35	0.5	0.5	3	6	0.6	0.64
Dy (ppm)	2.2	3.05	3.2	18.5	37	3.7	3.5
Ho (ppm)	0.4	0.6	0.585	3.9	7.8	0.78	0.8
Er (ppm)	1.2	1.75	1.7	11	22	2.2	2.3
Tm (ppm)	0.165	0.24	0.23	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	1.75	1.6	11	22	2.2	2.2
Lu (ppm)	0.15	0.25	0.2	1.5	3	0.3	0.32
Y (ppm)	12.1	16.8	16.15	100	200	20	22
TotalREE	117.8	144.9	151.5				
TotalLREE	94.6	113.0	118.8				
TotalHREE	17.8	24.9	24.2				
%LREE	80	78	78				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

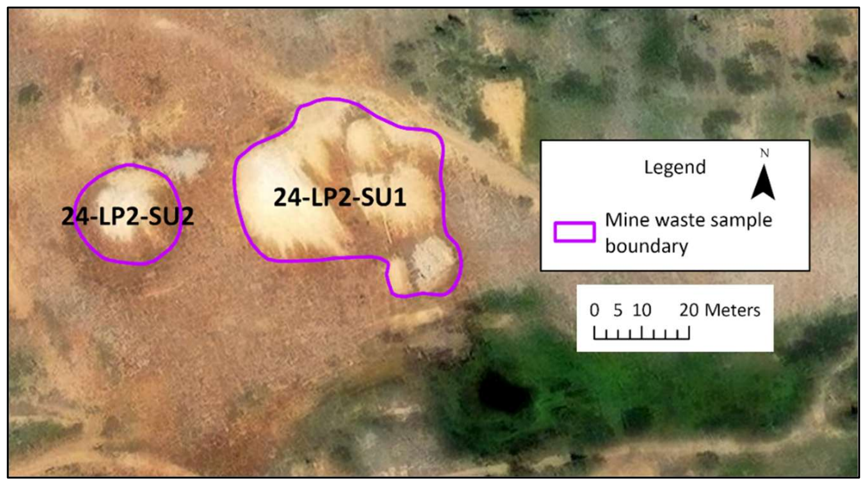
na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table 16 – Columbus site sampling units and summary of laboratory results.

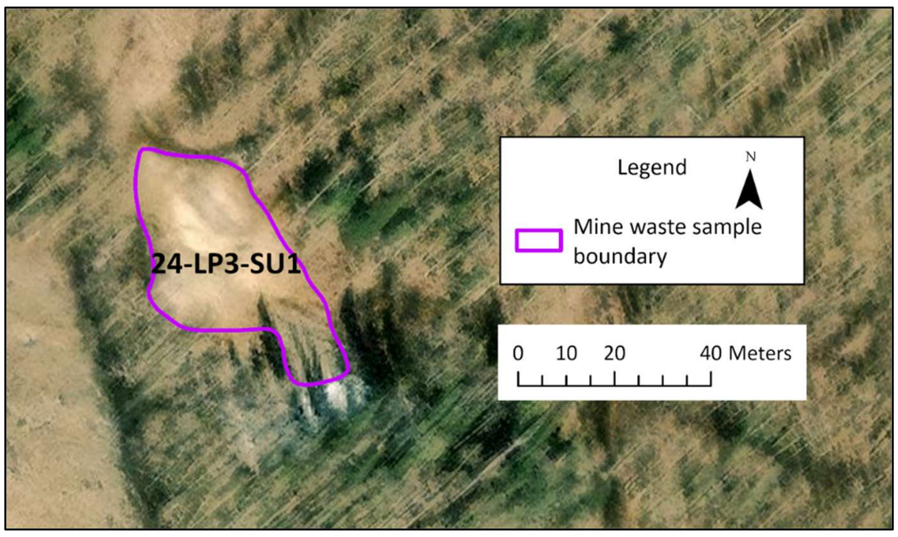


Sample Name	24-LP2-SU1	24-LP2-SU2	24-LP2-SU2-GRAB				
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Area	Doyle	Doyle	Doyle				
Sample Unit	SU1	SU2	SU2				
Volume (m^3) Est.[2]	12,454	3,347	na				
Au (ppm)	4.145	4.354	0.447	0.02	0.03	0.003	0.0018
Ag (ppm)	2.12	4.11	1.98	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	46,100	34,500	48,800	420,500	841,000	84,100	80,400
F (%)	0.055	0.026	0.007	0.28	0.553	0.0553	na
Fe (%)	4.86	2.88	22.7	35.35	70.7	7.07	3.5
Mg (ppm)	1101.5	659.5	<100	160,000	320,000	32,000	13,300
Ti (%)	0.133	0.112	0.122	2.7	5.4	0.5	0.39
As (ppm)	59.5	44.5	<10	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	497	486	820	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	17.4	24.1	8.2	0.3	0.6	0.06	0.127
Cd (ppm)	0.3	0.45	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	5.5	5	378	145	290	29	17
Cr (ppm)	12.5	20	<10	925	1,850	185	85
Cs (ppm)	5.2	2.25	<0.5	7.5	15	1.5	4.8
Cu (ppm)	82.5	28	<10	375	750	75	25
Ga (ppm)	15	8.5	9	90	180	18	17
Ge (ppm)	3.5	1.5	<1	8	16	1.6	1.6
Hf (ppm)	4.5	4	3	15	30	3.0	5.8
In (ppm)	1.6	0.4	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	14	46	<10	65	130	13	20
Mn (ppm)	185.5	56	15	7,000	14,000	1,400	600
Mo (ppm)	6	10	15	5	10	1.0	1.5
Nb (ppm)	5.5	5.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	209	640	1,280	128	50
Pb (ppm)	82	286.5	130	40	80	8.0	16
Rb (ppm)	88	88.5	163	185	370	37	112
Re (ppm)	<0.02	<0.02	0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	7.5	11	<1	1	2	0.2	0.2
Se (ppm)	7	7	26	250	500	50	50
Sn (ppm)	16.5	7.5	<5	13	25	2.5	5.5
Sr (ppm)	117.5	81.5	110	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	9.15	5	2.3	1.50	3	0.3	0.003
Th (ppm)	3.5	2	0.7	21	42	4.2	10.7
Tl (ppm)	2	1.5	<1	1.8	3.6	0.36	0.75
U (ppm)	8	6	5	5.5	11	1.1	2.8
V (ppm)	148	83	74	1,150	2,300	230	110
W (ppm)	56	19	8	5	10	1	2
Zn (ppm)	108	97.5	38	400	800	80	71
Zr (ppm)	200.5	175.5	122	500	1,000	100	190
Sc (ppm)	<5	<5	<5	150	300	30	13
La (ppm)	27.5	15	6	80	160	16	30
Ce (ppm)	42	25.5	8	165	330	33	64
Pr (ppm)	4.5	2.85	0.8	19.5	39	3.9	7.1
Nd (ppm)	17	10	3	80	160	16	26
Sm (ppm)	2.9	1.9	0.9	17.5	35	3.5	4.5
Eu (ppm)	0.95	0.55	0.3	5.5	11	1.1	0.88
Gd (ppm)	2.4	1.45	1.3	16.5	33	3.3	3.8
Tb (ppm)	0.3	0.25	0.3	3	6	0.6	0.64
Dy (ppm)	2.3	1.4	1.7	18.5	37	3.7	3.5
Ho (ppm)	0.48	0.285	0.31	3.9	7.8	0.78	0.8
Er (ppm)	1.45	0.9	0.9	11	22	2.2	2.3
Tm (ppm)	0.215	0.13	0.14	1.6	3.2	0.32	0.33
Yb (ppm)	1.65	1.05	1	11	22	2.2	2.2
Lu (ppm)	0.25	0.15	0.1	1.5	3	0.3	0.32
Y (ppm)	12.8	7.7	9.3	100	200	20	22
TotalREE	116.7	69.1	34.1				
TotalLREE	97.3	57.3	20.3				
TotalHREE	19.4	11.9	13.8				
%LREE	83	83	60				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 17 – Doyle Group site sampling units and summary of laboratory results.

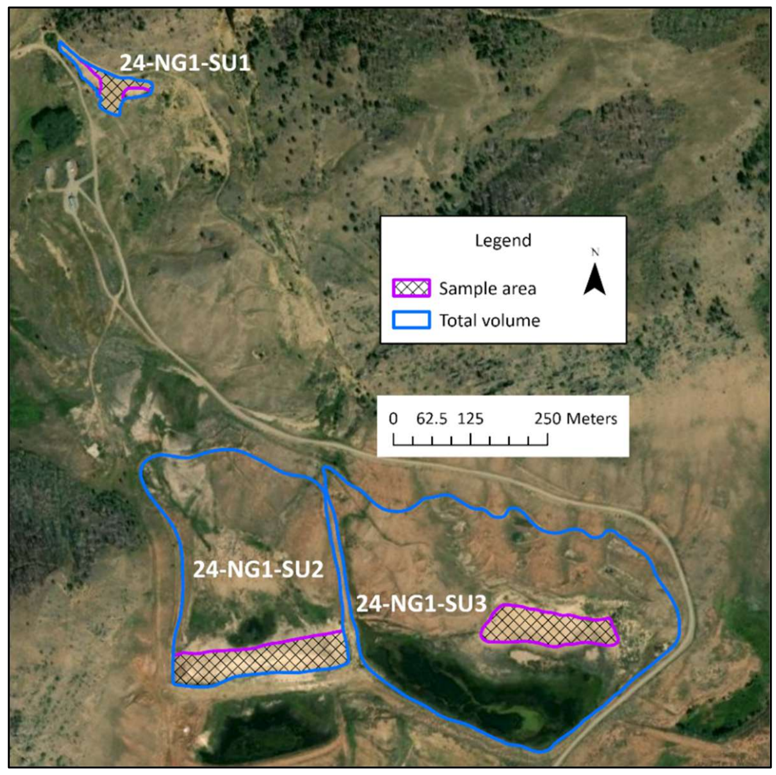


Sample Name	24-LP3-SU1				
Sample Type	Waste Rock				
Area	Thunder	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Unit	SU1				
Volume (m^3) Est.[2]	5,290				
Au (ppm)	0.3005	0.02	0.03	0.003	0.0018
Ag (ppm)	5.06	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	16,100	420,500	841,000	84,100	80,400
F (%)	0.035	0.28	0.553	0.0553	na
Fe (%)	4.59	35.35	70.7	7.07	3.5
Mg (ppm)	851	160,000	320,000	32,000	13,300
Ti (%)	0.080	2.7	5.4	0.5	0.39
As (ppm)	344.5	5.0	10	1	1.5
B (ppm)	<20	50	100	10	15
Ba (ppm)	106.5	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	3	0.3	0.6	0.06	0.127
Cd (ppm)	0.3	0.49	0.98	0.098	0.098
Co (ppm)	<2	145	290	29	17
Cr (ppm)	10	925	1,850	185	85
Cs (ppm)	1.85	7.5	15	1.5	4.8
Cu (ppm)	95.5	375	750	75	25
Ga (ppm)	3.5	90	180	18	17
Ge (ppm)	1.5	8	16	1.6	1.6
Hf (ppm)	3	15	30	3.0	5.8
In (ppm)	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	<10	65	130	13	20
Mn (ppm)	53	7,000	14,000	1,400	600
Mo (ppm)	5	5	10	1.0	1.5
Nb (ppm)	<5	55	110	11	12.5
Ni (ppm)	<20	640	1,280	128	50
Pb (ppm)	126.5	40	80	8.0	16
Rb (ppm)	38	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	28	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<5	13	25	2.5	5.5
Sr (ppm)	108.5	1,300	2,600	260	350
Ta (ppm)	<0.5	5	10	1.0	1.1
Te (ppm)	1.1	1.50	3	0.3	0.003
Th (ppm)	1.95	21	42	4.2	10.7
Tl (ppm)	86	1.8	3.6	0.36	0.75
U (ppm)	2.5	5.5	11	1.1	2.8
V (ppm)	19.5	1,150	2,300	230	110
W (ppm)	23.5	5	10	1	2
Zn (ppm)	90.5	400	800	80	71
Zr (ppm)	135.5	500	1,000	100	190
Sc (ppm)	<5	150	300	30	13
La (ppm)	9	80	160	16	30
Ce (ppm)	16	165	330	33	64
Pr (ppm)	1.9	19.5	39	3.9	7.1
Nd (ppm)	7	80	160	16	26
Sm (ppm)	1.15	17.5	35	3.5	4.5
Eu (ppm)	0.35	5.5	11	1.1	0.88
Gd (ppm)	1.1	16.5	33	3.3	3.8
Tb (ppm)	0.2	3	6	0.6	0.64
Dy (ppm)	1.05	18.5	37	3.7	3.5
Ho (ppm)	0.205	3.9	7.8	0.78	0.8
Er (ppm)	0.65	11	22	2.2	2.3
Tm (ppm)	0.095	1.6	3.2	0.32	0.33
Yb (ppm)	0.65	11	22	2.2	2.2
Lu (ppm)	0.1	1.5	3	0.3	0.32
Y (ppm)	5.5	100	200	20	22
TotalREE	45.0				
TotalLREE	36.5				
TotalHREE	8.5				
%LREE	81				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 18 – Thunder site sampling units and summary of laboratory results.



Sample Name	24-NG1-SU1	24-NG1-SU2	24-NG1-SU3	24-NG1-SU1-GRAB1	24-NG1-SU1-GRAB2	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Tailings	Tailings	Rock Grab Sample	Rock Grab Sample				
Area	Northgate	Northgate	Northgate	Northgate	Northgate				
Sample Unit	SU1	SU2	SU3	SU1	SU1				
Volume (m^3) Est.[2]	45,930	1,137,925	1,973,416	na	na				
Au (ppb)	1.5	<1	1.0	1.0	2.0		30	3	1.8
Au (ppm)	0.0015	<0.001	0.001	0.001	0.002	0.02	0.03	0.003	0.0018
Ag (ppm)	0.075	0.07	0.13	0.01	0.02	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	59,800	61,700	54,100	808	55,000	420,500	841,000	84,100	80,400
F (%)	5.14	1.25	3.26	18	0.05	0.28	0.553	0.0553	na
Fe (%)	2.34	1.11	1.66	0.0837	1.28	35.35	70.7	7.07	3.5
Mg (ppm)	3,085	1,020	1,240	<100	231	160,000	320,000	32,000	13,300
Ti (%)	0.194	0.062	0.082	<0.01	0.038	2.7	5.4	0.5	0.39
As (ppm)	282	126	189	36	923	5.0	10	1	1.5
B (ppm)	<20	<20	<20	<20	<20	50	100	10	15
Ba (ppm)	518.5	424	599	<10	1,100	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	0.45	<0.3	<0.3	<0.3	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	0.25	<0.2	<0.2	<0.2	0.3	0.49	0.98	0.098	0.098
Co (ppm)	2.5	<2	3	<2	<2	145	290	29	17
Cr (ppm)	26	10	<10	<10	<10	925	1,850	185	85
Cs (ppm)	8.4	10	9.6	<0.5	2.5	7.5	15	1.5	4.8
Cu (ppm)	25	21	23	<10	<10	375	750	75	25
Ga (ppm)	23	23	19	<1	13	90	180	18	17
Ge (ppm)	1.0	2.0	2.0	<1	1	8	16	1.6	1.6
Hf (ppm)	3.0	5.0	4.0	<2	2	15	30	3.0	5.8
In (ppm)	<0.2	<0.2	<0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	26	23	24	<10	28	65	130	13	20
Mn (ppm)	167	488	406	<10	22	7,000	14,000	1,400	600
Mo (ppm)	164	31	34	9	290	5	10	1.0	1.5
Nb (ppm)	17	19	24	<5	20	55	110	11	12.5
Ni (ppm)	<20	<20	<20	<20	<20	640	1,280	128	50
Pb (ppm)	24.5	39	39	<10	25	40	80	8.0	16
Rb (ppm)	171.5	288	224	3	179	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	7.0	2.0	4.0	<1	4	1	2	0.2	0.2
Se (ppm)	1	<1	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	7	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	124	58	87	55	93	1,300	2,600	260	350
Ta (ppm)	1.2	4	5.2	1.4	1.5	5	10	1.0	1.1
Te (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	1.50	3	0.3	0.003
Th (ppm)	17.75	11.8	12.6	1.7	5.1	21	42	4.2	10.7
Tl (ppm)	8.0	4.0	4.0	<1	21	1.8	3.6	0.36	0.75
U (ppm)	6.5	8.0	9.0	<1	14	5.5	11	1.1	2.8
V (ppm)	49	18	24	<10	13	1,150	2,300	230	110
W (ppm)	21	13	13	2.0	3.0	5	10	1	2
Zn (ppm)	33.5	30	30	<10	<10	400	800	80	71
Zr (ppm)	103	118	<100	<100	<100	500	1,000	100	190
Sc (ppm)	7.0	<5	<5	<5	<5	150	300	30	13
La (ppm)	24	10	15	9.0	<4	80	160	16	30
Ce (ppm)	48.5	20	29	21	4.0	165	330	33	64
Pr (ppm)	5.9	2.5	3.6	3.1	<0.5	19.5	39	3.9	7.1
Nd (ppm)	21.5	9.0	13	14	2.0	80	160	16	26
Sm (ppm)	4.85	2.9	3.7	6.1	1.1	17.5	35	3.5	4.5
Eu (ppm)	0.6	<0.3	0.4	0.7	<0.3	5.5	11	1.1	0.88
Gd (ppm)	5.25	3.9	4.7	11.1	3.1	16.5	33	3.3	3.8
Tb (ppm)	0.9	0.9	0.9	2.3	0.8	3	6	0.6	0.64
Dy (ppm)	5.75	6.1	6.8	15.2	6.7	18.5	37	3.7	3.5
Ho (ppm)	1.25	1.36	1.5	3.23	1.65	3.9	7.8	0.78	0.8
Er (ppm)	3.85	4.5	4.8	8.5	5.4	11	22	2.2	2.3
Tm (ppm)	0.585	0.79	0.77	1.15	0.79	1.6	3.2	0.32	0.33
Yb (ppm)	3.95	5.8	5.7	6.9	5.2	11	22	2.2	2.2
Lu (ppm)	0.6	0.9	0.9	0.9	0.8	1.5	3	0.3	0.32
Y (ppm)	39.8	42	46.4	209	49.6	100	200	20	22
TotalREE	174.3	110.7	137.2	312.2	81.1				
TotalLREE	110.6	48.3	69.4	65.0	10.2				
TotalHREE	56.7	62.4	67.8	247.2	70.9				
%LREE	63	44	51	21	13				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume, estimated volumes include the entire waste pile (only a portion was sampled).
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table 19 – Northgate site sampling units and summary of laboratory results.

Table 20 - Summary of elevated[1] critical mineral concentraions and other elements in historic mine-related waste at all the sites.

Mining District	Area	Sample Unit	Sample Type	Estimated Volume (m^3)	Au (ppm)	Ag (ppm)	**As (ppm)**	B (ppm)	**Ba (ppm)**	**Bi (ppm)**	Cd (ppm)	**Cs (ppm)**	**Cu (ppm)**	**F (%)**	**Ge (ppm)**	**In (ppm)**	**Li (ppm)**	**Mn (ppm)**	Mo (ppm)	Pb (ppm)	**Rb (ppm)**	**Sb (ppm)**	**Sn (ppm)**	**Ta (ppm)**	**Te (ppm)**	Th (ppm)	Tl (ppm)	U (ppm)	**V (ppm)**	**W (ppm)**	**Zn (ppm)**	**Ce (ppm)**	**Pr (ppm)**
Perigo	Tip Top	SU1	Waste rock	1,328	3.30	1.89	<10	<20	750.5	9.95	<0.2	0.7	47.5	0.122	2	0.2	<10	101	11.5	308.5	96.5	<1	6.5	0.65	1.6	4.85	<1	2	30.5	83.5	77	76.5	8.2
		SU2	Waste rock	7,894	1.54	1.20	<10	<20	463.5	4.25	<0.2	0.75	46.5	0.132	1	<0.2	<10	131.5	4.5	135	80.5	<1	6.5	0.55	1.65	5.5	<1	2.5	27	177	83.5	74	8.7
		SU3	Waste Rock	1,444	1.44	1.41	<10	<20	679.5	5.15	<0.2	0.95	40	0.143	1.5	<0.2	<10	84	14	204.5	90.5	1	10.5	0.7	1.6	5.3	<1	2.5	42	63	83	71.5	8.5
Alma	Sacramento	SU1	Waste Rock / Ore Stockpile	3,200	6.73	44.59	<10	<20	300.5	68.4	101.5	1.45	669	0.092	1.5	18.25	15.5	4,015	9	5,850	42	2	<5	<0.5	2.4	4.55	<1	2	29.5	9	15,500	26.5	2.65
		SU2	Waste Rock / Ore Stockpile	399	5.74	37.56	<10	<20	380.5	48.25	61.95	1.75	418	0.104	2	14.1	18.5	3,030	9	4,715	59	<1	<5	<0.5	3.8	4.95	<1	2	38.5	9.5	9,765	32.5	3.4
	Orphan Boy	SU1	Waste Rock	31,190	2.14	93.49	<10	<20	493.5	93.7	31.5	3.3	411.5	0.0865	2	6.25	10	778	4.5	3,045	115.5	<1	75	<0.5	11.85	4.25	1	1.5	35.5	3	5,250	39	4.4
Montezuma	Peruvian West MZ1	SU1	Waste Rock	2,908	0.03	4.0	19	30.5	1,537	16.7	0.2	8.9	22	0.135	2.0	0.5	11	420.5	2.5	702	236	8.6	5.0	0.9	1.26	13	4.05	2.8	66.5	6.5	71.5	136	16.49
	Peruvian West MZ2	SU1	Waste Rock	782	0.16	44.5	141.5	30.5	>10,000	28.0	17.3	7.4	44.5	0.202	2.0	3	<10	225	4.0	22,550	277	88.25	8.0	1.15	1.86	16.3	4.3	3.6	81	13	6,173	138	17.03
	Peruvian	SU1	Waste Rock	9,900	0.18	175	281	33	>10,000	54.4	21.2	10.8	513.5	0.177	3.5	5.5	14	427	9.5	20,350	199	661.5	11.5	0.85	1.24	18.75	3.5	2.12	45.5	4	4,277	154.5	18.93
		SU2	Waste Rock	3,847	0.18	26.5	98.5	34.5	2,789	15.7	4.75	12.2	124.5	0.206	3	1.9	14.5	385	3	5,204	234.5	104.3	10	0.95	1.62	16.45	3.7	2.57	59	4	1,223	159.5	19.19
Peru-Argentine	Santiago 1	SU1	Waste Rock	1,500	0.07	38.22	<10	<20	674	0.9	3.85	9.4	19.5	0.119	2	0.5	10.5	643	3	2,575	188	2	<5	0.85	11.4	17.1	2.5	4.5	56.5	2.5	682	109.5	12.8
		SU2	Waste Rock	3,525	0.19	152.98	<10	<20	655.5	26	2.05	7.45	19.5	0.119	2	0.8	<10	1,070	<2	8,885	180.5	3.5	<5	0.85	23.35	13.9	2.5	4	59.5	2.5	478	90.5	10.1
	Santiago 2	SU1	Waste Rock	1,737	0.12	7.22	12.5	<20	654	0.7	2.15	8.05	20.5	0.142	2.5	1.05	<10	1,245	4	2,070	163.5	4	<5	0.9	<0.5	12.7	2.5	3.5	61.5	16.5	365.5	91	10.05
	Sidney	SU1	Waste Rock	6,566	0.11	151.80	31	<20	625.5	<0.3	7.95	7.55	64	0.166	2	0.2	13.5	140.5	7	4,060	174	46	<5	0.55	<0.5	29.95	2.5	3.5	48	2.5	1,455	167	19.75
La Plata	Columbus	SU1	Waste Rock	3,749	3.20	6.92	699.5	88	5,840	<0.3	0.4	20.7	13.5	0.202	8.5	<0.2	50	60	34	119	92.5	90	<5	<0.5	3.7	2.9	9	5.5	254.5	54.5	148	41	5
		SU2	Waste Rock	5,646	0.31	1.56	404.5	57	4,600	<0.3	<0.2	17.45	18.5	0.152	5.5	<0.2	41	524	22.5	90.5	85.5	50	<5	<0.5	0.85	3.2	7	3.5	163.5	40	93.5	49.5	5.9
		SU3	Tailings(?)/Waste Rock	689	1.07	1.29	394.5	164.5	1,361	<0.3	0.35	37.4	10.5	0.265	8	<0.2	51	400	5	65.5	133	43	<5	<0.5	3.7	3.05	2.5	3	191.5	107.5	109.5	52	6.25
	Doyle	SU1	Waste Rock	12,454	4.15	2.12	59.5	<20	497	17.4	0.3	5.2	82.5	0.055	3.5	1.6	14	185.5	6	82	88	7.5	16.5	<0.5	9.15	3.5	2	8	148	56	108	42	4.5
		SU2	Waste Rock	3,347	4.35	4.11	44.5	<20	486	24.1	0.45	2.25	28	0.026	1.5	0.4	46	56	10	286.5	88.5	11	7.5	<0.5	5	2	1.5	6	83	19	97.5	25.5	2.85
	Thunder	SU1	Waste Rock	5,290	0.30	5.06	344.5	<20	106.5	3	0.3	1.85	95.5	0.035	1.5	<0.2	<10	53	5	126.5	38	28	<5	<0.5	1.1	1.95	86	2.5	19.5	23.5	90.5	16	1.9
Breckenridge	Wellington	SU1	Waste Rock	9,949	0.22	36.5	128.5	39.5	483.5	27.75	32	10.25	316.5	0.065	2	20.85	36	1,055	3.5	10,593	124	10.95	7	1	0.37	11.85	2.95	3.55	91	12	6,639	84.9	9.67
		SU2	Waste Rock	16,203	0.33	23.5	106	37.5	740.5	27	96.5	8.55	356.5	0.077	2	21.1	33	1,988	4.5	4,291	127.5	7.1	5.5	1	0.31	12.6	2.75	4.56	122	13	15,950	82.45	9.64
		SU3	Waste Rock	14,188	0.97	86.5	425	58.5	294	78.5	20.55	5.85	114.5	0.040	2	17.4	29	434.5	2.5	6,271	87.65	11.45	11	0.6	2.27	5.95	2.55	2.04	48	8.5	3,774	50	5.77
		SU4	Waste Rock	36,222	0.43	25.5	161	45	667	8.85	125.5	10.6	372.5	0.066	2	15.7	28.5	3,019	3.5	15,750	109	19.55	32.5	0.8	0.19	12.25	2.7	4.34	118.5	12	22,550	77.35	9.15
		SU5	Waste Rock	14,393	0.18	20.5	151	43.5	1,431	9.7	33.2	10.95	182	0.073	2	7.5	25	1,948	4	13,800	132.5	12.1	7	0.85	0.37	10.85	2.3	3.59	147	10	6,565	83	9.64
		SU6	Waste Rock	6,959	0.16	7	87	35.5	1,190	3.35	17.4	12.4	67.5	0.083	2	4.7	26.5	1,984	2	2,457	141.5	4.7	5.5	1.05	0.15	14.95	2	4.16	144.5	19.5	3,277	115.5	13.48
Leadville	Little Prince	SU1	Waste Rock	6,552	0.95	29	122.5	29	659.5	91.2	3.25	5.25	416.5	0.069	3	3.6	29	443.5	5	857.5	108.5	47.9	17.5	1.6	4.01	15.4	4.3	12.9	24	15.5	677	57.2	7.16
	President	SU1	Waste Rock	3,511	1.56	12	77.5	30	1,149	69.25	0.95	4.8	726	0.127	2	4.65	15	267.5	6.5	721	128.5	10.5	19	1	30.06	12.9	1.75	12.2	41	32	532	81.75	9.34
		SU2	Waste Rock	704	2.62	22	100	23.5	1,529	84.8	0.75	3.85	714.5	0.124	3	7.25	21	157.5	5.5	1,316	103.4	24.6	19.5	1.1	36.67	11.05	2.2	9.2	33	25	179.5	63.5	7.22
		SU3	Waste Rock	7,887	1.38	17.5	137.5	37.5	1,013	182	1.3	3.85	930.5	0.114	3	5.3	18	404.5	8	1,203	112.5	28.75	23	0.9	28.84	12.8	2.3	10.1	38.5	43	200.5	55.4	6.41
	Penn 3	SU1	Waste Rock	41,224	5.22	39.5	751.5	62	1,561	462	2.25	4.4	1,088	0.082	4	9.3	21	164.5	9	3,210	75.6	181	52	0.8	36.72	10.1	5.9	13.3	46	51	311.5	56.95	6.74
		SU2	Waste Rock	19,263	4.64	39.5	504	47.5	1,120	490.5	2.1	4.85	885	0.113	4	7.45	22.5	275	11.5	2,967	89.0	145	34.5	0.85	33.62	12.3	5.8	13.5	42	39.5	280.5	76.2	8.87
		SU3	Waste Rock	13,521	2.37	39	936.5	63	2,065	373.5	3.8	4.05	1,997	0.078	4	20.25	22	462	6.5	1,407	56	172.5	57.5	<0.5	26.79	9.3	9.9	15.3	50	54	331.5	56.6	6.23
	Ballard	SU1	Waste Rock	5,852	1.47	38.5	1,073	45	852.5	691	10.3	3.45	1,340	0.073	5	10.4	36.5	1,781	15.5	6,660	40.6	164	15.5	0.55	17.40	6.7	27.6	20.3	37	22	1,355	43.35	5.13
		SU2	Waste Rock	5,707	3.75	28.5	679.5	50.5	649	343.5	12.6	3.55	1,368	0.072	4.5	7.35	41.5	3,034	12	4,884	39.7	116.75	7.5	0.55	15.09	7.4	9.7	19.9	36	19	1,699	46.5	5.42
		SU3	Waste Rock	13,274	2.56	55.5	1,571	48	782.5	1,795	15.65	4	876.5	0.055	6.5	7.8	37	204.5	26.5	6,921	36.8	357	18.5	0.55	23.62	7.35	31.55	12.1	36.5	43.5	1,008	56.65	6.61
Eureka	Mayflower	SU1	Tailings	3,000,120	0.93	29.5	34	15	514.5	12.1	36.65	4.9	944.5	0.293	1	3.8	41	33,135	11.5	5,555	110.5	20.25	2	0.65	6.17	10.05	2.35	3.06	69	90.5	7,941	40.75	4.9
		SU1	Tailings	3,000,120	1.50	17.5	35.5	27	531	14.25	31.55	5.25	993.5	0.184	1	4.55	37.5	9,072	9	4,138	122.4	16.7	3	0.65	8.01	11.05	2.35	3.73	73	56.5	7,504	48.75	5.89
		SU1	Grab/Tailings	3,000,120	1.33	17	10	17	550	13.7	7.6	4.9	266	0.065	1	1.2	36	7,196	10	1,986	126	22	3	<0.5	2.97	7.2	3.2	2.37	68	63	2,196	23.3	2.69
		SU1	Grab/Tailings	3,000,120	2.03	99	32	<10	137	17.7	105	2.7	2,041	2.359	1	5.3	42	80,280	13	11,900	43.1	47.4	1	<0.5	6.6	2.5	1.1	1.28	21	139	28,700	13	1.67
	North Star	SU1	Waste Rock	3,238	0.52	89	262	140.5	862.5	19.05	4.5	28.75	307.5	0.150	2	0.6	64.5	214.5	18.5	13,700	279.5	659.5	2	0.95	4.08	14.5	5.8	3.44	90	89	956.5	76.15	8.85
		SU2	Waste Rock	13,244	0.66	31	286	111.5	919	41.25	1.45	24.3	259	0.129	1.5	0.6	41.5	442.5	8.5	3,133	293	371	2.5	0.95	2.63	15.8	5.25	3.89	97	61	386	87.1	10.21
	Brooklyn	SU1	Waste Rock	34,458	5.19	28.5	75	47	997	26.1	1.05	8.15	115.5	0.078	1	2	14.5	410	7	2,706	213.5	29.6	7.5	1.3	10.2	19.35	5.15	6.02	164	6	341.5	90.5	10.69
	Highland Mary	SU1	Tailings	47,616	0.91	31	42	35	606	0.1	2.6	13.8	159	0.072	1	<0.2	101	1,475	84	1,536	207	53.3	<1	<0.5	0.25	8.6	3.8	2.98	57	10	470	38.8	4.51
Northgate	Northgate	SU1	Waste Rock	45,930	0.0015	0.075	282	<20	518.5	0.45	0.25	8.4	25	5.14	1.0	<0.2	26	167	164	24.5	171.5	7.0	<5	1.2	<0.5	17.75	8.0	6.5	49	21	33.5	48.5	5.9
		SU2	Tailings	1,137,925	<0.001	0.07	126	<20	424	<0.3	<0.2	10	21	1.25	2.0	<0.2	23	488	31	39	288	2.0	7	4	<0.5	11.8	4.0	8.0	18	13	30	20	2.5
		SU3	Tailings	1,973,416	0.001	0.13	189	<20	599	<0.3	<0.2	9.6	23	3.26	2.0	<0.2	24	406	34	39	224	4.0	<5	5.2	<0.5	12.6	4.0	9.0	24	13	30	29	3.6
			5x bulk continental crust[1]		0.015	0.40	5.0	50	1,250	0.30	0.49	7.5	375	0.28	8.0	0.25	65	7,000	5	40	185	1	13	5	1.50	21	1.8	5.5	1,150	5	400	165	19.5
			10x bulk continental crust[1]		0.03	0.8	10	100	2,500	0.6	0.98	15	750	0.553	16	0.5	130	14,000	10	80	370	2	25	10	3	42	3.6	11	2,300	10	800	330	39
			bulk continental crust[1]		0.003	0.08	1	10	250	0.06	0.098	1.5	75	0.0553	1.6	0.05	13	1,400	1.0	8.0	37	0.2	2.5	1.0	0.3	4.2	0.36	1.1	230	1	80	33	3.9
			upper continental crust[1]		0.0018	0.05	1.5	15	550	0.127	0.098	4.8	25	na	1.6	0.05	20	600	1.5	16	112	0.2	5.5	1.1	0.003	10.7	0.75	2.8	110	2	71	64	7.1

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - Elevated refers to 5- to 10-times bulk continental crust from others.

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds

(Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003).

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

m3 - cubic meters

ppm - parts per million.

APPENDICES

APPENDIX A

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 23-MZ1-SU1-FINE, 23-MZ1-SU1-COARSE] ALL ARE COMPOSITE SAMPLES

Site and Sample Unit ONE DISTINCT PILE, TWO SAMPLES

Date and Time:
9/6/23 12:10 p.m., 12:14 p.m.

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG.

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
ROTHSCHILD TUNNEL AREA, MONTEZUMA MINING DISTRICT. PILE IS ABOUT 125 by 80 feet wide. SEE SATELLITE PHOTO. PILE IS ABOUT ' HIGH. COLLECT SAMPLES FROM ABOUT 7 ROWS, SUB SAMPLES IN TOP 4 TRANSECTS SUB SAMPLES IN LOWER 3 TRANSECTS. SUBSAMPLES ≃ 5 CM DEPTH, COLLECTED IN BUCKET. 5 SUBSAMPLES COLLECTED IN EACH TRANSECT = 35 SUBSAMPLES

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
WASTE ROCK MATERIAL, SURFACE IS SEMICEMENTED IN PLACES, BROWN TO LIGHT BROWN TO LIGHT GRAY, MOSTLY COARSE TO FINE SAND w/ ABUNDANT 2-INCH AND ABOVE ROCKS.

Sieving notes:
FINE SAMPLE IS SIEVED TO <2 mm AND COARSE SAMPLE IS MATERIAL ON TOP OF THE 2 mm SCREEN.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? PLASTIC HAND SHOVELS, STAINLESS STEEL SCREEN, PERU CREEK IS ≥ 500 FT. TO THE SOUTHEAST, PILE IS NOT VEGETATED, ONE SWALE THAT CUTS PILE TO WEST. MOSTLY ALTERED WASTE ROCK WITH SULFIDES (PYRITE, BLACK OXIDIZED MINERALS), QUARTZ, FEOX. ~~SAMPLE~~ SUBSAMPLES COLLECTED IN ONE PLASTIC 5-GALLON BUCKET AND SIEVED IN FIELD.

Sample ID 23-MZ1-SU1
Date 9/6/23

Weather notes: current conditions? Recent precipitation?

CLEAR, DRY

Latitude/longitude of subsamples (description of how data collected and/or data collected):
FLAGS SET ON GROUND AND GRID SPACING ESTIMATED IN THE FIELD.
COORDS COLLECTED AT CENTER OF ALE AND VERIFIED IN GIS.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
23-MZ1-SU1 CENTER COORD. = 39.607883°, -105.802599°

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-MZ1-SW1
Date 9/6/23

Field Sketch (if applicable – include a north arrow and general dimensions).

SEE ATTACHED MAP


Untitled Map
Write a description for your map.
Legend
Montezuma Mining District/Cinnamon Gulch area
Google Earth
N
400 ft

X

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 23-MZ2-SU1-FINE, 23-MZ2-SU1-COARSE } ALL ARE COMPOSITES

Site and Sample Unit ONE DISTINCT WASTE ROCK PILE, TWO SAMPLES

Date and Time:
9/6/23, 12:55 p.m. (FINE), 12:59 (COARSE).

Collected by: A. GIEBEL, J. GRAVES

Photo(s) taken ✓ SEE PHOTO LOG.

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
ROTHSCHILD TUNNEL AREA, MONTEZUMA MINING DISTRICT. WASTE ROCK PILE IS ≈ 61 FEET WIDE AND 110 FEET LONG, COLLECTED SUB SAMPLES ALONG 5 TRANSECTS FLAGGED IN THE FIELD, 7 SAMPLES ~~GEO~~ SUBSAMPLES COLLECTED ALONG 5 TRANSECTS FROM 5 cm DEPTH.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
DRY WASTE ROCK, VERY COARSE TO FINE SAND MATERIAL BUT SURFACE MATERIAL IS MOSTLY ANGULAR 1 TO 3 INCH MATERIAL, LIGHT BROWN - DARK YELLOWISH BROWN - GRAY, BOULDERS AND LARGER MATERIAL ON TOP OF PILE.

Sieving notes:
SUBSAMPLES COLLECTED IN 5-GALLON PLASTIC BUCKET AND SIEVED IN THE FIELD USING A 2 mm STAINLESS STEEL SIEVE. 23-MZ2-SU1-FINE SAMPLE CONTAINS < 2 mm MATERIAL, 23-MZ2-SU1-COARSE CONTAINS > 2 mm FRACTION.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? PLASTIC HAND SHOVEL, PLASTIC 5-GALLON BUCKET, VERY CEMENTED ON SURFACE, SLIGHT SULFUR SMELL, WASTE ROCK MATERIAL INCLUDES PYRITE, ALTERED ROCK FRAGMENTS (e.g. SCHIST), FEOX STAINED MATERIAL, BLACK OXIDIZED SULFIDES, MORE PYRITE THAN 23-MZ1, FEOX STAINING IN SOME AREAS, QUARTZ. PERU CREEK IS ≈ 830 FEET TO SOUTHEAST. WASTE ROCK PILE IS NOT VEGETATED, BASE OF PILE LOOKS ERODED.

Sample ID 23-MZ2-SU1

Date 9/6/23

Weather notes: current conditions? Recent precipitation?

CLEAR, DRY

Latitude/longitude of subsamples (description of how data collected and/or data collected):

FLAGS SET ON GROUND, GRID SPACING ESTIMATED IN THE FIELD. FLAGS EVENLY SPACED ON SIDES OF PILE AND SUBSAMPLE LOCATIONS ESTIMATED BASED ON VISUAL OBSERVATIONS.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

CENTER OF THE PILE FROM GIS = 39.607893°, -105.803938°.

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-MZ2-SW1
Date 9/6/23

Field Sketch (if applicable – include a north arrow and general dimensions).


Untitled Map
23-MZ2-SW1
Write a description for your map.
Legend
Montezuma Mining District/Cinnamon Gulch area
23-MZ2-SW1
N
400 ft
Google Earth

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

ALL SAMPLES ARE COMPOSITE EXCLUDING 1 GRAB SAMPLE

Tailings composite sample

Sample ID 23-MZ3-SU1-FINE, 23-MZ3-SU1-COARSE, 23-MZ3-SU1-BLANK, 23-MZ3-SU1-GRAB

Site and Sample Unit PERUVIAN MINE, SU1 IS SOUTH LOBE

Date and Time:
9/6/23, 15:00 (FINE), 15:03 (COARSE), 16:04 (BLANK), 15:30 (GRAB)

Collected by: A. GIEBEL, J. GRAVES, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
WASTE ROCK PILE IS ≈ 98 FEET WIDE AND 161 FEET LONG. PERUVIAN MINE. BOTH SU1 + SU2 ARE SIMILAR IN COMPOSITION BUT LOOKS LIKE THEY WERE PLACED AT DIFFERENT TIMES, COLLECTED SUBSAMPLES ALONG 7 TRANSECTS (EVENLY SPACED W/ FLAGS IN FIELD), 5 SAMPLES COLLECTED ALONG EACH TRANSECT. AREA ON WESTERN SLOPE OF PILE WAS NOT SAMPLED BECAUSE IT WAS TOO STEEP. SUBSAMPLES COLLECTED AT 5 CM DEPTH AND COMPOSITED IN ONE BUCKET.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
MOSTLY DRY BUT MOIST IN SOME AREAS, SURFACE COLOR VARIES FROM GRAY-YELLOWISH BROWN TO REDDISH BROWN, MATERIAL SIZE VARIES FROM FINES TO SCATTERED BOULDERS, MOST MATERIAL ON SURFACE IS FINE TO VERY COARSE SAND SIZED MATERIAL WITH ABUNDANT 1 TO 2 INCH MATERIAL WITH LARGER MATERIAL (4-5 INCH) ON LESS STEEP SLOPES. SUBSURFACE IS MORE YELLOWISH BROWN.

Sieving notes:
FINE SAMPLE IS SIEVED TO < 2 MM MATERIAL, COARSE SAMPLE IS > 2 MM.
GRAB SAMPLE CONTAINS MINERALIZED ROCK SAMPLES SCATTERED ON PILE (PYRITE, BARITE, GALENA, BLACK Mn? MINERALS). BLANK SAMPLED COLLECTED WITH PURE SILICA SAND PROVIDED BY THE USGS ~~and~~ - SAMPLING WAS USED TO SCOOP SILICA SAND INTO SIEVE AND BUCKETS ON THEN SAMPLED (< 2 MM SILICA SAND).

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? PLASTIC HAND SHOVELS, PLASTIC 5-GALLON BUCKETS, STAINLESS STEEL 2 MM SCREEN. PILE IS GENERALLY UNVEGETATED, PERU CREEK IS ≈ 870 FEET TO EAST. ALTERED ROCK MATERIAL, QUARTZ, PYRITE, BARITE, GALENA, BLACK Mn? MINERALS (APPEARS TO BE COATING BUT SOME MATERIAL APPEARS THICKER AND CRYSTALLINE

Sample ID 23-MZ3-SU1
Date 9/6/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

FLAGS SPACED EVENLY IN THE FIELD FOR TRANSECTS, GRID SPACING ESTIMATED IN THE FIELD.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

23-MZ3-SU1 CENTER COORD. FROM GIS = 39.614580°, -105.798757°

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-MZ3-SW1

Date 9/6/23

Field Sketch (if applicable – include a north arrow and general dimensions).

SEE ATTACHED.


Peruvian Mine area
23-MZ3-SU1
ONE AREA NOT SAMPLED (TOO STEEP)
98'
23-MZ3-SU2
NOT SAMPLED
23-MZ3-SU1
NOT SAMPLED
N
300 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample ALL SAMPLES ARE COMPOSITES

Sample ID 23-MZ3-SU2-FINE, 23-MZ3-SU2-COARSE, 23-MZ3-SU2-FINE-DUP, 23-MZ3-SU2-COARSE-DUP

Site and Sample Unit PERUVIAN MINE, SU2 IS ~~SOUTH~~ NORTH LOBE.

Date and Time:
9/6/23, 14:30 (FINE), 14:32 (COARSE), 15:15 (FINE-DUP), 15:18 (COARSE-DUP)

Collected by: A. GIEBEL, J. GRAVES, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG.

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
WASTE ROCK PILE IS ≈ 33 FEET WIDE AND 178 FEET LONG. PERUVIAN MINE. SU1 + SU2 ARE SIMILAR COMPOSITION BUT LOOKED LIKE THEY WERE PLACED AT DIFFERENT TIMES, COLLECTED SUBSAMPLES FOR SU2 AND SU2-DUP ALONG 8 TRANSECTS EVENLY FLAGGED IN THE FIELD WITH 4 SUBSAMPLES COLLECTED ALONG THESE TRANSECTS (32 SUBSAMPLES) AND COMPOSITED IN A PLASTIC BUCKET. DUP SAMPLE COLLECTED FROM DIFFERENT SUBSAMPLE LOCATIONS BUT ON SAME GENERAL GRID (COMPOSITED IN SEPARATE BUCKET).

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
DRY, SURFACE COLOR VARIES (GRAY-YELLOWISH BROWN – REDDISH BROWN), SU2 APPEARS TO HAVE MORE REDDISH BROWN FEOX STAINS THAN SU1, SUBSURFACE COLOR IS REDDISH BROWN (LIKELY DUE TO DRAINAGE FROM ADIT THAT FLOWS TOWARDS SU2), MOST MATERIAL ON SURFACE IS FINE TO VERY COARSE SAND SIZED W/ ABUNDANT 1-2 INCH MATERIAL AND SCATTERED MATERIAL UP TO 5-INCHES AND LARGER

Sieving notes:
FINE SAMPLES ARE SIEVED TO < 2 mm, COARSE SAMPLES ARE SIEVED TO > 2 mm.
DUP SAMPLES COLLECTED ALONG SAME GRID BUT DIFFERENT LOCATIONS.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? NOT VEGETATED, GENERALLY SMALLER VOLUME THAN SU1 (ABOUT 10 FEET LOWER IN ELEVATION), PERU CREEK IS ≈ 870 FEET TO EAST. WASTE ROCK INCLUDES ALTERED ROCK, QTZ VEIN MATERIAL, PYRITE, BLACK Mn? MINERAL. SAMPLING EQUIP. INCLUDE PLASTIC HAND TROWELS, STAINLESS STEEL SCREEN AND PLASTIC BUCKETS. DRAINAGE FROM NEARBY ADIT APPEARS TO FLOW TO SU2.

Sample ID 23-MZ3-SU2
Date 9/6/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):
FLAGS SPACED EVENLY IN FIELD FOR TRANSECTS, GRID SPACING ESTIMATED IN THE FIELD

Additional data collected (paste pH, pXRF, etc):

N/A.

Geospatial data (description of measurements if made in the field):
23-MZ3-SU2 CENTER COORD. FROM GCS = 39.614719°, -105.798623°

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-MZ3-SU2

Date 9/6/23

Field Sketch (if applicable – include a north arrow and general dimensions).

SEE ATTACHED MAP.


Peruvian Mine area
23-MZ3-Su2
23-MZ3-Su2
N
300 ft
Google Earth

FINE = < 2mm
COARSE = > 2mm

23-SSJ-SUI-COMPOSITE 1-FINE
23-SSJ-SUI-COMPOSITE 2-COARSE

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (unless otherwise noted)

11:22
23-SSJ-SUI-COMPOSITE 2

Sample ID 23-SSJ-SUI-GRAB 1, 23-SSJ-SUI-GRAB 2, 23-SSJ-SUI-COMPOSITE 1
9:36 10:13 10:51
23-SSJ-SUI-COMPOSITE 1-COARSE

MILL

Site and Sample Unit MAYFLOWER TAILINGS, ONE LARGE PILE BUT CAPPED IN MOST PLACES, SAMPLE AREAS ARE WHERE EPA IS CURRENTLY REMOVING CAP TO PLACE ADDITIONAL MATERIAL, ONLY SAMPLED WHERE POSSIBLE.

Date and Time:
9/13/23 - TIMES SHOWN ABOVE. ACTIVE CONSTRUCTION SITE.

THIS IS REPORTEDLY THE POND 4 AREA & BONITA PEAK REPOSITORY. ALSO REPORTED MUCH OF TAILS CAME FROM THE SUNNYSIDE MINE.

Collected by: A. GEBEL, K. BROWN, M. O'KEEFFE
SAMPLES COMPOSITE 1+2 WERE SIEVED IN THE LAB.

Photo(s) taken ✓ SEE PHOTO LOG

NOTE: SAMPLED WHERE WE COULD SEE TAILS (LIMITED AREA OF PILE).

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions): PILE IS ABOUT 30-40' HIGH AND VERY LARGE. ONLY PORTIONS COULD BE SAMPLED. ALONG THE LONGEST AXIS, PILE IS ≈ 2,036', WIDEST AXIS ≈ 686'. TWO AREAS AT SURFACE WHERE SAMPLED ARE ≈ 90 x ~~[illegible]~~ 300' (COMPOSITE) AND 66 x 208' (COMPOSITE 2).
GRAB 1 SAMPLE COLLECTED IN SMALL (1-FOOT OR SO) TAILINGS CUT IN DRAINAGE AT BASE OF PILE (≈ 9,373' amsl).
GRAB 2 SAMPLE COLLECTED IN 3-FOOT CUT IN TAILS ON TOP OF PILE (≈ 9,436' amsl). "COMPOSITE" SAMPLE COLLECTED IN 90 x 480 AREA BUT IT WAS MIXED WITH SOME CAP MATERIAL (GRAVEL - PULLED BACK CAP BUT SOME REMAIN. "COMPOSITE 2" COLLECTED FROM GRADED TAILS W/O CAP MATERIAL.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability? ALL SAMPLES WERE MOIST FROM RECENT RAIN (COMPOSITE 2 WAS VERY MOIST).
GRAB 1 = SANDY, FINE TO COARSE SAND, YELLOWISH TAN W/ FE OXIDES, WELL SORTED, TRACE COARSER MATERIAL IN PLACES
GRAB 2 = LIGHT TAN SAND, 2-INCH BLACK CLAY LAYER, FINE TO COARSE SAND, WELL-SORTED.
COMPOSITE = BROWN TO YELLOWISH BROWN, FINE TO VERY COARSE SAND (MOSTLY) W/ 3 10 TO 15% GRAVEL/COBBLES (MIXED TAILS AND OLD GRAVEL CAP)
COMPOSITE 2 = LIGHT GRAY TO LIGHT YELLOWISH BROWN, VERY FINE TO COARSE SAND, VERY WELL SORTED, NO LARGER MATERIAL, TRACE CLAY, FEW SCATTERED PEBBLES.

Sieving notes:
COULD NOT SIEVE IN FIELD DUE TO MOISTURE.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? PLASTIC DELONNED REUSABLE PLASTIC TROWELS, 5-GALLON PLASTIC BUCKETS, DISPOSABLE NITRILE GLOVES. NO VEGETATION - ACTIVE CONSTRUCTION. EDGE OF THE PILE IS ABOUT 75' FROM THE ANIMAS RIVER. THIS SITE IS CURRENTLY MANAGED BY REGION 8 EPA.
GRAB 1 = CHANNEL GRAB SAMPLE IN A 1-2 FOOT EXPOSURE OF TAILS AT THE BOTTOM OF A DRAINAGE DITCH.
GRAB 2 = CHANNEL SAMPLE IN A 3-FOOT EXPOSURE OF TAILINGS ALONG A BENCH ON TOP OF THE PILE. MOSTLY QUARTZ, FELDSPAR, AND OTHER UNKNOWN MINERALS.

SUBSAMPLES COLLECTED FROM ≈ 5 CM
COMPOSITE = 10 TRANSECTS, 4 ~~SUBS~~ SUBSAMPLES PER TRANSECT, FINER MATERIAL IS MOSTLY QUARTZ, FELDSPAR, UNKNOWN BLACK MINERALS, AND ≈ 10% FINE PYRITE.
COMPOSITE 2 = 10 TRANSECTS, 4 SUBSAMPLES PER TRANSECT, 20% - 25% PYRITE, QUARTZ, FELDSPAR, OTHER UNKNOWN MINERALS.

Sample ID 23-SSI-SU1
Date 9/13/23

Weather notes: current conditions? Recent precipitation?
DRIZZLING DURING SAMPLING BUT MOSTLY DRY, RAINED LAST NIGHT AND YESTERDAY.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
GRAB 1 = 9,372'amsl (est.), 37.81859, -107.646679 (handheld gps)
GRAB 2 = 9,436'amsl (est), 37.819791, -107.644936 (handheld gps).
COMPOSITE 1 = 9,436'amsl (est), 37.819536, -107.645594 (near center) (handheld gps)
COMPOSITE 2 = 37.819774, -107.647834 (estimated from GIS satellite imagery).

Additional data collected (paste pH, pXRF, etc): ~~SU~~ Sample grid estimated in field using flags and by visually estimating subsample spacing using evenly spaced flags.

N/a

Geospatial data (description of measurements if made in the field):

SEE ABOVE.

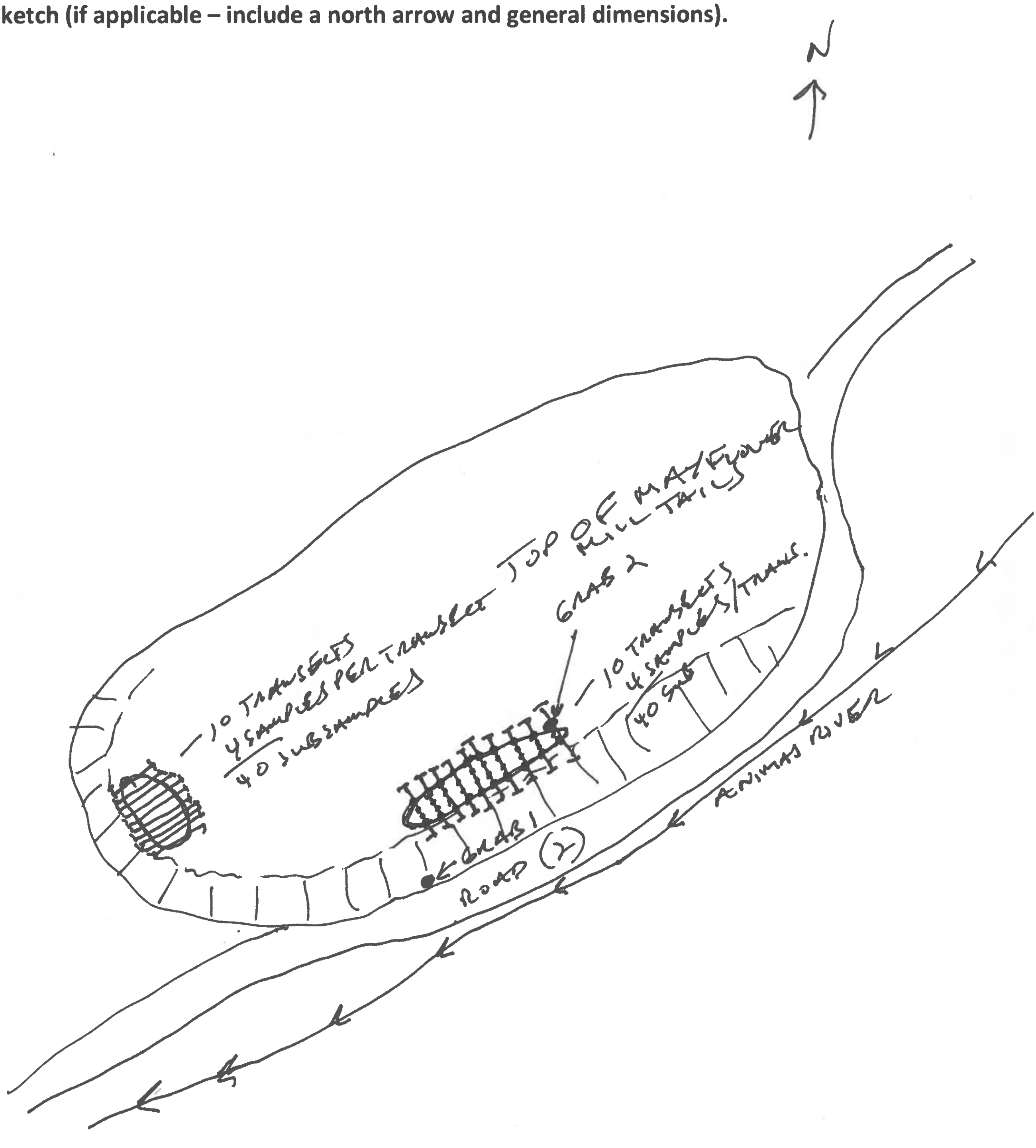
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-SJ1-SW1
Date 9/13/23

Field Sketch (if applicable – include a north arrow and general dimensions).



Mayflower area
2
≈ 2036'
≈ 686'
CAP IS PULLED BACK, EXPOSED TAILS
MAYFLOWER TAILINGS PILE
(UNDER CONSTRUCTION)
23-SS1-SU1-GRAB 2 (EXPOSED TAILS)
23-SS1-SU1-COMPOSITE 2
CAP IS PULLED BACK BUT MIXED WITH SOME CAP.
300'
23-SS1-SU1-COMPOSITE 1
≈ 208'
(SAMPLE AREA)
23-SS1-SU1-COMPOSITE 1
(SAMPLE AREA)
≈ 90'
23-SS1-SU1-GRAB 1 (EXPOSED TAILS)
Google Earth
900 ft
N

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth) / SIEVED IN LAB 23-SJ2-SU1-COMPOSITE-FINE 23-SJ2-SU1-COMPOSITE-COARSE

FINE = < 2mm
COARSE = > 2mm

23-SJ2-SU1-COMPOSITE

Sample ID ~~TAIL~~ WASTE ROCK SAMPLES ARE VERY MOIST - COLLECTED IN A BUCKET FOR SIEVE AFTER DRYING.

Site and Sample Unit NORTH STAR LEVEL 6 SU1

Date and Time:
9/13/23, 13:05

Collected by: K. BROWN, A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

SEE ATTACHED MAP FOR DIMENSIONS/AREA. PILE (WASTE ROCK) IS ~20 TO 25' HIGH BASED ON VISUAL OBSERVATIONS. PILE IS ≈ 96' LONG ALONG LONG AXIS AND ≈ 51' WIDE (AT ITS WIDEST PORTION). SU2 SHOWN ON MAP FOR REFERENCE.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability? THIS IS WASTE ROCK (NO TAILS).

SURFACE IS LIGHT GRAY TO REDDISH/YELLOWISH BROWN, MOSTLY <1 INCH MATERIAL ON THE SURFACE (LESS LARGER MATERIAL THAN THE NEIGHBORING SU2 PILE). MATERIAL IS SOMEWHAT FINER @ 0.5 CM DEPTH)

Sieving notes:

SAMPLE TO VERY MOIST DUE TO RECENT RAINS THE DAY BEFORE AND LIGHT RAIN DURING SAMPLING. SAMPLE COLLECTED IN 5-GALLON BUCKET FOR DRYING AND SIEVING LATER.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? SOME SMALL TREES ON TOP OF WASTE ROCK PILE (FLAT PORTION) UP TO 15' BUT MOST ARE 2-3' HIGH. MOST OF PILE IS UNVEGETATED. PILES ARE STACKED NEXT TO EACH OTHER W/ SMALL DRAINAGES IN BETWEEN THE PILES. WASTE ROCK INCLUDES ALTERED ROCK, QUARTZ VEIN MATERIAL, PYRITE, MANGANESE? MINERALS. NEARBY RIVER TO NORTHEAST/NORTH (MINERAL CREEK). SAMPLES COLLECTED WITH REUSABLE PLASTIC TROWELS THAT WERE CLEANED AND RINSED WITH DEIONIZED WATER PRIOR TO SAMPLING. SAMPLERS WORE DISPOSABLE NITRILE GLOVES.

Sample ID 23-SSJ-SU1-COMPOSITE
Date 9/13/23

Weather notes: current conditions? Recent precipitation?
RAINED THE DAY BEFORE SAMPLING, LIGHT RAIN ON AND OFF DURING SAMPLING.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
CENTER OF PILE ON TOP = 37.806429, -107.683~~810~~ 231. ESTIMATED ELEVATION ON TOP OF PILE (GPS) ≈ 9,524. PILE WAS SAMPLED ALONG SIX TRANSECTS ALONG THE CONTOURS OF THE PILE SPACED ~~[illegible]~~ EVENLY APART. FIVE SAMPLES WERE COLLECTED ALONG EACH TRANSECT (EVENLY SPACED BASED ON VISUAL ESTIMATES). TRANSECTS WERE MARKED USING FLAGS IN THE FIE[LD]. 30 SUBSAMPLES WERE COLLECTED AT ≈5 CM DEPTH.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV AT TOP OF PILE COLLECTED BY HANDHELD GPS AND VERIFIED USING SATELLITE IMAGERY. ELEV. IS ESTIMATED.

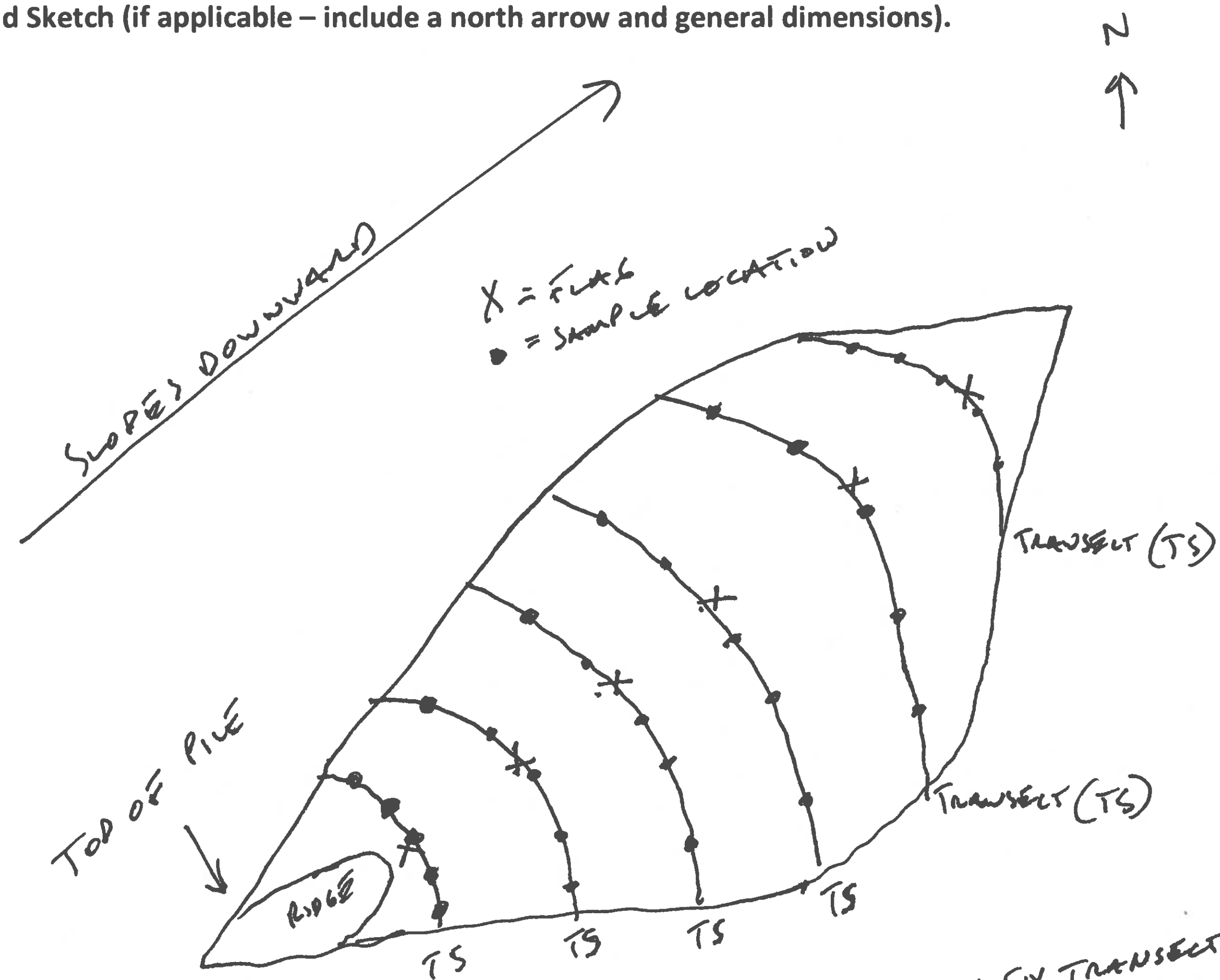
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-SJ2-SU1 - COMPOSITE
Date 9/13/23

Field Sketch (if applicable – include a north arrow and general dimensions).



+ SIX TRANSECTS
+ 5 SAMPLES PER TRANSECT
≈ 5 cm DEPTH
+ ALL COLLECTED IN ONE BUCKET.
+ VERY MOIST SO WILL HAVE TO BE DRIED + SIEVED LATER.

SU2
SU1
96'
51'
DISTURBED NOT SAMPLED
DISTURBED NOT SAMPLED
NORTH STAR LEVEL 6 ADIT
N
200 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth) SIEVED IN LAB 23-SS2-SU2-COMPOSITE-FINE 23-SS2-SU2-COMPOSITE-COARSE

Sample ID 23-SS2-SU2-COMPOSITE WASTEROCK, SAMPLES ARE VERY MOIST - COLLECTED 40 SUBSAMPLES IN ONE BUCKET FOR SIEVE AFTER DRYING.
23-SS2-SU2-GRAB

Site and Sample Unit NORTH STAR LEVEL 6 SU 2

GRAB SAMPLE INCLUDES MISC. PIECES OF MINERALIZED SAMPLE.

Date and Time: 9/13/23, 12:56

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

SEE ATTACHED MAPS. PILE (WASTE ROCK) IS ≈ 20-25' HIGH BASED ON VISUAL OBSERVATIONS, PILE IS ≈ 206' LONG ALONG THE LONGEST AXIS AND ≈ 135' WIDE ALONG THE WIDEST PORTION. THIS PILE IS ADJACENT (TO THE NORTH) OF SU1.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

SURFACE IS YELLOWISH BROWN W/ SOME REDDISH BROWN, MOST MATERIAL IS < 1 INCH ON THE SURFACE WITH LARGER ROCKS UP TO 1-2 FEET, WASTE ROCK IS VERY MOIST DUE TO RECENT RAIN, SUBSURFACE APPEARS FINER WITH LESS LARGE ROCKS.

Sieving notes:

NOT ~~SAMP~~ SIEVED IN THE FIELD DUE TO MOISTURE (RAINED YESTERDAY AND INTERMITTENT RAIN DURING SAMPLING DAY). SUBSAMPLES COLLECTED IN ONE BUCKET FOR SIEVING AFTER DRYING.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

MOST OF THE PILE SLOPES ARE UNVEGETATED - FLATTER AREA TO WEST HAS SOME TREES (SOME UP TO 15' BUT MOST ARE 2-3 FEET). WASTE ROCK PILES ARE STACKED AGAINST EACH OTHER WITH SMALL DRAINAGES ON EITHER SIDE, PYRITE, BLACK Mn? MINERALIZATION, SOME GALENA ON LARGER PIECES, ~~QUARTZ~~ QUARTZ IS ABUNDANT, ALTERED ROCK, MOSTLY ALTERED ROCK AND QUARTZ. SAMPLES COLLECTED WITH CLEAN REUSABLE PLASTIC TROWELS (CLEANED AND RINSED WITH DEIONIZED WATER). SAMPLERS WEAR DISPOSABLE NITRILE GLOVES DURING SAMPLING. MINERAL CREEK IS TO THE NORTH-NORTHEAST.

Sample ID 23-SS2-SU3-COMPOSITE
Date 9/13/23

Weather notes: current conditions? Recent precipitation?
RAINED YESTERDAY, INTERMITTENT RAIN TODAY.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
CENTER OF PILE ON TOP = 37.806614, -107.683739, ESTIMATED ELEVATION ≅ 9524 ft amsl. PILE WAS SAMPLED ALONG 4 TRANSECTS (FLAGGED IN THE FIELD) GENERALLY EVENLY SPACED. TEN SAMPLES WERE COLLECTED ALONG THESE TRANSECTS, TO A DEPTH ≅ 5CM, GENERALLY EVENLY SPACED BASED ON VISUAL OBSERVATIONS.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV. AT TOP OF PILE COLLECTED BY HANDHELD GPS AND VERIFIED USING SATELLITE IMAGERY. ELEV. IS ESTIMATED.

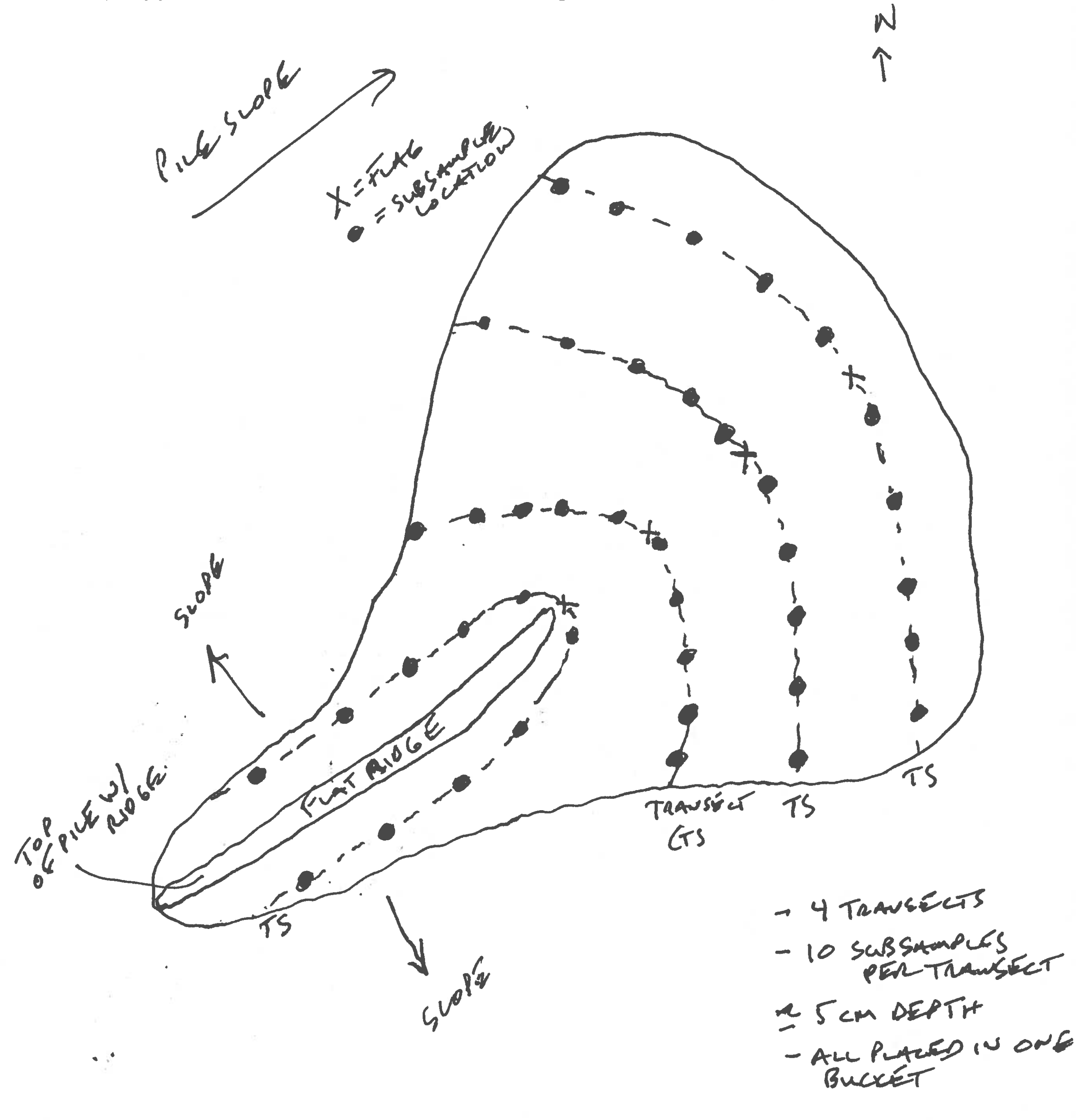
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-SJ2-SU2-COMPOSITE
Date

Field Sketch (if applicable – include a north arrow and general dimensions).



~20ft
135'
SU2
SU1
DISTURBED NOT SAMPLED
DISTURBED NOT SAMPLED
NORTH STAR LEVEL 6
N
200 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 23-SS3-SU1-COMPOSITE ↗ SIEVED IN LAB 23-SS3-SU1-COMPOSITE-FINE / 23-SS3-SU1-COMPOSITE-COARSE

Site and Sample Unit BROOKLYN MINE, ONE WASTE ROCK PILE

Date and Time:
9/13/23, 14:25

Collected by: A. GIEBEL, K. BROWN, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

SEE MAP FOR DIMENSIONS/AREA. PILE (WASTE ROCK) IS ≈ 50' HIGH BASED ON VIS. ESTIMATE. PILE IS ≈ 340' ALONG LONGEST AXIS, ≈ 111' WIDE ALONG WIDEST SECTION (EAST) AND ≈ 60' WIDE TO WEST (≈ AT ABOUT 100' TO EAST OF WESTERN EDGE). UPPER ROAD (NORTH) IS DISTURBED AND WAS NOT SAMPLED. ALSO, ROAD ALONG (OR GRADED AREA) APPEARED DISTURBED). ELEV. ≈ 11,417 (TOP PILE). K. BROWN INDICATED PILE MAY HAVE ≈ 20,000 CY OF MATERIAL BUT NEED TO CHECK.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

WASTE ROCK IS VERY MOIST DUE TO RECENT RAIN (YESTERDAY - DRIZZLING TODAY). MOST MATERIAL IS ~~[illegible]~~ < 1-INCH WITH COARSER (1" TO 2' BOULDERS) ON SURFACE. ABUNDANT DEBRIS IN PILE (WOOD/METAL/NAILS/COAL/SLAG?).

Sieving notes:

ONE COMPOSITE SAMPLE COLLECTED ALONG SEVEN N-S TRANSECTS, 5 SAMPLES COLLECTED ALONG EACH GENERALLY EVEN-SPACED TRANSECT (≈ 35 SUBSAMPLES). SAMPLE IS VERY MOIST SO COLLECTED IN ONE 5-GALLON BUCKET AND WILL SIEVE LATER.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? GENERALLY UNVEGETATED, PILE IS IN AREA THAT DRAINS INTO A TRIBUTARY OF MINERAL CREEK THAT IS LOCATED TO THE WEST (≈ 2,900'), PILE HAS SEVERAL SMALL SWALES, ABUNDANT ALTERED ROCK, QUARTZ, ABUNDANT PYRITE SCATTERED ON SURFACE, SOME MULTI-COLORED WHITE CLAY IN ONE AREA. PILE IS MULTI-COLORED (YELLOWISH BROWN + LIGHT GRAY WITH VARIATIONS OF EACH). REDDISH BROWN TO GRAY AT DEPTH. USED PLASTIC 5-GALLON BUCKET, PLASTIC HAND TROWELS (DECON IN FIELD W/ FINAL DEIONIZED WATER RINSE), NITRILE GLOVES (DISPOSABLE).

Sample ID 23-553-SU1-COMPOSITE
Date 9/13/23

Weather notes: current conditions? Recent precipitation?
DRIZZLING DURING SAMPLING, RAINED LAST NIGHT AND DAY BEFORE.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
CENTER OF PILE/SAMPLING UNIT = 37.860974° -107.715598°.
PILE WAS SAMPLED ALONG SEVEN TRANSECTS, 5 SUB SAMPLES ALONG EACH TRANSECT.
TRANSECTS WERE ALONG FLAGS PLACED IN THE FIELD - GENERALLY EVENLY
SPACED AND SUBSAMPLES COLLECTED EVENLY SPACED ALL BASED ON VISUAL OBSERVATION.
SUBSAMPLE DEPTH ≈ 5 CM.

Additional data collected (paste pH, pXRF, etc):
N/A.
ELEV. ON TOP OF PILE ≈ 11,417.

Geospatial data (description of measurements if made in the field):
COORDS COLLECTED FROM GIS SATELLITE IMAGERY.

SAMPLES (from original USGS text and summarized here).

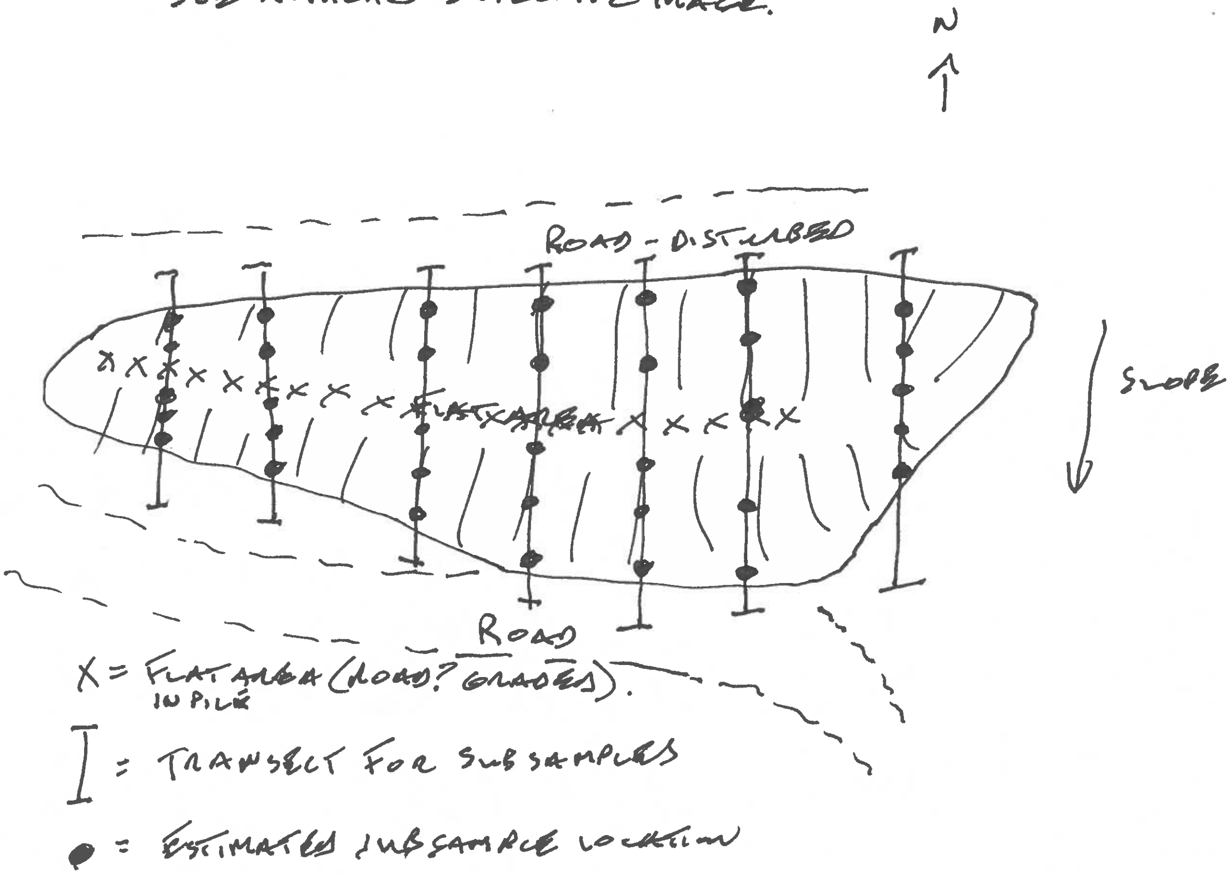
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-SS3-SW-COMPOSITE
Date 9/13/23

Field Sketch (if applicable – include a north arrow and general dimensions).

SEE ATTACHED SATELLITE IMAGE.



Brooklyn Mine
DISTURBED AREA
2340
23-SS3-SUB-COMPOSITE
(SUB1)
N
300 ft
Google Earth

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 23-SSJ-SU1-COMPOSITE-FINE → COLLECTED IN BUCKET TO LET DRY. LATER SIEVED BUT NO COARSE (>2mm) FRACTION.

Site and Sample Unit HIGHLAND MARY MILL TAILINGS, ONE TAILINGS PILE SAMPLE

Date and Time:
9/13/23, 15:38

Collected by: A. GIEBEL, K. BROWN, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
SUBSAMPLES COLLECTED ALONG THE FACE OF SLOPE - NO SUBSAMPLES COLLECTED ON TOP OF PILE BECAUSE IT'S VERY DISTURBED (ACCORDING TO DRMS, FILL WAS PLACED ON TOP OF PILE AS GROWTH MEDIUM FOR REVEG. EFFORT). SEE ATTACHED MAP. PILE IS ≈ 20' HIGH, ELEV. ON TOP OF PILE ≈ 10,392' amsl, PORTION OF PILE (TO SOUTH) WAS NOT SAMPLED DUE TO PRIVATE OWNERSHIP. PILE IS ≈ 346' LONG (SAMPLED PORTION) AND 67' WIDE ALONG WIDER PART OF SAMPLED AREA.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
TAILS ARE MOIST DUE TO RECENT RAIN, DRIZZLING DURING SAMPLING. LIGHT GRAY WITH LIGHT YELLOWISH BROWN AREAS, FINE TO MED. TO COARSE SAND WITH LITTLE SILT SIZED MATERIAL, WELL-SORTED, UNCONSOLIDATED. TOP OF PILE (UNSAMPLED) HAS LOW BUSHES. SOME THIN FEOX STRINGERS/LAYERS IN SUBSURFACE AS WELL AS PLANT ROOTS.

Sieving notes:
ONE COMPOSITE SAMPLE COLLECTED IN FIELD ALONG NINE TRANSECTS (GENERALLY EVENLY SPACED IN FIELD USING FLAGS), 4 SUBSAMPLES COLLECTED ALONG EACH TRANSECT (GENERALLY EVENLY SPACED BASED ON VISUAL OBSERVATIONS), SUBSAMPLES COLLECTED AT ≈ 5 CM, COMPOSITED IN ONE 5-GALLON BUCKET, COULD NOT SIEVE IN FIELD (TOO MOIST).
(36 SUBSAMPLES)

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? USED DECONNED PLASTIC REUSABLE HAND TROWELS, NITRILE GLOVES (REUSABLE), EQUIPMENT DECONNED PRIOR TO SAMPLING USING DISTILLED WATER WITH FINAL DEIONIZED WATER RINSE, COLLECTED SAMPLE IN PLASTIC 5-GALLON BUCKET FOR FUTURE SIEVING. TAILS ARE MOSTLY QUARTZ AND OTHER SILICATE MINERALS, NO EVIDENCE OF SULFIDES. TAILS ARE ADJACENT TO CUNNINGHAM CREEK (FLOWS NORTH TO ANIMAS RIVER).

Sample ID 23-SJ4-SU1-COMPOSITE-FINE
Date 9/13/23

Weather notes: current conditions? Recent precipitation?
DRIZZLING DURING SAMPLING, RAINED LAST NIGHT AND YESTERDAY.

Latitude/longitude of ~~sub~~samples (description of how data collected and/or data collected):
CENTER OF SAMPLED PILE UNIT = 37.789408°, -107.578615° FROM GIS SATELLITE IMAGERY. SUBSAMPLES WERE VISUALLY SPACED IN THE FIELD ALONG FLAGGED TRANSECTS.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
COORDS COLLECTED FROM SATELLITE IMAGERY (GIS).

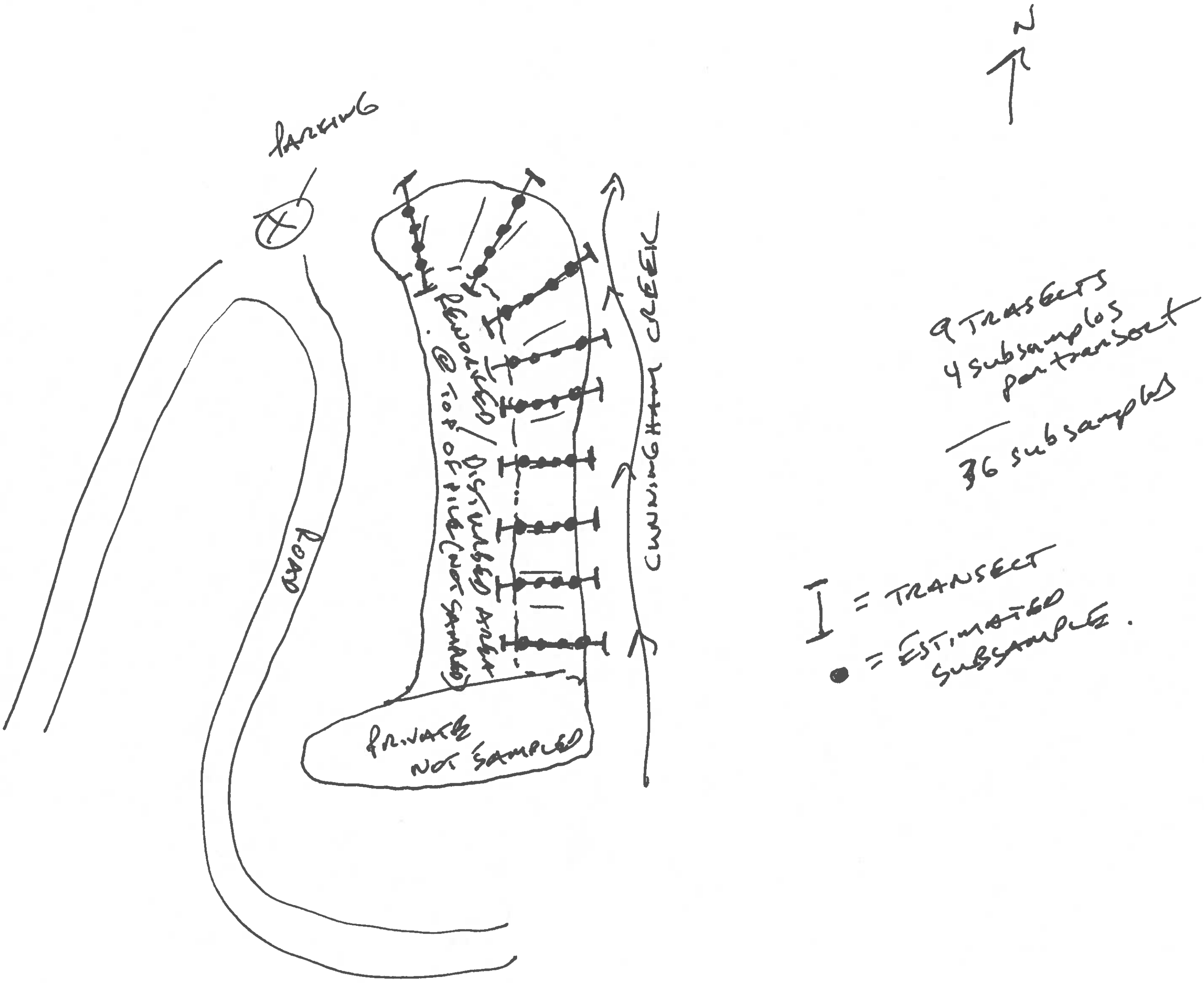
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-SS4-SU1-COMPOSITE-FINE
Date 9/13/23

Field Sketch (if applicable – include a north arrow and general dimensions).




Highland Mary Area
23-554-SW1 - COMPOSITE
SW1
~67'
DISTURBED
DISTURBED
~346'
PRIVATE
4
N
300 ft
Google Earth

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 11:38 (<2mm sieve) 23-BK1-SU1-FINE 11:35 23-BK1-SU1-COARSE } BOTH ARE COMPOSITE SAMPLES

Site and Sample Unit SU1, WELLINGTON MINE, NEAR MILL

Date and Time: 9/26/23, 11:35 a.m. (COARSE SAMPLED FIRST, FINE SAMPLED 3 MINUTES AFTER

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

PILES ARE ABOUT ~~[illegible]~~ 30-40' HIGH IN ALL SAMPLING UNITS IN THIS AREA. TOPS OF PILES HAVE BEEN COVERED IN GRAVEL (SEE AERIAL). MOST OF LOBES ARE YELLOWISH BROWN, TO LIGHT GRAY, TO DARK REDDISH BROWN (SOME WASTE ROCK PILES WITHIN LOBES ARE DARKER). SULFUR SMELL. ~10 GRID BUT SOME POINTS CAN'T BE SAMPLED DUE TO STEEPNESS ESPECIALLY TOWARDS TOP OF PILE.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability? SUBSURFACE IN MOST LOBES LOOKS SIMILAR TO SURFACE w/ REGARDS TO SIZE + COLOR

WASTE ROCK, MOST MATERIAL ON SURFACE IS ERODED WASTE ROCK, MOST MATERIAL IS < 1 inch @ SURFACE, SOME PILES WITHIN LOBES HAVE LARGER MATERIAL UP TO 1-2 FEET, SCRAP WOOD, METAL, ETC. IN PLACES. WASTE ROCK APPEARS DRY TO SLIGHTLY MOIST. SOME PILES OF WOOD w/ METAL IN SMALL SWALES BETWEEN PILES.

Sieving notes:

SUBSAMPLES COLLECTED @ ≈ 5 cm, SIEVED IN FIELD WITH STAINLESS STEEL 2mm SIEVE. FINE = < 2mm, COARSE = > 2mm

Detailed site description and site notes: SIEVED IN FIELD

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? 5 cm + BELOW SAMPLE.

PLASTIC TROWELS, PLASTIC BUCKETS ~~OF~~ NO VEG. ON SIDES OF PILE w/ SMALL GULLIES IN PLACES, SMALL ASPEN + PINES ON TOPS ARE SMALL (UP TO 10' OR SO), PILE IS CEMENTED ON SURFACE ESPECIALLY NEAR TOPS WHERE THEY STEEPEN, RIVER IS TO SOUTH, BLEBS ABUNDANT PYRITE, ALTERED ROCK w/ PYRITE STRINGERS + ~~BLEBS~~, CHUNKS OF PYRITE EVERYWHERE, BLACK SPHALERITE (WEATHERED), GALENA?, BLACK OXIDES, QTZ (ABUNDANT), LARGE TO SMALL PYRITE ~~CLUSTERS~~ CLUSTERS (< 1 inch up to 3-4 inches)

Sample ID 23-BKH-SU1

Date 9/26/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):

SAMPLES GENERALLY COLLECTED ALONG 8 TRANSECTS EVENLY SPACED IN THE FIELD. APPROXIMATELY 36 SUBSAMPLES COLLECTED, EVENLY SPACED AS ESTIMATED IN THE FIELD, INTO 5-GALLON PLASTIC CONTAINER. SAMPLE POINTS PLACED ON HIGH RESOLUTION SATELLITE PHOTO AND COORDS GEN. IN GIS.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

SAMPLE LOCATIONS BASED ON FLAGGING IN THE FIELD.

~CENTER OF ~~PILE~~ SU1 IS ≃ 39.485118°, -106.010238.

ELEV @ TOP ≃ 10,150' amsl

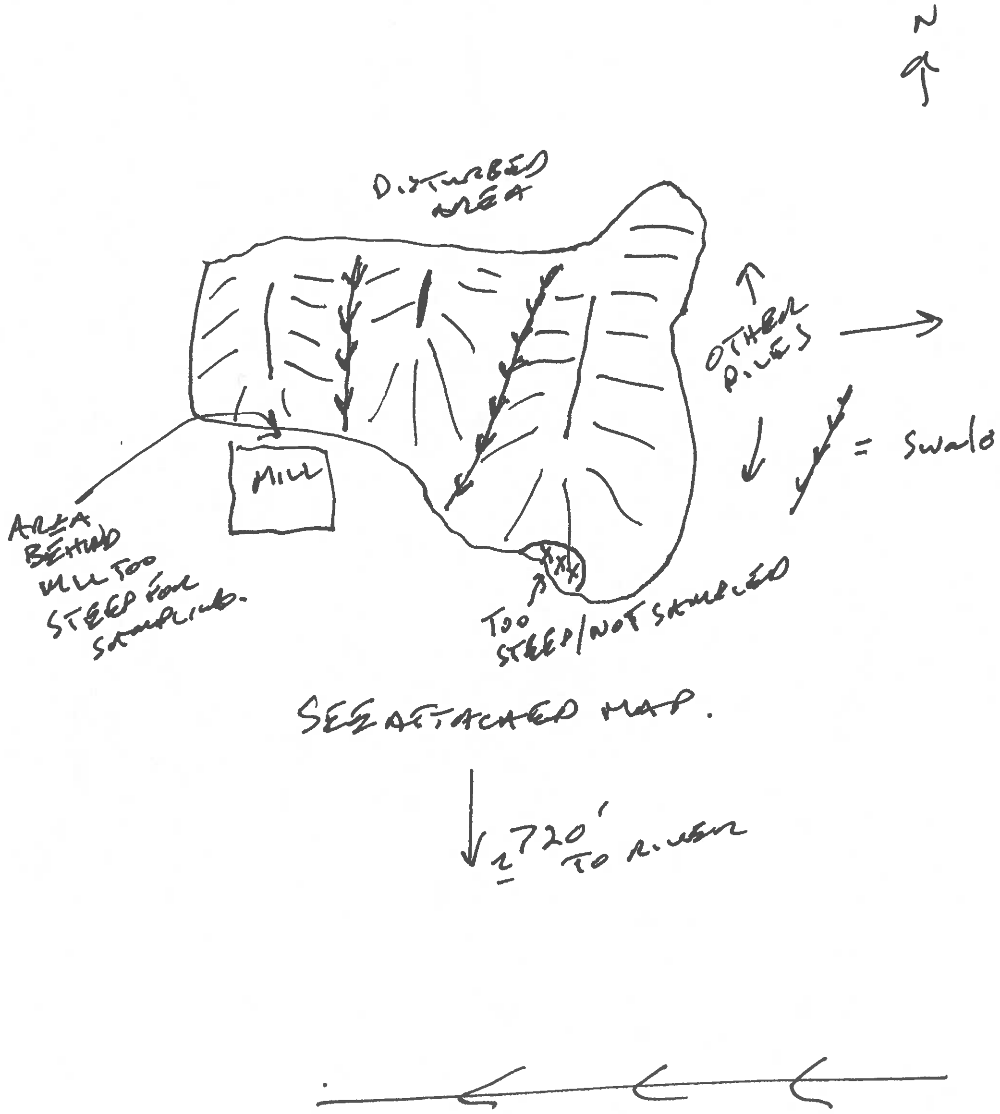
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BK1-SW1
Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).




Wellington
23-BKI-SW1
→ = SWALE
● = SAMPLE LOCATION
23-BKI-SW1
88'
121'
N
200 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

(23-BK1-SU2)

Sample ID 23-BK1-SU2 ~~[illegible]~~

23-BK1-SU2-FINE
23-BK1-SU2-COARSE
↑ BOTH ARE COMPOSITE SAMPLES

Site and Sample Unit SU2, WELLINGTON MINE, JUST EAST OF MILL

Date and Time: 9/26/23 12:25 (COARSE), 12:29 (FINE)

Collected by: A. GOEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

SU2, WELLINGTON MINE, SIMILAR TO SU1 BUT BROKEN OUT AS SEPARATE UNIT, MOST MATERIAL ESPECIALLY ALONG ~~[illegible]~~ SLOPES IS SUB 1", WITH ABUNDANT MATERIAL UP TO 2", TOP OF WESTERN LOBE HAS ABUNDANT LARGER MATERIAL UP TO 2'.

↑ SEE ABOVE

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

WASTE ROCK, ERODED WASTE ROCK, YELLOWISH BROWN TO GRAY TO PURPLISH GRAY STREAKS, SOME STREAKS ARE REDDISH BROWN, DRY ~~[illegible]~~, DRY, SIZE VARIABILITY IS SIMILAR TO SU1

Sieving notes:

SIEVED IN FIELD (FINES ARE < 2 mm), COARSE IS MATERIAL FROM TOP OF SIEVE, > 2 mm.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? SAMPLING EQUIPMENT THE SAME AS SU1.

AS SU1, WASTE ROCK, ABUNDANT PYRITE MASSES, PYRITE AND OTHER SULFIDES IN WASTE ROCK AS VEINS/VEINLETS, QTZ, LARGE (UP TO 6-8" MASSES OF PYRITE + BLACK SULFIDES?), RIVER IS SOUTH (± 750').

Sample ID 23-BK1-SU2

Date 9/26/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

SAMPLES COLLECTED ALONG ≈ 6 TRANSECTS (ONE PORTION OF PILE TOO STEEP TO SAMPLE) GENERALLY W/ SOME INFILLING. ABOUT 33-34 SUBSAMPLES COLLECTED FROM 5 CM DEPTH, EASTERN PORTION OF SU2 NOT SAMPLED (STEEP). TRANSECTS VISUALLY FLAGGED IN FIELD AND SAMPLING POINTS VISUALLY ESTIMATED AS SHOWN IN ATTACHED MAP. COORDS FROM HIGH RES. SATELLITE PHOTOS.

Additional data collected (paste pH, pXRF, etc):

N/A.

Geospatial data (description of measurements if made in the field):

SAMPLE LOCATIONS BASED ON FLAGGING IN FIELD.

≈ CENTER OF SU2 ≈ 39.485167°, -106.009782. ELEV. ≈ 10,148' amsl (estimate from handheld GPS)

SAMPLES (from original USGS text and summarized here).

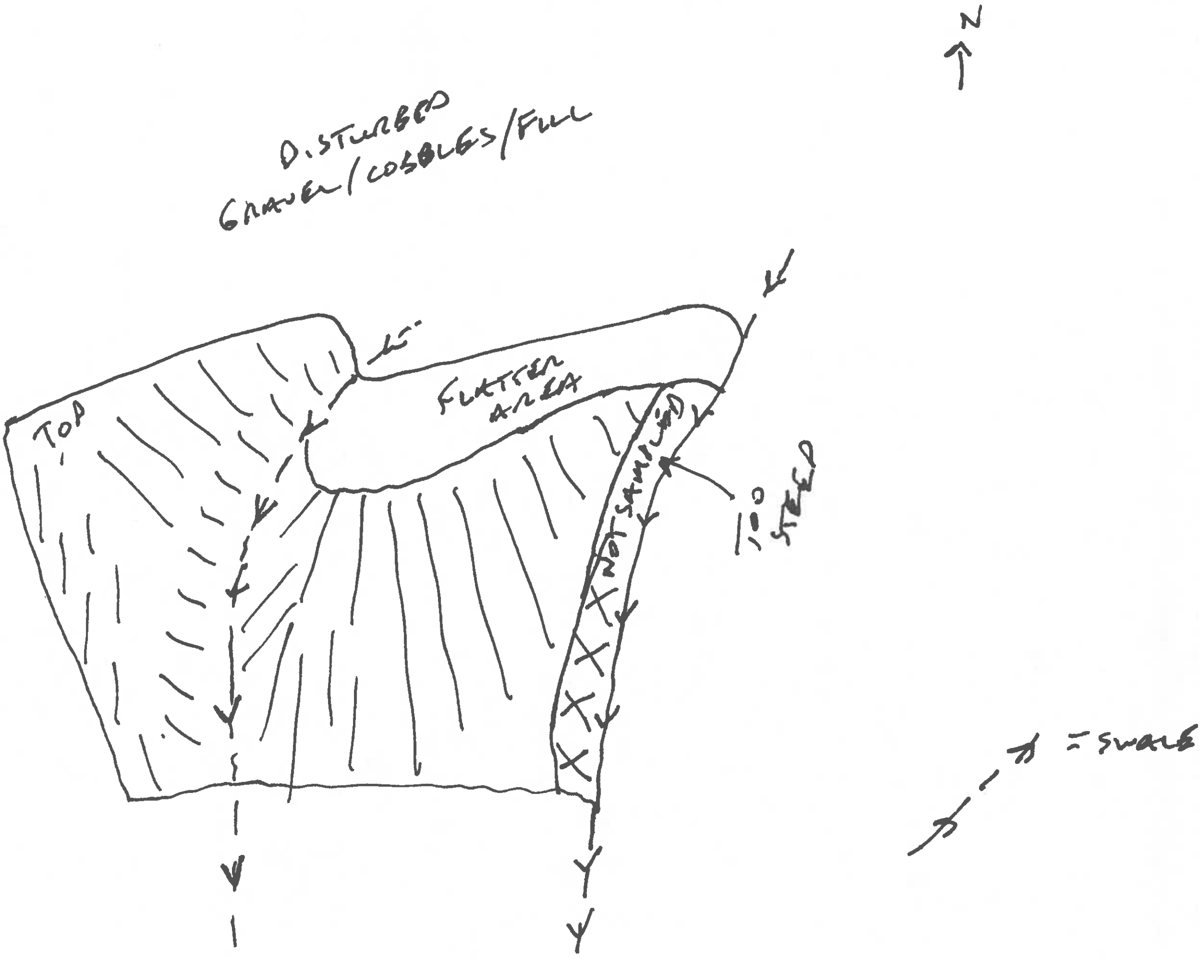
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called “Example Tailings Site” in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: “22_ETS_SU1_composite”, with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled “22_ETS_SU1_composite_dup” to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BKL1-SL2

Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).



SEE ATTACHED MAP.


Wellington
23-BX1-Su2
GRAVEL/COBBLES PLACED ON PILE DURING REMEDIATION?
186'
108'
NOT SAMPLED STEEP
Google Earth
N
200 ft

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-BK1-SU3-FINE, 23-BK1-SU3-COARSE ALL ARE COMPOSITE SAMPLES

Site and Sample Unit WELLINGTON PILES

Date and Time: 9/26/23 13:23 (COARSE), 13:27 (FINE)

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ (SEE PHOTO LOG)

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

LARGER LOBE, ≃50' HIGH, PILE INCLUDES WASTE ROCK, ERODED WASTE ROCK, WOOD, CINDERS AT TOP OF PILE NEAR WESTERN GULLY (NOT SAMPLED), MOST MATERIAL IS SUB 1" BUT AS WITH OTHER PILES, HAS SOME MATERIAL >2" UP TO 2-3 FEET, METAL, GLASS (MUCH OF THIS DEBRIS IS @ THE SURFACE + ON BACK TOP OF PILE).

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

EAST + WEST SIDES OF PILE ARE STAINED YELLOW BROWN TO PURPLISH GRAY, SOUTH FACING SLOPE IS GRAY TO LIGHT GRAY, MOST OF MATERIAL ON SOUTH FACING SLOPE IS <1".

Sieving notes:

SIEVED IN FIELD W/ 2MM SIEVE (STAINLESS STEEL). SUBSAMPLES COLLECTED IN 5-GALLON PLASTIC BUCKET.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? NO VEGETATION, YELLOWISH GRAY CLAYS NEAR BASE (LOOKS MORE ALTERED AND FINER), ABUNDANT PYRITE ~~HERE~~ HERE (ENTIRE SLOPE IS REFLECTING PYRITE), IRON OXIDES, WASTE ROCK, OTHER SULFIDES ARE ABUNDANT (BLACK SPHALERITE? LOOKS WEATHERED, GALENA?), SURFACE IS CEMENTED IN PLACES, SLOPE NEAR TOP IS VERY STEEP (NOT SAMPLED), EROSION GULLIES ON PILE (APPEARS WASHED OUT AT BOTTOM OF SLOPE), RIVER ≃ 750' TO SOUTH.

Sample ID 23-BK1-SU3
Date 9/26/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):
FLAGS FOR TRANSECTS (4 TRANSECTS) SPACED IN FIELD WHERE WE COULD GET SAMPLES, 43 SUBSAMPLES COLLECTED FROM PILE - EVENLY SPACED AND DENOTED ON ATTACHED MAP (VISUALLY ESTIMATED IN FIELD).

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):
≈ CENTER OF SU3 ≈ 39.485200°, -106.009504°, ELEV. ≈ 10148' amsl (TOP OF PILE) (ESTIMATED FROM FIELD GPS -

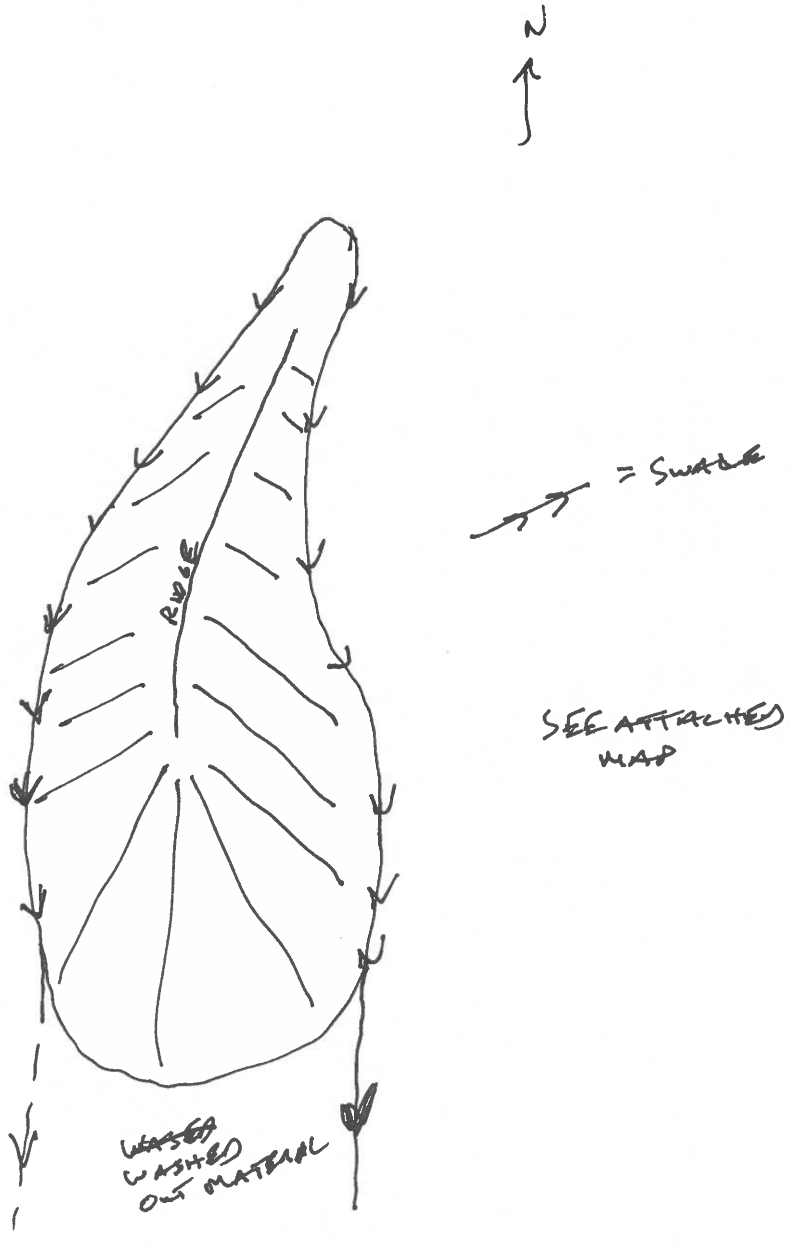
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BK1-SW3
Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).




Wellington
COBBLES/GRAVEL/ BOULDERS
FILL DISTURBED
~180'
TOO STEEP
NOT SAMPLED
~68'
N
200 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

14:18
23-BK1-SU4-DUP-COARSE
23-BK1-SU4-DUP-FINE
14:1

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-BK1-SU4-FINE, 23-BK1-SU4-COARSE

ALL SAMPLES ARE COMPOSITES

Site and Sample Unit WELLINGTON MINE, SU4 (SEVERAL LOBES)

Date and Time: 9/26/23 13:50 (COARSE), 13:57 (FINE)

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

SEVERAL LOBES OF MATERIAL 35-40' HIGH, MOST LOBES VARY IN SIZE AND COLOR [ALL HAVE MIXED COLORS RANGING FROM YELLOWISH BROWN, TO DARK GRAY/BLACK (ROCK)], DARK PURPLISH GRAY, ORANGISH BROWN, SUBSURFACE COLOR VARIES, ABUNDANT METAL, WOOD, NAILS, ETC., SCATTERED OVER PILES.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

~~[illegible]~~ WASTE ROCK + ERODED WASTE ROCK, MOST MATERIAL IS SUB 1-INCH BUT ABUNDANT 2" AND GREATER IN PLACES, GENERALLY DRY.

Sieving notes:

SIEVED IN FIELD W/ 2MM SIEVE. FINE = < 2MM COARSE = > 2MM STAINLESS STEEL SCREEN. DUP = DUPLICATE SAMPLE GENERALLY COLLECTED OVER SAME GRID/TRANSECTS MIXED/COMPOSITED IN DIFFERENT 5-GALLON BUCKET (PLASTIC) AND SIEVED IN FIELD SEPARATE FR[OM] NON-DUP SAM[PLE]

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? PLASTIC TROWEL, PLASTIC BUCKETS SCATTERED TREES ON TOP OF PILE BUT MOST IS UNVEGETATED, ABUNDANT ALTERED WASTE ROCK, PYRITE, QTZ, ERODED SULFIDES (BLACK-SPHAL? GALENA, OTHER SULFIDES?)

Sample ID 23-BKL-SU4
Date 9/28/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):
DIFFICULT TO SAMPLE, FLAGGED ≈ 9 TRANSECTS AND COLLECTED 39 SUBSAMPLES WHERE WE COULD, GENERALLY EVENLY SPACED BASED ON VISUAL EXAMINATION. SUBSAMPLES GENERALLY MARKED ON SATELLITE PHOTO IN FIELD.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):
CENTER (ESTIMATED) OF PILE ≈ 39.485378°, -106.009036° (BASED ON SATELLITE GIS). ELEV. @ TOP OF PILE ≈ 10148' amsl.

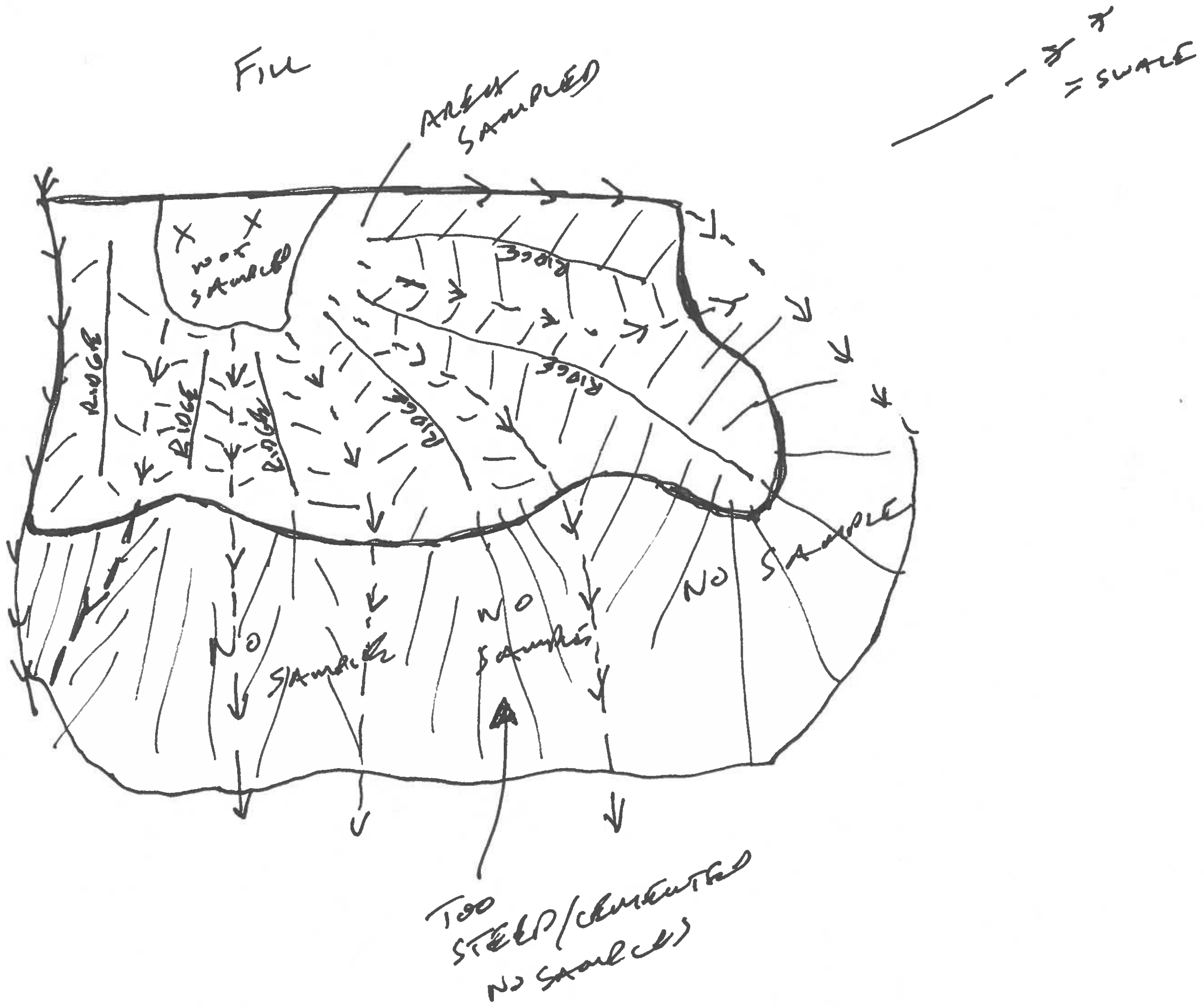
SAMPLES (from original USGS text and summarized here).

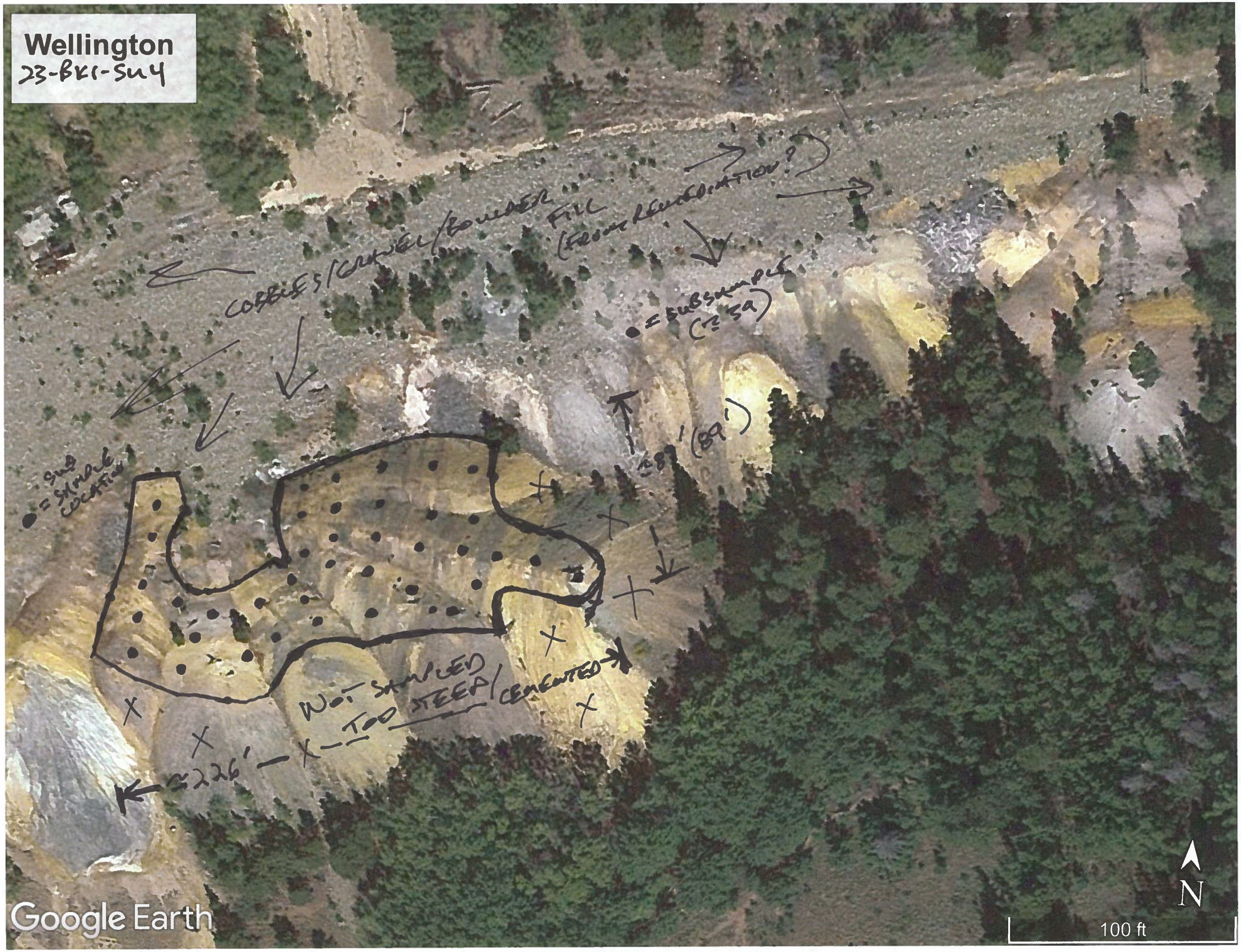
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BK1-SW4
Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).





Wellington
23-BKI-SU4
COBBLES/GRAVEL/BOULDER FILL (FROM REMEDIATION?)
• = SUBSAMPLE (≈ 59)
≈ 89' (89')
• = SUB SAMPLE LOCATION
NOT SAMPLED TOO STEEP/CEMENTED
≈ 226'
Google Earth
100 ft
N

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

ALL SAMPLES ARE COMPOSITES.

Sample ID 23-BK1-SU5-FINE, 23-BK1-SU5-COARSE

Site and Sample Unit SU5, WELLINGTON MINE, SEVERAL LOBES,

Date and Time: 9/26/23, 14:55 - COARSE, 14:57 - FINE

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
25-30' HIGH PILES RIVER GRAVEL COVER ON TOP OF THESE PILES COMES CLOSER TO THE TOP EDGE OF PILES (EROSION MAT PLACED BY OTHERS). PILES VARY BY COLOR FROM YELLOW BROWN - PURPLISH GRAY - GRAY BROWNISH YELLOW MOST MATERIAL IS SUB 1" MATERIAL, ABUND. 2" AND ABOVE W/ OCCASIONAL LARGER MATERIAL 1-2'.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
WASTE ROCK, ERODED WASTE ROCK, SEE ABOVE FOR COLOR, DRY, WOOD, METAL, GLASS, BEER CANS, ETC.

Sieving notes:
SIEVED IN FIELD. SUBSAMPLES COLLECTED IN A 5-GALLON PLASTIC BUCKET AND SIEVED USING STAINLESS STEEL SCREEN (2mm). FINE SAMPLE = <2mm. COARSE SAMPLE = >2mm.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?
PLASTIC TROWEL, TREES ON TOP AND A FEW IN GULLIES, PYRITE (LESS THAN OTHER AREAS), FEOX, ERODED/OXIDIZED BLACK SULFIDES, ALTERED ROCK QTZ, RIVER IS TO THE SOUTH (≈775'). SEVERAL SWALES IN BETWEEN LOBES.

Sample ID 23-BKI-SU5
Date 9/26/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):
≈40 SUBSAMPLES COLLECTED ALONG FLAGGED TRANSECTS WITH SOME INFILLING ~~SAMPLE~~ SAMPLES. GENERAL SUBSAMPLE LOCATIONS MAPPED IN THE FIELD ON SATELLITE PHOTOS. SEVERAL (2) AREAS NOT SAMPLED DUE TO ABUNDANCE OF DEBRIS (WOOD/METAL, ETC). SEE ATTACHED MAP.

Additional data collected (paste pH, pXRF, etc):

N/A.

Geospatial data (description of measurements if made in the field):
APPROX. CENTER OF SU5 FROM SATELLITE ≈ 39.485674°, -106.008413°
ELEV @ TOP OF PILE IS SIMILAR TO OTHER MEASUREMENTS ≅ 10147' amsl (BASED ON HANDHELD GPS).

SAMPLES (from original USGS text and summarized here).

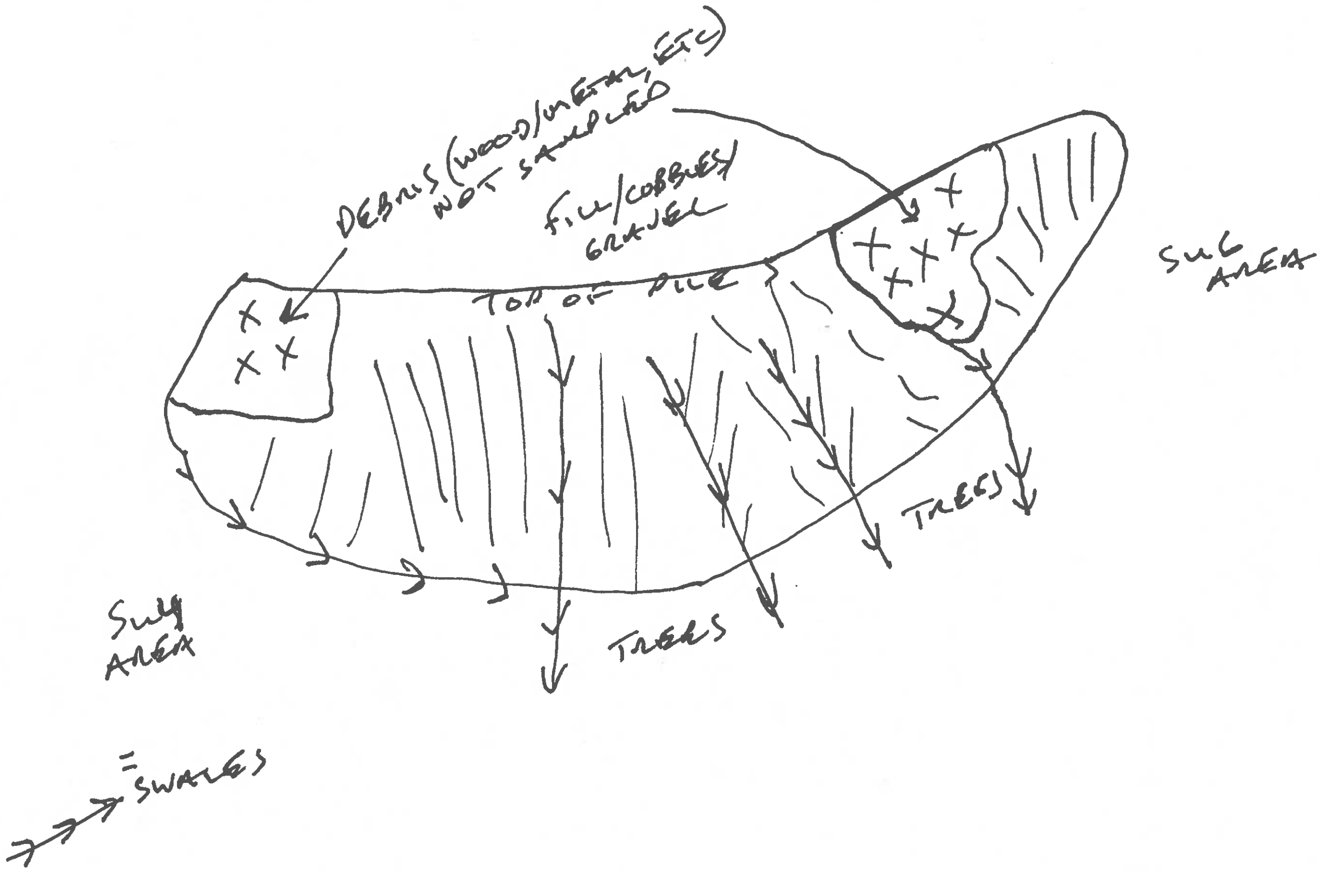
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BK1-SW5
Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).

N



Wellington
23-BX1-SU5
± 283'
COBBLES/GRAVEL FILL
NOT SAMPLED
NOT SAMPLED (DEBRIS)
NOT SAMPLED (DEBRIS)
± 115'
N
100 ft
Google Earth

X

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

ALL SAMPLES ARE COMPOSITE

Sample ID 23-BK1-SUG-FINE, 23-BK1-SUG-COARSE

Site and Sample Unit SUG, WELLINGTON MINE, FAR EAST AREA, SEVERAL LOBES

Date and Time: 9/6/23, ~~[illegible]~~ 15:26 (COARSE), 15:31 (FINE)

15:45 23-BK1-SUG-DUP-COARSE

15:49 23-BK1-SUG-DUP-FINE

DUPLICATE SAMPLE

Collected by: A. GIEBEL, M. O'KEEFFE

Photo(s) taken ✓ SEE PHOTO LOG

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

2 LOBES AT FAR EAST END OF PILE ≥30' HIGH, MOSTLY DARK GRAYISH PURPLE, YELLOW BROWN, GRAY TO LIGHT GRAY IN SMALLER AREAS, THESE PILES ARE COARSER W/ MOSTLY <1" MATERIAL, BUT AN ABUNDANCE OF +2" MATERIAL UP TO 1.5' OR SO, WOOD, METAL, NAILS, LEAVES, PINE NEEDLES.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability? — SEE ABOVE

~~WASTE ROCK~~ ERODED WASTE ROCK DRY SUBSURFACE APPEARS MORE ERODED IN SUBSURFACE W/ MORE FINES, SEE ABOVE FOR SIZE/VARIABILITY.

Sieving notes:

SUBSAMPLES FOR SAMPLE AND DUP (DUPLICATE) COLLECTED IN SEPERATE PLASTIC 5-GALLON BUCKETS AND SIEVED IN FIELD USING STAINLESS STEEL 2MM SCREEN. DUPLICATE COLLECTED AT DIFFERENT LOCATIONS USING SAME GENERAL GRID. FINE = <2mm COARSE = >2mm

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies? ALL PLASTIC SAMPLING EQUIP. MORE TREES + VEGETATION ON THESE PILES, SMALL TREES BUT SOME UP TO 25' HIGH - LOOKS OLDER DUE TO VEGETATION, PYRITE, BLACK SULFIDES? MN? STAINING, ALTERED WASTE ROCK (WR HAS PYRITE IN IT), GULLIES ON SIDES OF PILES, RIVER TO SOUTH ± 775'.

Sample ID 23-BKI-SU6
Date 9/6/23

Weather notes: current conditions? Recent precipitation?

CLEAR, COOL

Latitude/longitude of subsamples (description of how data collected and/or data collected):

SUBSAMPLE LOCATIONS (34) BASED ON GENERAL GRID AS FLAGGED AND VISUALLY DETERMINED IN FIELD. ONE AREA NOT SAMPLED DUE TO STEEPNES SEE ATTACHED MAP FOR LOCATIONS AS ESTIMATED USING SATELLITE PHOTO IN THE FIELD.

Additional data collected (paste pH, pXRF, etc):

N/A.

Geospatial data (description of measurements if made in the field):

CENTER OF AREA SU6 ESTIMATED FROM GIS ≅ 39.485756, -106.007936. EST. ELEV. @ TOP OF PILE ≅ 10,147' amsl.

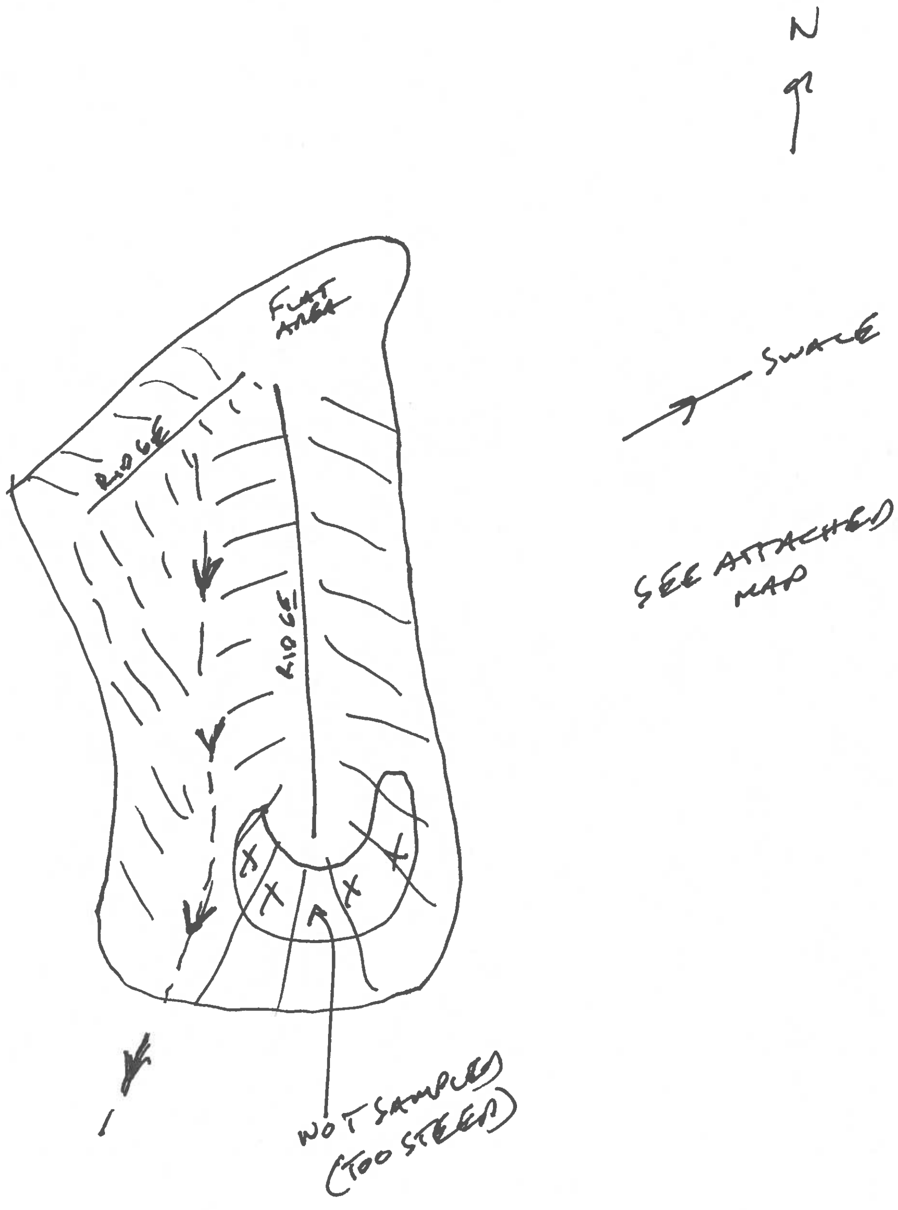
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-BK1-SU6
Date 9/26/23

Field Sketch (if applicable – include a north arrow and general dimensions).




Wellington
23-BKI-SUG
≅123'
FALL
DEBRIS
= SUBSAMPLE
NOT SAMPLED
≅129'
N
100 ft
Google Earth

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV1-SU1-COMPOSITE-FINE; 23-LV1-SU1-COMPOSITE-COAR

Site and Sample Unit CJK PROPERTY - LITTLE PRINCE - SU1

Date and Time:
10-3-2023, 11:00 AM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

PILE (WASTEROCK) LOCATED ALONG COUNTY RD, ON GENTLE SLOPE. HEIGHT RANGES FROM ~10' ON THE UPPER END OF THE SLOPE (EAST) to ~15' ON THE LOWER END (WEST). GENERALLY LEVEL ACROSS THE TOP. COLLAPSED SHAFT LOCATED CENTER/BACK OF THE PILE. SEE ATTACHED MAP FOR AREAL DIMENSIONS.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

SURFACE IS REDDISH BROWN, WITH SUBSURFACE RANGING FROM REDDISH BROWN to DARKER GREY. Mostly Fine to very fine MATERIAL with COARSE FRACTION RANGING TO 1", MINOR COARSER CONTENT ON SURFACE. MATERIAL is WET FROM ~1/2" OF MELTING SNOW FALLEN THE NIGHT BEFORE.

Sieving notes:

SAMPLE IS WET. SIEVING NOT POSSIBLE ON SITE. COLLECTED AND BAGGED FOR DRYING AND LATER SIEVING

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected with plastic trowel and bucket, both cleaned and rinsed with deionized water prior to collection. Sampler wore nitrile gloves.

Conifers (10-15') along crest of pile w/various low forbs and grasses along lower slopes. Minor erosional/drainage features along pile flanks, do not affect pile stability. No nearby surface waters.

Material appears to be primarily heavily altered siliciclastic and silicious carbonates. Minor sulfides present in the form of oxidized pyrite.

Sample ID 23-LV1- SU1 -COMPOSITE
Date 10-3-2023

Weather notes: current conditions? Recent precipitation?
Light rain and snow (~1/2") the night before sampling. Snow flurries during sample collection

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 39.2505, -106.24724 ~11,140' ELEV.
Three parallel transects covered the pile from east to west. One accross the top, and two along contour at mid slope and toe. 10 sub samples spaced evenly apart (based on visual estimates) were collected along each transect at a a depth of ~5cm, for a total of 30 subsamples.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV collected using iPhone GPS

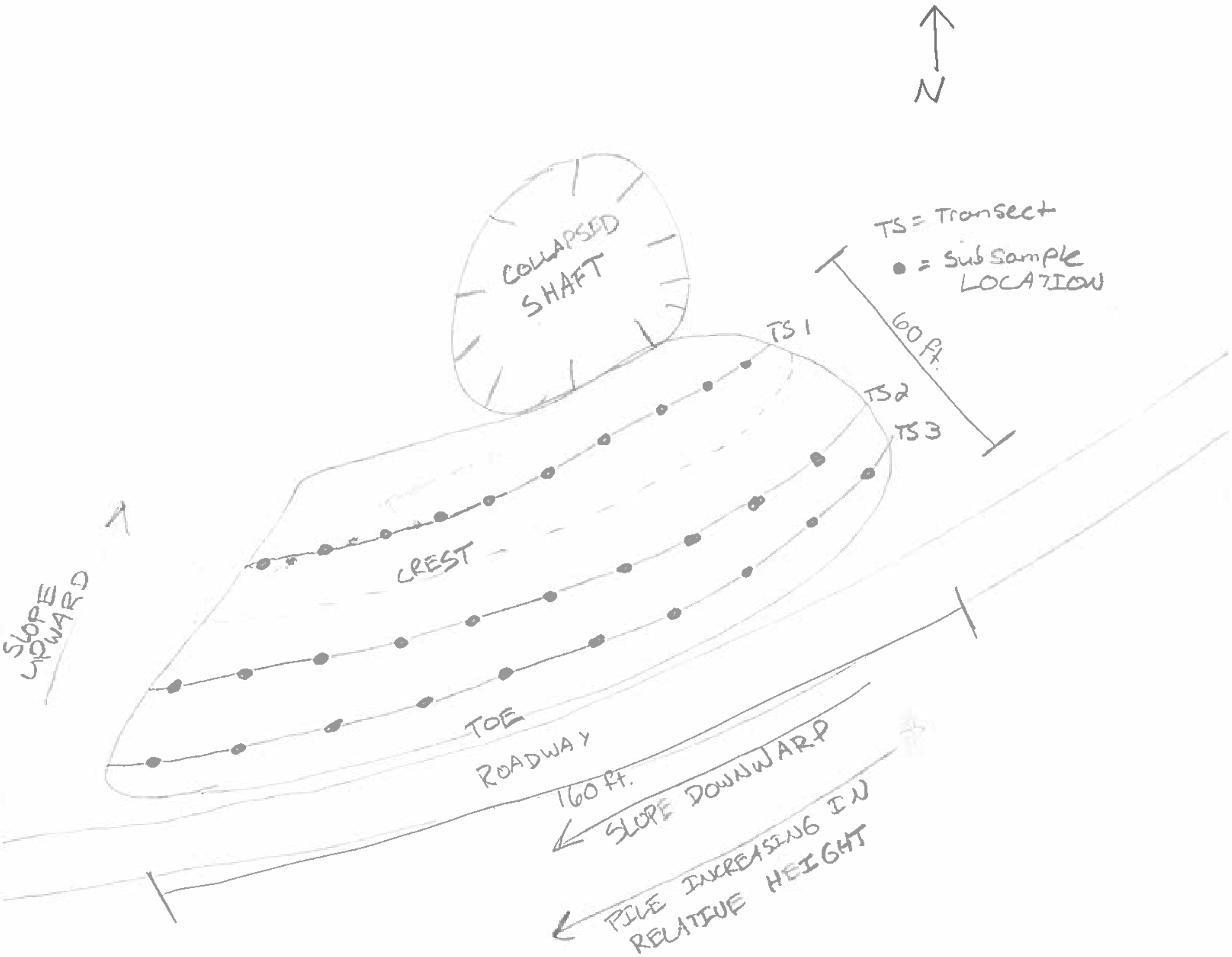
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23 - LV1 - SU1 - COMPOSITE
Date 10-3-2023

Field Sketch (if applicable – include a north arrow and general dimensions).



N
SU1
LV1- LITTLE PRINCE
Google

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV1-SU1-COMPOSITE-DUP-FINE; 23-LV1-SU1-COMPOSITE-DUP-COARSE

Site and Sample Unit CJK PROPERTY - LITTLE PRINCE - SU1

Date and Time:
10-3-2023, 12:30 PM

Collected by: A. GIEBEL

Photo(s) taken _____

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 23-LV1-SU1-COMPOSITE-DUP
Date 10-3-2023

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV1-SU1-COMPOSITE-DUP
Date 10-3-2023

Field Sketch (if applicable – include a north arrow and general dimensions).


N
SW1
LV1- LITTLE PRINCE
Google

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV2-SU1a-COMPOSITE-FINE; 23-LV2-SU1-COMPOSITE-COARS

Site and Sample Unit CJK PROPERTY - PRESIDENT

Date and Time:
10-4-2023, 11:15 AM

Collected by: A. GIEBEL

Photo(s) taken ✓

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is a fairly uniform oval shaped dome with a narrow, level top on relatively flat surface ground, with a fairly uniform height ~20 ft. SEE attached map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is variable in color, ranging from dark brown/black to redish/brown, yellowish brown and on to tan/grey. Subsurface is equally variable, though often not matching surface w/color change occuring at less than 1" depth. Material size is variable, dominantly very fine, ranging to ~2" w/smaller amounts of coarse material up to 12". Moist.

Sieving notes:
Material is very damp due to recent snow melt. Collected in cloth bag for later drying and sieving.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected with plastic trowel into plastic bucket, both cleaned with deionized water prior to collection. Sampler wore disposable nitrile gloves.

No vegitation on pile, and no nearby surface waters. Minor erosional/drainage features along pile flanks, do not affect pile stability.

Material is heavily altered and weathered/decomposed. Likely siliciclastics and altered carbonate. Some massive qtz vein material sporadically mixed in. Minor sulfides present, mostly in the form of oxidized pyrite.

Sample ID 23- LV- ~~SU1~~ SU1 COMPOSITE
Date 10-4- 2023

Weather notes: current conditions? Recent precipitation?

Partly cloudy and cool, ~40°F. Light rain and snow accumulating ~1/2" fell 36 hours prior to collection. Most had melted, leaving wet ground conditions.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

PILE CENTERED AT 39.2488, -106.24331, ~ 11,390' ELEVATION

THREE Parallel transects cover the pile, including one on each mid-flank, and one over the crest. 10 subsamples equally spaced allong each transect, based on visual estimates for a total of 30 subsamples at a depth of 5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV collected using iPhone GPS

SAMPLES (from original USGS text and summarized here).

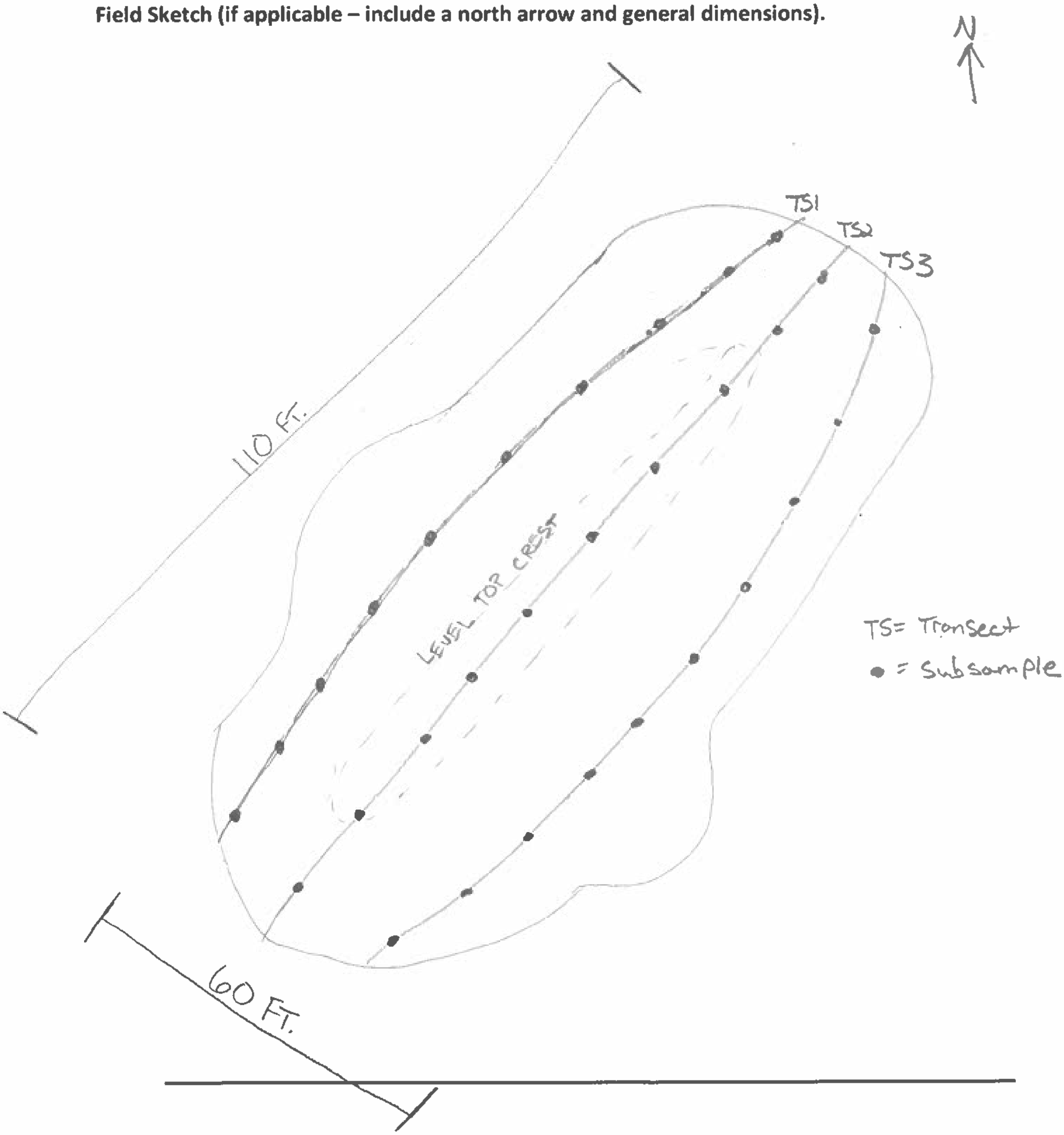
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called “Example Tailings Site” in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: “22_ETS_SU1_composite”, with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled “22_ETS_SU1_composite_dup” to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

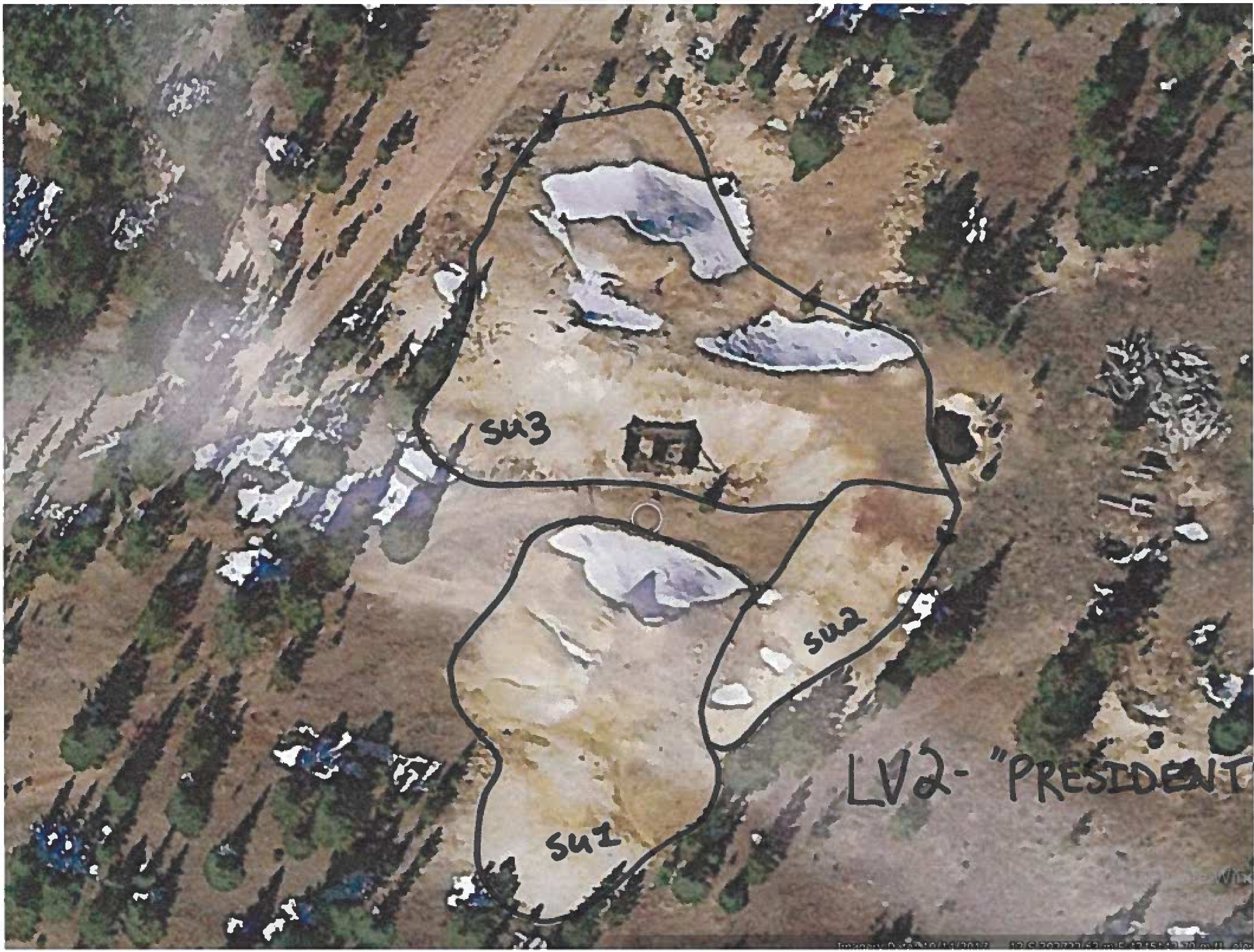
22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV2-SU1-COMPOSITE

Date 10-4-2023

Field Sketch (if applicable – include a north arrow and general dimensions).





N
su3
su2
su1
LV2- "PRESIDENT"

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV2-SU2-COMPOSITE-FINE ; 23-LV2-SU2-COMPOSITE-COARS

Site and Sample Unit CJK PROPERTY - PRESIDENT

Date and Time:
10-4-2023, 12:20 PM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is a roughly crescent shape between two larger piles, ranging from ~5-10' in height with an undulating crest.
See attached map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is primarily reddish brown with minor streaks of lighter tan and dark brown/black. Subsurface generally matches surface color to a depth of 5 cm. Size mixed ranging from very fine grained to ~2" w/some larger clasts up to ~12". High moisture content due to precipitation

Sieving notes:
Material is moist due to recent snowmelt. Collected in cloth bag for later drying and sieving.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel into plstic bucket. Both cleaned w/DI water prior to collection. Sampler wore disposable nitrile gloves. No vegitation on pile. No nearby surface waters. Minor erosional drainage features along flanks, do not affect pile stability. Material is heavily altered and decomposing. Primarlily appears to be volcanic w/some porphyry material. Minor carbonates(?) present. Little observed mineralization compared to neighboring piles.

Sample ID 23-LV2-SU2 - COMPOSITE
Date 10-4-2023

Weather notes: current conditions? Recent precipitation?

Partly cloudy and cool, ~40°F. Light rain and snowfall ~36 hrs. prior. ~1/2" snow mostly melted leaving wet ground conditions.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

PILE centered at 39.24891, -106.2431, ELEV. ~ 11,380'.

Three parallel transects along crescent shape including crest and mid flank of each side. 10 subsamples along each transect spaced equally based on visual estimate for a total of 30 subsamples collected to a depth of ~5cm

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV collected using iPhone GPS.

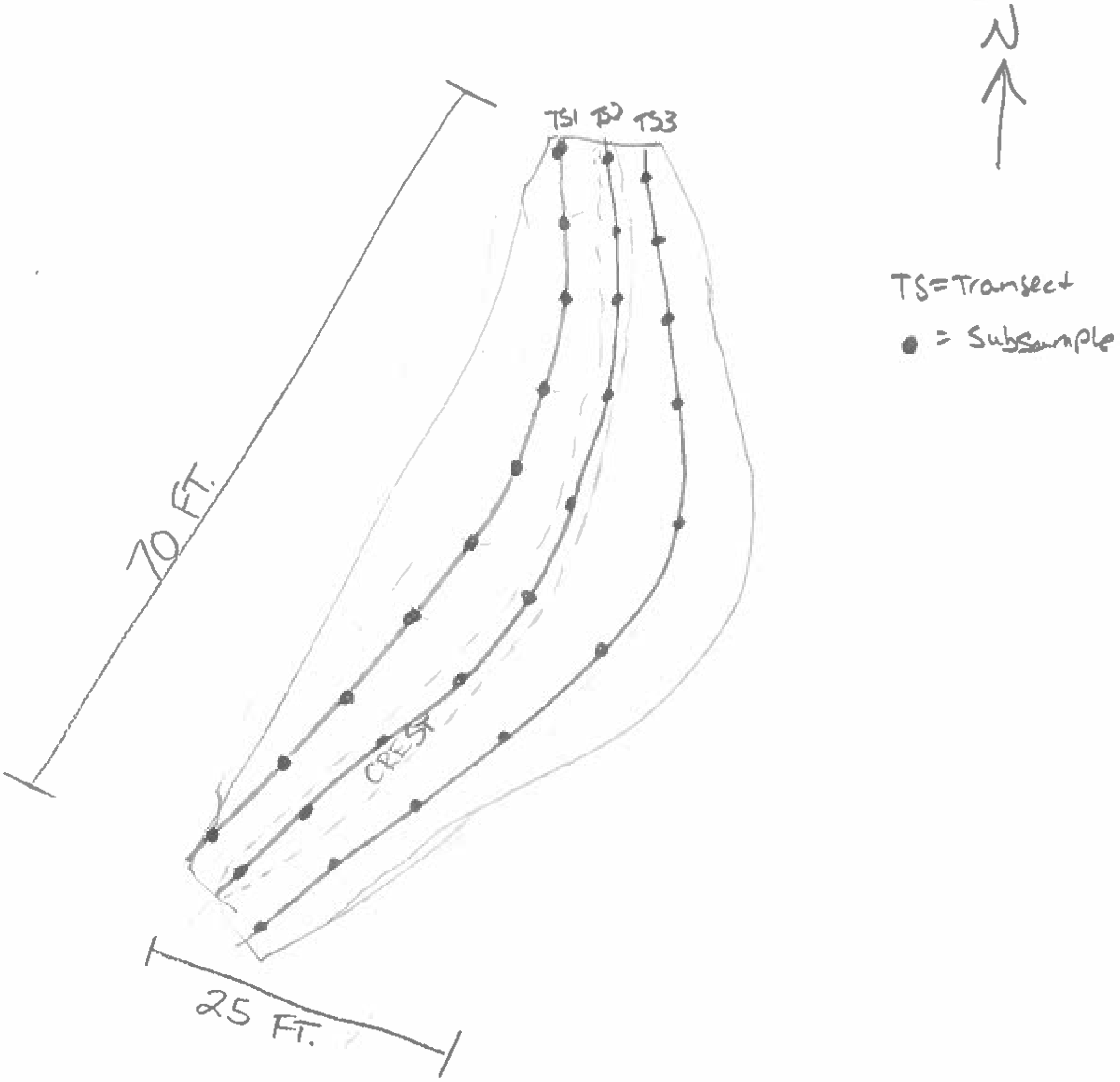
SAMPLES (from original USGS text and summarized here).

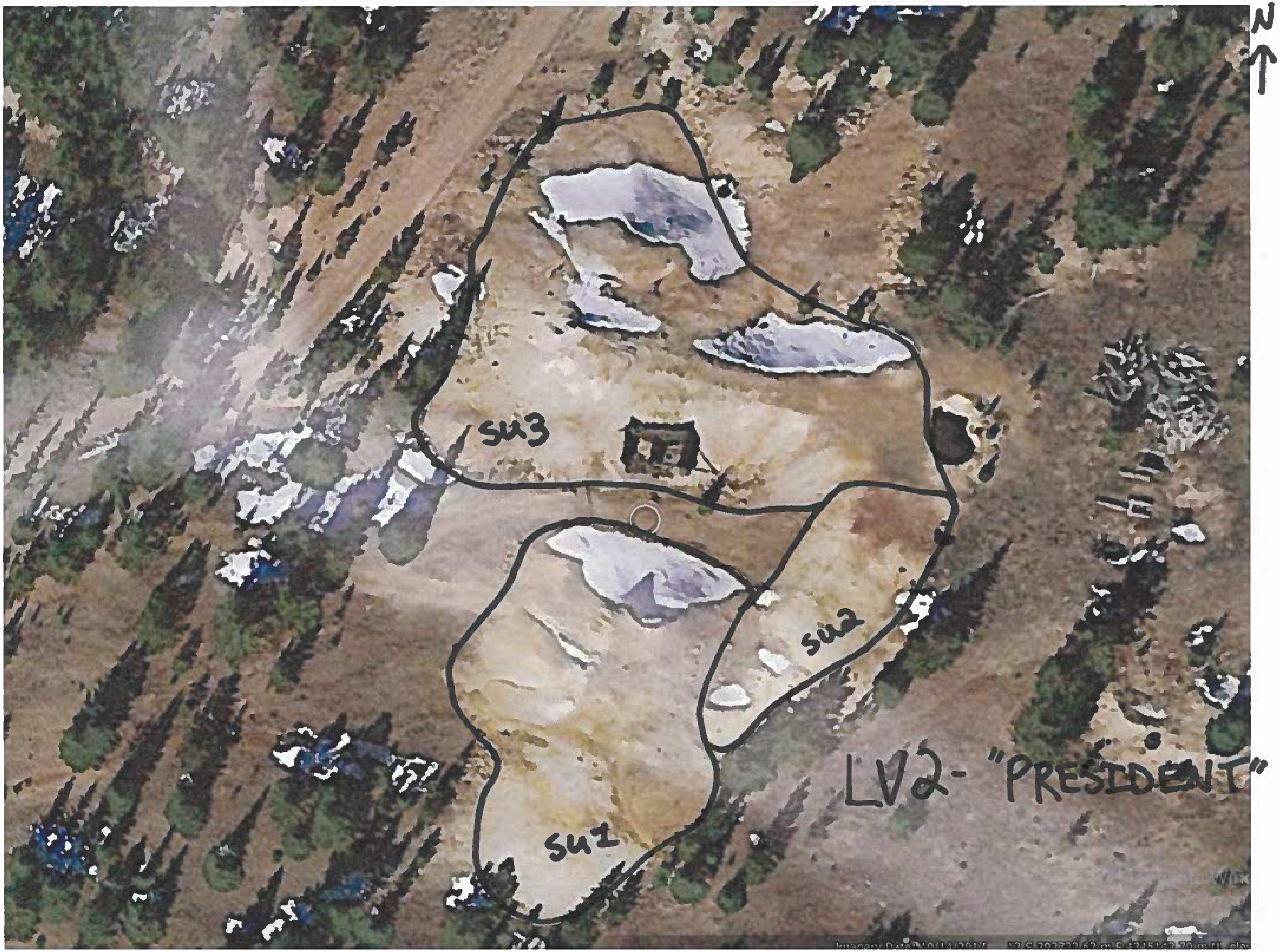
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV2-SU2-COMPOSITE
Date 10-4-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




N
SU3
SU2
SU1
LV2- "PRESIDENT"

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV2-SU3- COMPOSITE-FINE; 23-LV2-SU3-COMPOSITE-COARSE

Site and Sample Unit CJK PROPERTY - PRESIDENT

Date and Time:
10-4-2023, 13:15 pm

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

The pile (wasterock) is an irregular fan-shape with a level central crest. Approx ~25 feet ~~at the~~ highest point of the down slope side in the center of the fan. Numerous infrastructure ruins are present within. See attached map for areal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Surface is variable in color. Mostly Reddish brown to tan with streaks of yellow/tan and darker brown. Subsurface is highly variable in color, red/brown/tan/yellow/grey, generally not matching surface. Color change occurs within ~1" of surface. Generally fine grained with coarse fraction up to ~1" and minor larger clasts 2-12", concentrated near surface. Moist material

Sieving notes:

Material is very damp due to recent precipitation. Collected in cloth bag for later drying and sieving.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and bucket, cleaned w/DI water prior to collection. Sampler wore disposable nitrile gloves. No vegitation on pile, and no nearby surface waters.

Minor erosional/drainage features along pile flanks, do not affect pile stability. Numerous infrastructure ruins occur within this pile, along with large timbers and other wood and metalic debris sticking out of the surface along crest and slopes.

Material is heavily altered and weathered/decomposing. Composed primarily of volcanics rhyolite(?) and some porphyritic material. Minor sulfides present in the form of oxidized pyrite.

Sample ID 23-LV2-SU3-COMPOSITE

Date 10-4-2023

Weather notes: current conditions? Recent precipitation?

Partly cloudy and cool, ~40°F. light rain and snow (~1/2") approx. 36 hours prior to sampling. Some snow remaining on the northern flank of the pile. Most other snow has melted, resulting in wet ground conditions.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile centered at 39.24906, -106.24324, ELEV. ~ 11,400'.

Six transects cover the pile, roughly equally spaced. Due to the irregular shape, slope, and presence of ruined infrastructure, deviations and gaps in the transects were made. Subsamples were collected at rough equal intervals where possible, totally 30 subsamples at ~5cm depth. See sketch for approx sampling locations/intervals.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV data collected using iPhone GPS

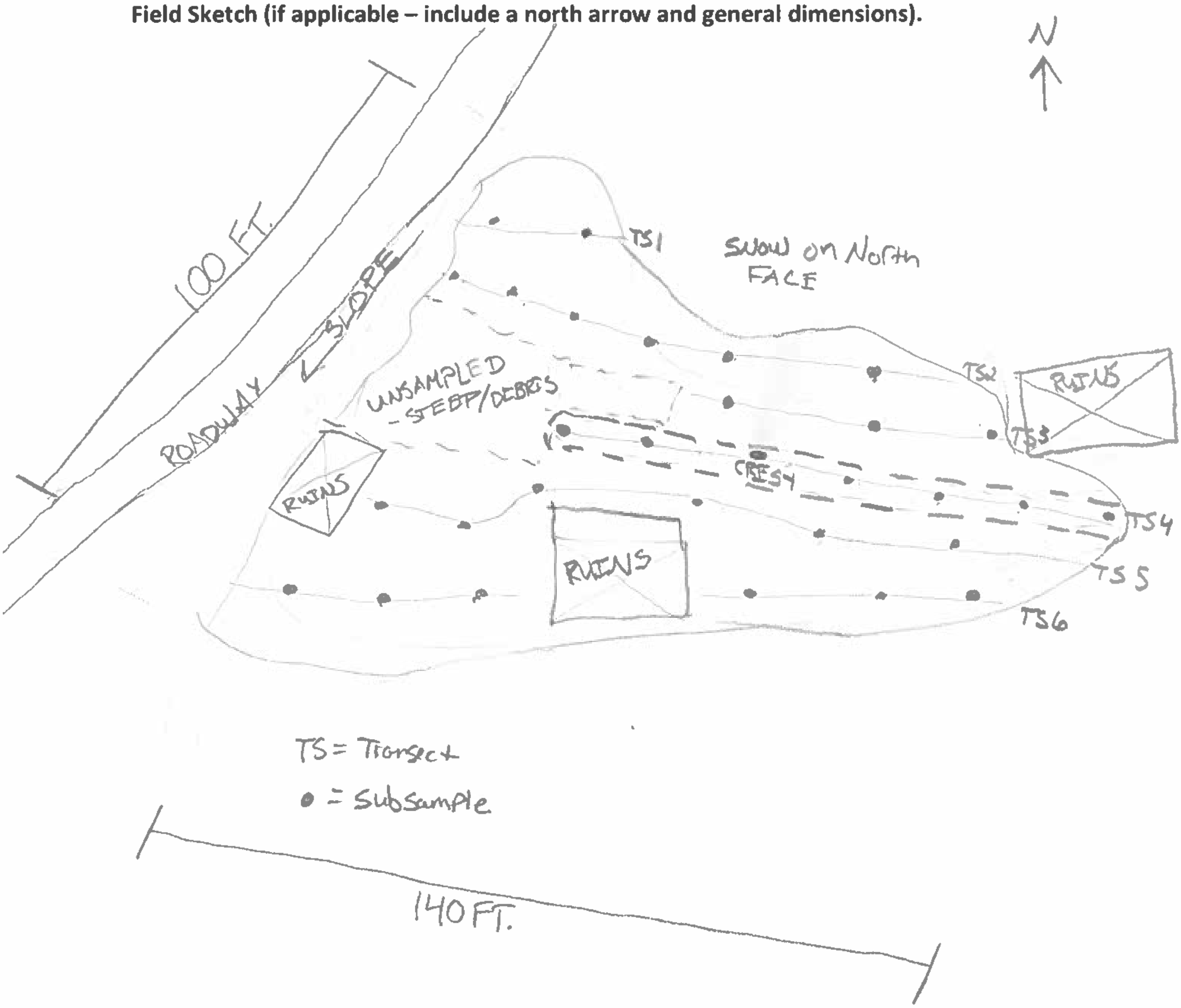
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV2-SU3-COMPOSITE
Date 10-4-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




N
su3
su2
su1
LV2- "PRESIDENT"

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV3-SU1-COMPOSITE-FINE; 23-LV3-SU1-COMPOSITE-COARSE

Site and Sample Unit CJK PROPERTY - PENN 3

Date and Time:
10-5-2023, 10:45 AM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Large, roughly crescent shaped pile (wasterock). Broad sloping south face rising ~50' at crest. Steep, unsampleable north face.
See attached map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Surface is uniformly reddish brown in finegrained material w/coarse component comprised of tan up to 2". Few larger pieces. Subsurface is uniformly darker brown with same mix of fine to coarse seen on surface. Material is moist.

Sieving notes:

Material is moist due to recent precipitation. Bagged in cloth bag for later drying and sieving.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and bucket. Cleaned and rinsed w/DI water prior to collection. Sampler wore disposable nitrile gloves. No vegitation on pile. No nearby surface waters. Erosional/drainage features up to 18" wide and 24" deep occur on flanks of pile but do not appear to affect stability. North flank of pile is near vertical, cemented material and seems fairly unstable.
Material is ~~[illegible]~~ heavily weathered and decomposing. Appears to have been primarily volcanics/rhyolite (?) and siliciclastics. Minor pyrite distributed throughout

Sample ID 23-LW3-SU1-COMPOSITE
Date 10-5-2023

Weather notes: current conditions? Recent precipitation?
Clear and sunny. ~45° F. Light rain an snow ~72 HRS prior to sampling.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 39.24851, -106.24541, ELEV ~11,280'.
Pile crossed from bottom to top with 8 transects and 4 subsamples per transect were collected at a depth of ~5cm for a total of 32 subsamples. The narrow and very steep Northern Flank was not sampled. See sketch.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data were collected using iPhone GPS

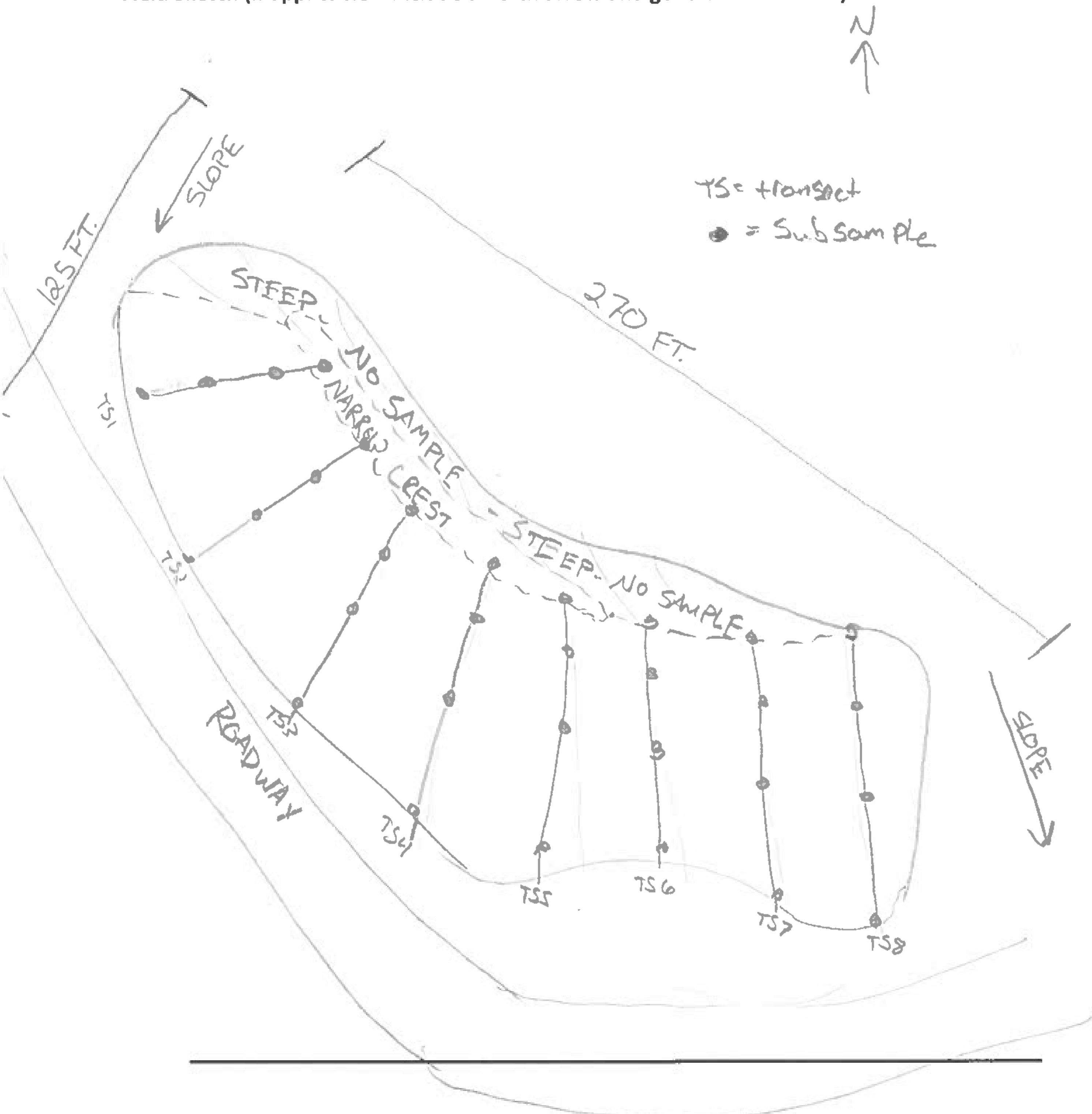
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV3-SU1-COMPOSITE
Date 10-5-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




LV3 - "PENN 3"
SU3
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV3-SU2-COMPOSITE-FINE; 23-LV3-SU2-COMPOSITE-COARS

Site and Sample Unit CJK PROPERTY - PENN 3

Date and Time:
10-5-2023, 11:45 AM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Rectangular wedge shaped pile, between two larger domed and crescent shaped piles. Roughly 50' at the crest. See map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is reddish brown with a mix of clasts ranging from very fine up to ~2". Subsurface is darker reddishbrown w/ some variation to light yellow/tan and grey. Color change occurs less than 1" below surface. Material is moist.

Sieving notes:
Material is moist due to recent precipitation. Collected in cloth bag for later drying and sieving.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/ plastic trowel and bucket, cleaned and rinsed w/ DI water prior to collection. Sampler wore disposable nitrile gloves. No vegetation on pile. No nearby surface waters. Pile is mostly stable w/ some steep erosional features weakening small sections.
Material is highly weathered and decomposing. Mostly a mix of altered volcanics and siliciclastics. Minor sulfides (Pyrite) present.

Sample ID 23-LV3-SU2-COMPOSITE
Date 10-5-2023

Weather notes: current conditions? Recent precipitation?
Clear, sunny ~45°. Light rain and snow ~72 hrs prior.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 39.24872, -106.24544, ELEV ~ 11,280'.
Three roughly parallel transects from bottom to top, w/ 10 subsamples per transect for a total of 30 subsamples at ~5cm depth. Toe end of pile was too steep to sample.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
Lat/long/elev data collected with iPhone GPS

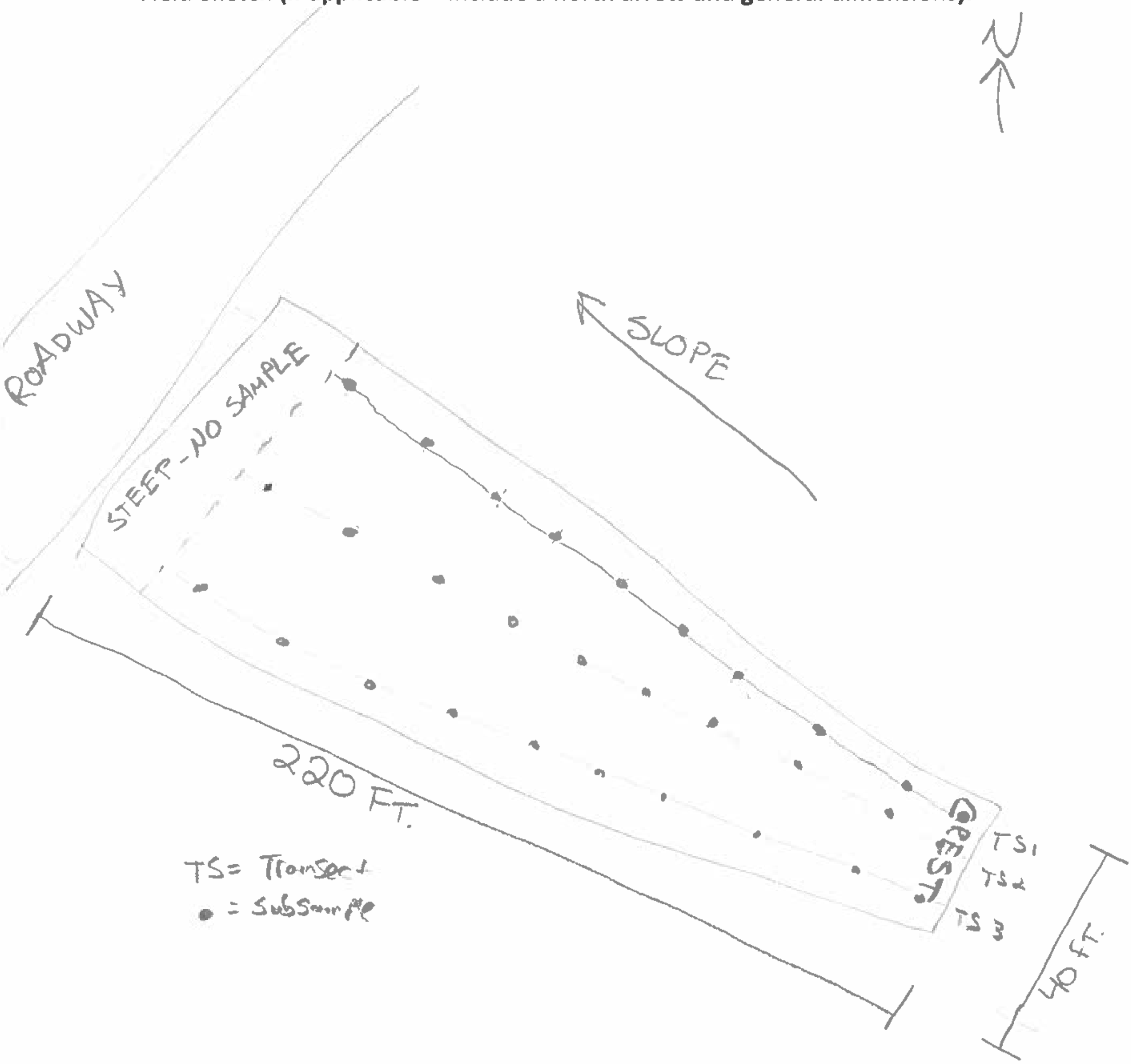
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23- LV3 - SU2 - COMPOSITE
Date 10-5-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




LV3 - "PENN 3"
su1
su2
su3

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV3-SU3-COMPOSITE-FINE; 23-LV3-SU3-COMPOSITE-COARSE

Site and Sample Unit CJK PROPERTY - PENN 3

Date and Time: 10-5-2023, 12:40 PM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) is roughly conical, approximately 40' high with a cirque-like feature eroded out of its southwestern flank. See attached map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Surface is fairly uniform reddish brown. Dominantly fine graded w/lesser coarse component up to ~2". Subsurface is uniformly dark brown. Color change occuring at ~½" depth. Material is moist.

Sieving notes:

Material is moist due to recent precipitation. Collected in cloth bag for later drying and sieving.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and bucket, cleaned and rinsed w/DI water prior to collection. Sampler wore disposable nitrile gloves. Conifer saplings and low mixed forbs scattered over pile. No nearby surface waters. Pile is generally stable.

Material is heavily weathered and decomposing, most of unknown protolith. The larger clasts visible appear to be altered volcanics. Scattered pyrite, oxidized among the fine grained material.

Sample ID 23-LV3-SU3 -COMPOSITE

Date 10-5-2023

Weather notes: current conditions? Recent precipitation?

Clear and sunny. ~45°F. Light rain and snow ~72 hrs. prior.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile centered at 39.24903, -106.2454, ELEV ~ 11,270'.
Five roughly parallel transects w/6 subsamples per transect, evenly spaced by visual estimate for a total of 30 subsamples at a depth of ~5cm. See sketch.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

Lat/long/ELEV data collected with iPhone GPS

SAMPLES (from original USGS text and summarized here).

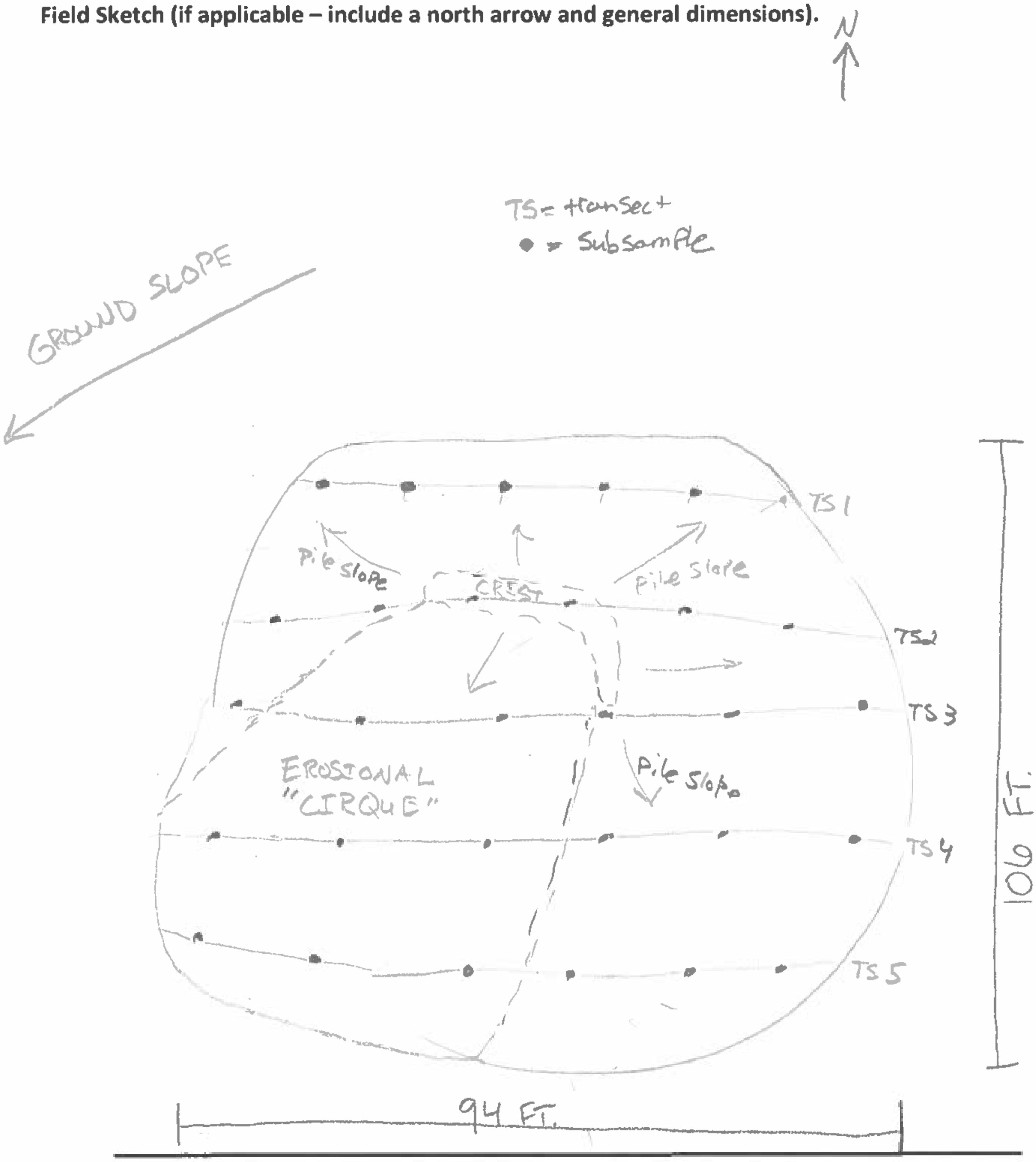
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV3-SU3-COMPOSITE

Date 10-5-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




LV3 - "PENN 3"
SU1
SU2
SU3

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV4-SU1-COMPOSITE-FINE; 23-LV4-SU1-COMPOSITE-CO

Site and Sample Unit CJK PROPERTY- BALLARD

Date and Time:
10-10-2023, 11:00 AM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is an elongate ridge ending in semi-circular fan. Approx 25 feet tall at crest. See map for aireal dimensions

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface reddish brown to dark brown/black. Subsurface generally following surface. Mix of fine to coarse material, up to ~2". Dry surface, moist subsurface beginning at ~1" depth. Variably cemented.

Sieving notes:
Collected in cloth bag for later sieving.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?
Sample collected w/plastic trowel and bucket, cleaned and rinsed w/ DI water prior to collection. Sampler wore disposable nitrile gloves. No vegetation on pile. No nearby surface waters. Pile generally stable.
Material is heavily weathered and decomposing. Appears to be a mix of volcanics and siliciclastics, though exact provinence is difficult to discern. Very little mineralization present.

Sample ID 23-LV4-SU1-COMPOSITE
Date 10-10-2023

Weather notes: current conditions? Recent precipitation?
Partly cloudy, cool ~45°F w/light wind. Most recent precip ~1 week prior.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 39.25038, -106.24343, ELEV ~11,375'.
Three parallel transects, 10 subsamples roughly equally spaced per transect at ~5cm depth for a total of 30 subsamples

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected w/ iPhone GPS

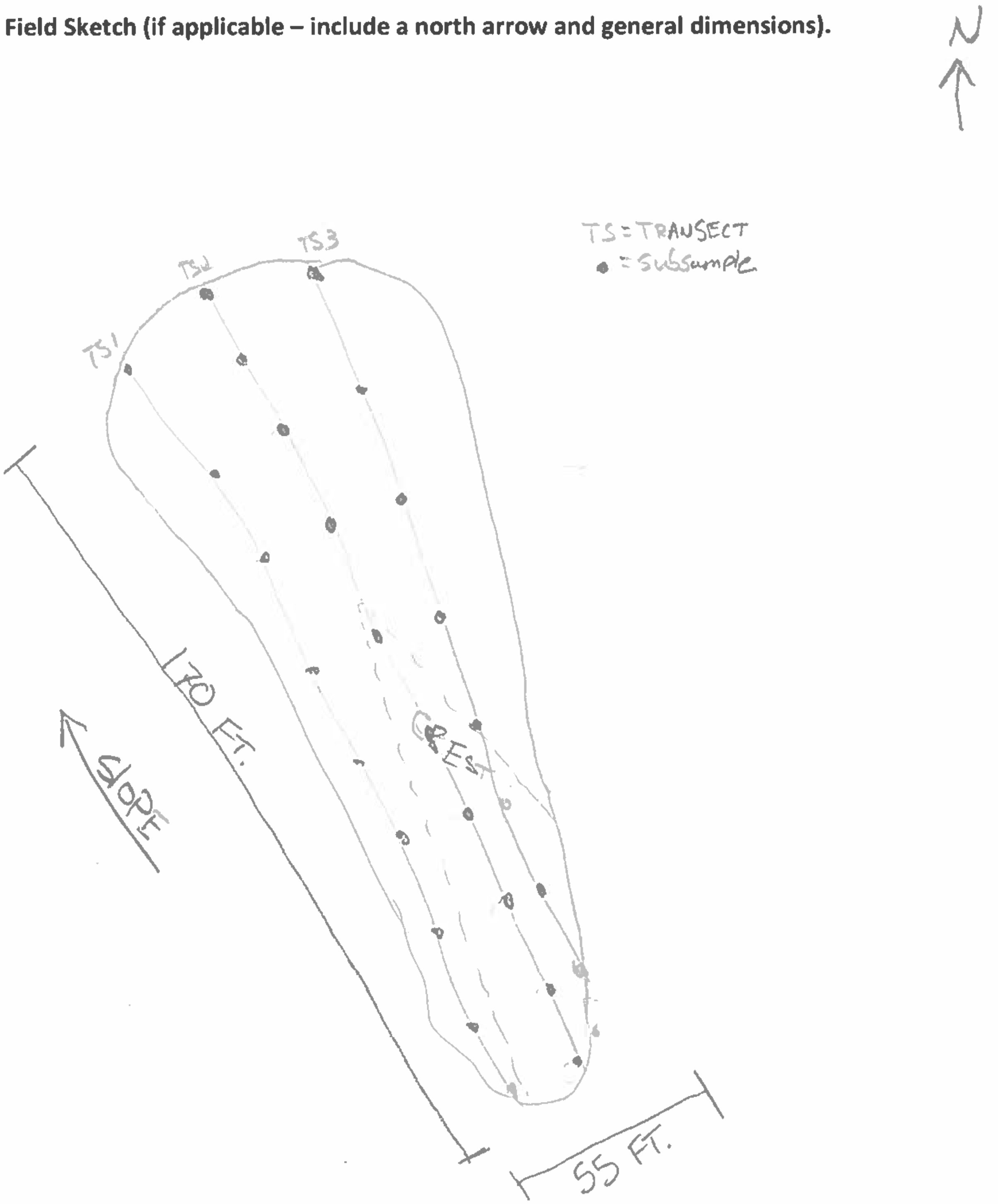
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV4-SWJ - COMPOSITE
Date 10-10-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




LV4 "BALLARD"
N
SU3
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 23-LV4-SU1-COMPOSITE-DUP-FINE
23-LV4-SU1-COMPOSITE-DUP-COARSE

Site and Sample Unit CJK PROPERTY - BALLARD

Date and Time:
10-10-2023, 13:15 PM

Collected by: A. GOEBEL

Photo(s) taken ✓

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 23-LU4-SU1-COMPOSITE-DUP
Date 10-10-2023

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV4-SU1-COMPOSITE-DUP
Date CJK PROPERTY-BALLARD
10-10-2023

Field Sketch (if applicable – include a north arrow and general dimensions).


LV4 "BALLARD"
N
SU3
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample (30 cell grid, 5 cm depth)

Sample ID 23-LV4-SU2-COMPOSITE-FINE; 23-LV4-SU2-COMPOSITE-COARSE

Site and Sample Unit CJK PROPERTY- BALLARD

Date and Time:
10-10-2023, 12:00 PM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) is an elongate ridge ending in a semicircular fan. Approx 25' at the crest. See map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

surface varies from reddish brown to tan. Subsurface varies from reddish brown to dark brown/black. Material mixed, ranging from very fine to ~2" coarse fraction. surface dry, moist within 1" of surface. Variably cemented

Sieving notes:

Bagged in cloth bags for later sieving.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and bucket, cleaned and rinsed w/DI water prior to collection. Sampler wore disposable nitrile gloves. No vegetation on pile. No nearby surface waters. Pile appears generally stable.

Material is heavily weathered and decomposing. Appears to be primarily volcanic in origin w/some siliciclastics. Exact protolith difficult to determine due to state of weathering. Very little mineralization observed.

Sample ID 23-LV4-SU2-COMPOSITE
Date 10-10-2023

Weather notes: current conditions? Recent precipitation?
Partly cloudy and cool. ~45°F w/moderate wind. Most recent precip ~1 week prior.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 39.25049, -106.24338, ELEV ~ 11,375'.
Four transects. Three roughly parallel along contour of the piles fan, and one along the crest. Each transect w/8 equally spaced sub samples for a total of 32 subsamples to ~5 cm depth.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV Collected w/ iPhone GPS.

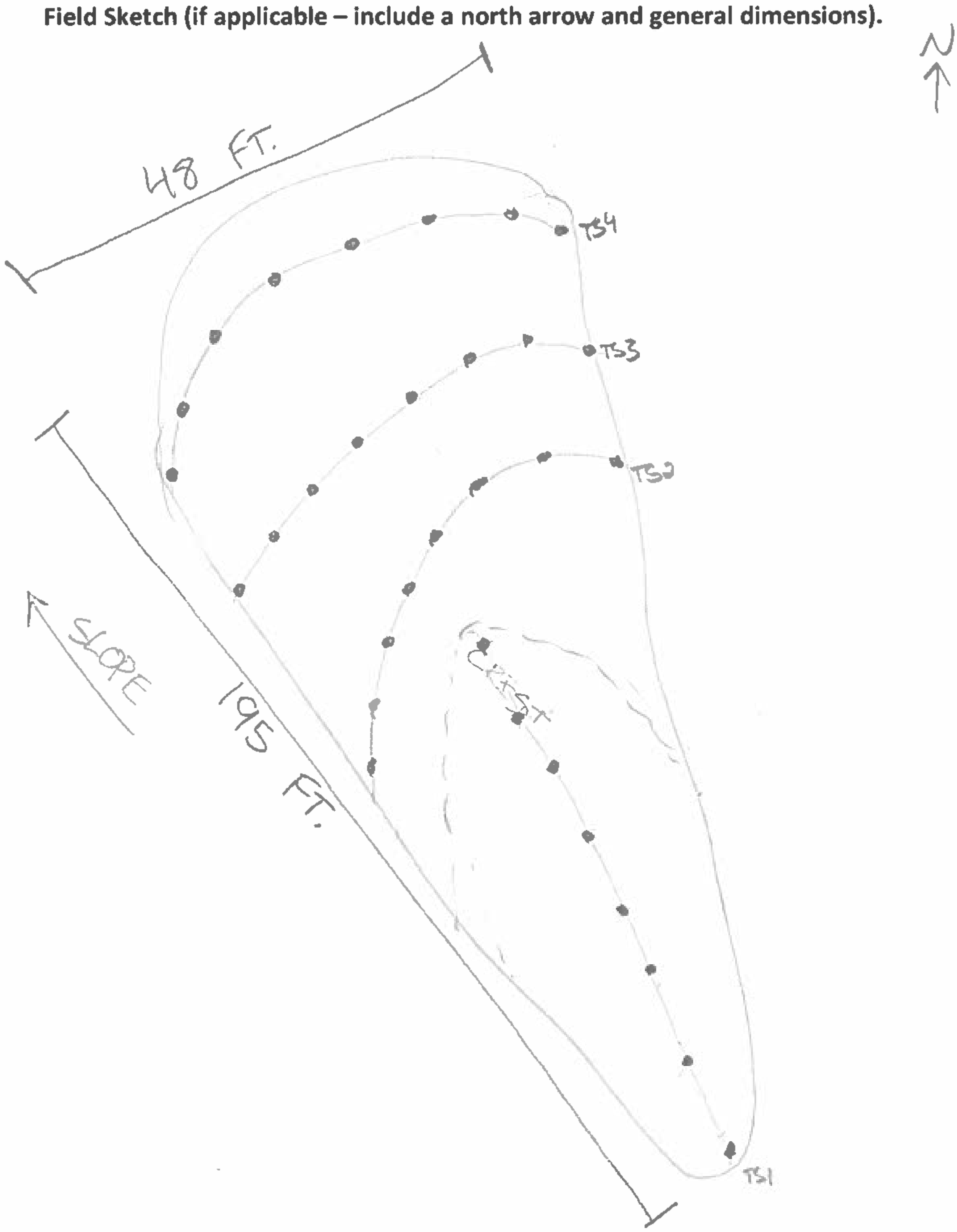
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV4-SW2-COMPOSITE
Date 10-10-2023

Field Sketch (if applicable – include a north arrow and general dimensions).




LV4 "BALLARD"
N
SU3
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 23-LW4-SU3-COMPOSITE-FINE; 23-LW4-SU3-COMPOSITE-COA[rse]

Site and Sample Unit CJK PROPERTY - BALLARD

Date and Time:
10-10-2023, 12:45 PM

Collected by: A. GIEBEL

Photo(s) taken ✓

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (waste rock) is a triangular shaped fan w/large flat area on top and several lobate ridges width. Approx. 25' high at the crest. See map for aireal dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Material is relatively uniform reddish brown at the surface, and a darker reddish brown subsurface. Mixed size ranging from very fine to ~2". Dry at surface, variably moist at ~1" depth.

Sieving notes:

Bagged in cloth bag for later sieving

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and bucket, cleaned and rinsed w/DI water prior to collection. Sampler wore disposable nitrile gloves. Conifers up to 10' scattered over flat surface of pile. No nearby surface waters. Pile appears stable.
Material is heavily weathered and decomposed. Likely altered volcanics and siliciclastics. Minor fine grained pyrite scattered in different areas of the pile.

Sample ID 23-LV4-SU3-COMPOSITE
Date 10-10-2023

Weather notes: current conditions? Recent precipitation?
Partly cloudy and cool, ~45°F. Light to moderate breeze. Most recent precip ~1 week prior.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 39.25051, -106.24288, ELEV ~ 11,375'.
Five transects, three along contour on pile flanks, and two parallel across the flat top. Each transect contains 6 subsamples at a depth of ~5cm for a total of 30 subsamples.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV collected w/ iPhone GPS

SAMPLES (from original USGS text and summarized here).

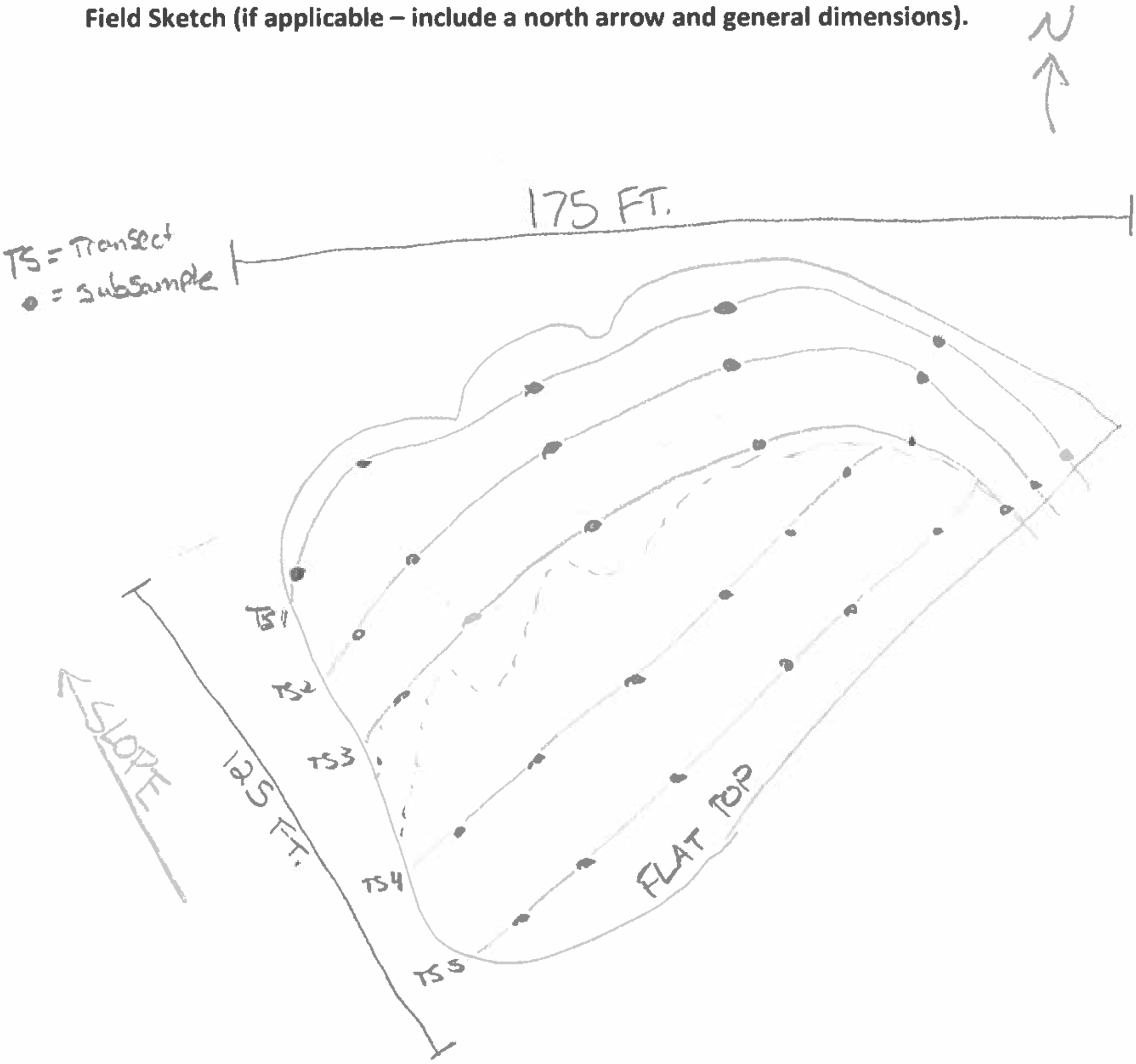
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 23-LV4-SU3-COMPOSITE

Date 10-10-2023

Field Sketch (if applicable – include a north arrow and general dimensions).



LV4 "BALLARD"
N
SU3
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-GG1-SU1-COMPOSITE-FINE; 24-GG1-SU1-COMPOSITE-COARSE

Site and Sample Unit GAMBLE GULCH - TIPTOP

Date and Time:
6-17-24; 10 AM

Collected by: A. GIEBEL, G. KING, C. VILLARRUEL, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (waste rock) located along FS road. Steep slope. Pile itself is ~8-12', pinching down in center. See attached map for Dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface and subsurface reddish brown. Material is mostly fine to very fine w/coarse content ranging 1"-6". Material is dry.

Sieving notes:
Dry material. Sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel and buckets, cleaned and rinsed w/DI water prior to collection. Samplers wore nitrile gloves.

Conifers, ~8-10' scattered along pile flanks and toe. Minor erosional drainage features along pile flanks do not affect pile stability. No nearby surface waters.

Coarse Material is primarily schist and granite w/varying degrees of surface oxidation. Minor oxidized pyrite present.

Sample ID 24-GG1-SU1-Composite
Date 6-17-24

Weather notes: current conditions? Recent precipitation?
Clear, Full sun, ~70°, No recent precip.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 39.87127, -105.53299, 10,080'.
Three parallel transects cover the narrow pen-shaped pile. One along the crest and on approx 1/2 way up each flank. Each transect contains 10-subsample points collected at ~5cm depth for a total of 30 subsamples.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
Lat/LONG/ELEV collected using iPhone GPS.

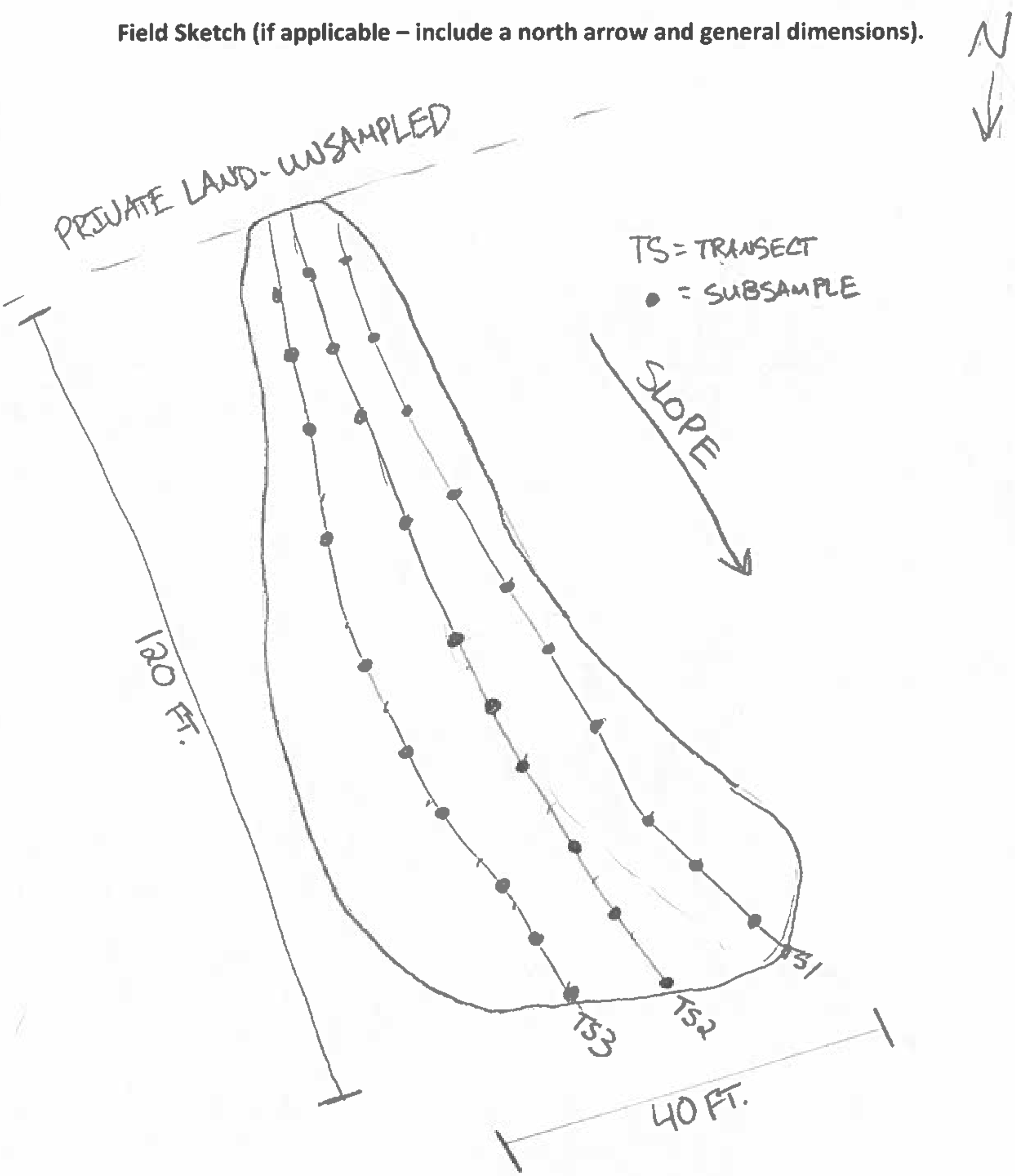
SAMPLES (from original USGS text and summarized here).

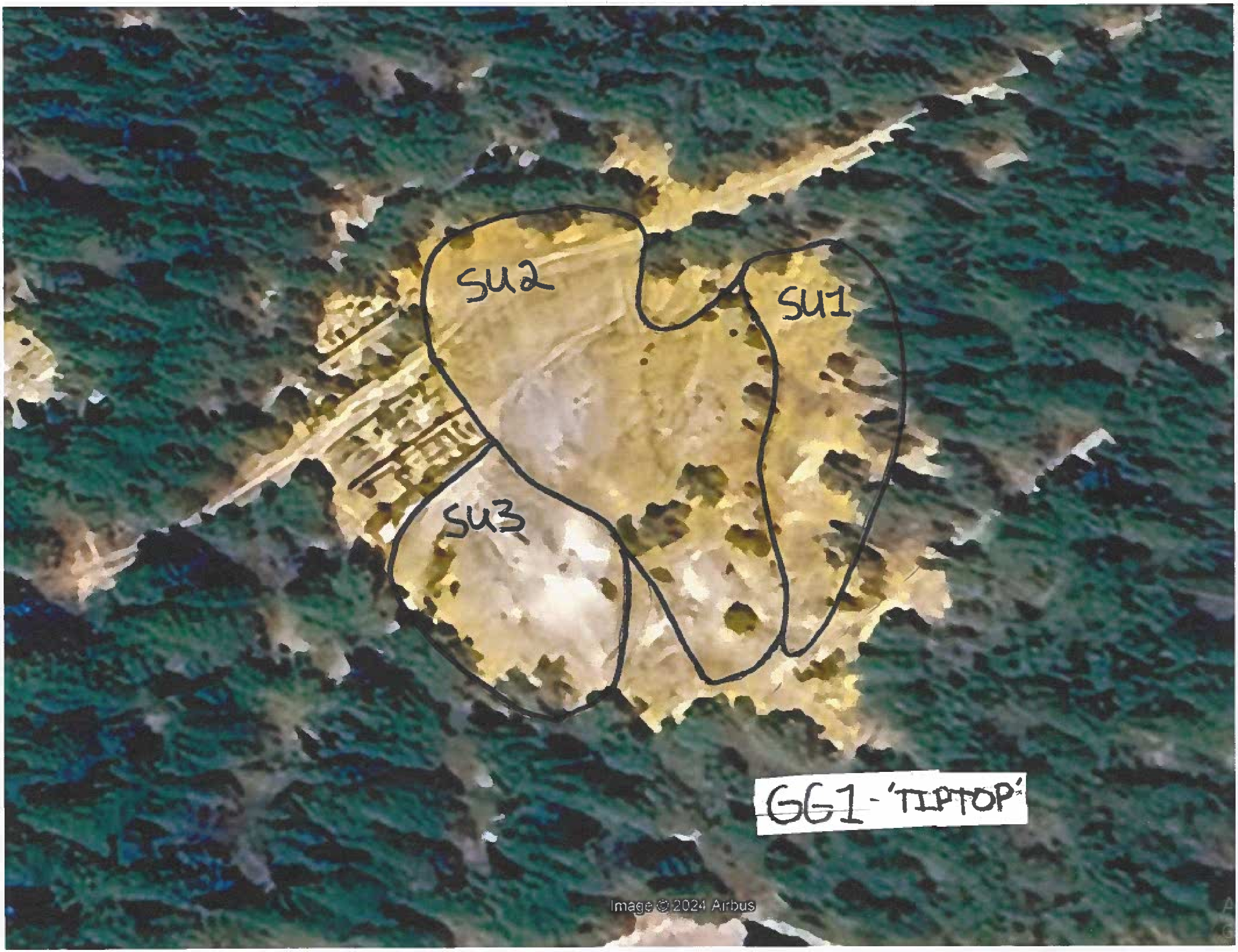
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-GG1-SW1-COMPOSITE
Date 6-17-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU2
SU1
SU3
GG1 - 'TIPTOP'
Image © 2024 Airbus

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-GG1-SU2-COMPOSITE-FINE; GG1-SU2-COMPOSITE-COARSE

Site and Sample Unit Gamble Gulch - Tip Top

Date and Time:
6-17-24, 11:30 AM

Collected by: A. GIEBEL, G. KING, C. VILLARRUEL, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) located along FS road. Moderately steep slope. Pile ~20ft tall relative to slope at crest. Collapsed shaft on private ~~ground~~ ground at bed of pile.
See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Reddish brown to grey. More evenly mixed material size ranging from sand to cobble, ~6"

Sieving notes:

Dry material. Sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/ plastic trowel and buckets, each rinsed w/ DI water prior to collection
Conifers, ~8-10' along pile crest. No nearby surface waters
Minor erosional/drainage channels along pile flanks, do not affect pile stability

Primarily Granite, Schist and lesser quartzite. Few sulfides present, mainly in the form of oxidized pyrites. Moderate surface oxidation and argillic alteration.

Sample ID 24-GG1-SU2-composite
Date 6-17-24

Weather notes: current conditions? Recent precipitation?
Clear - sunny - ~70°. No recent precipitation

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 39.87126, -105.53313, 10,080'.
Roughly fan shaped pile. 5 parallel transects along fan containing 6 subsample points
2 parallel transects of 3 subsample points for a total of 36 subsample collected at a depth of ~5cm. See attached sketch.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/Elev collected at center of pile w/ iphone GPS

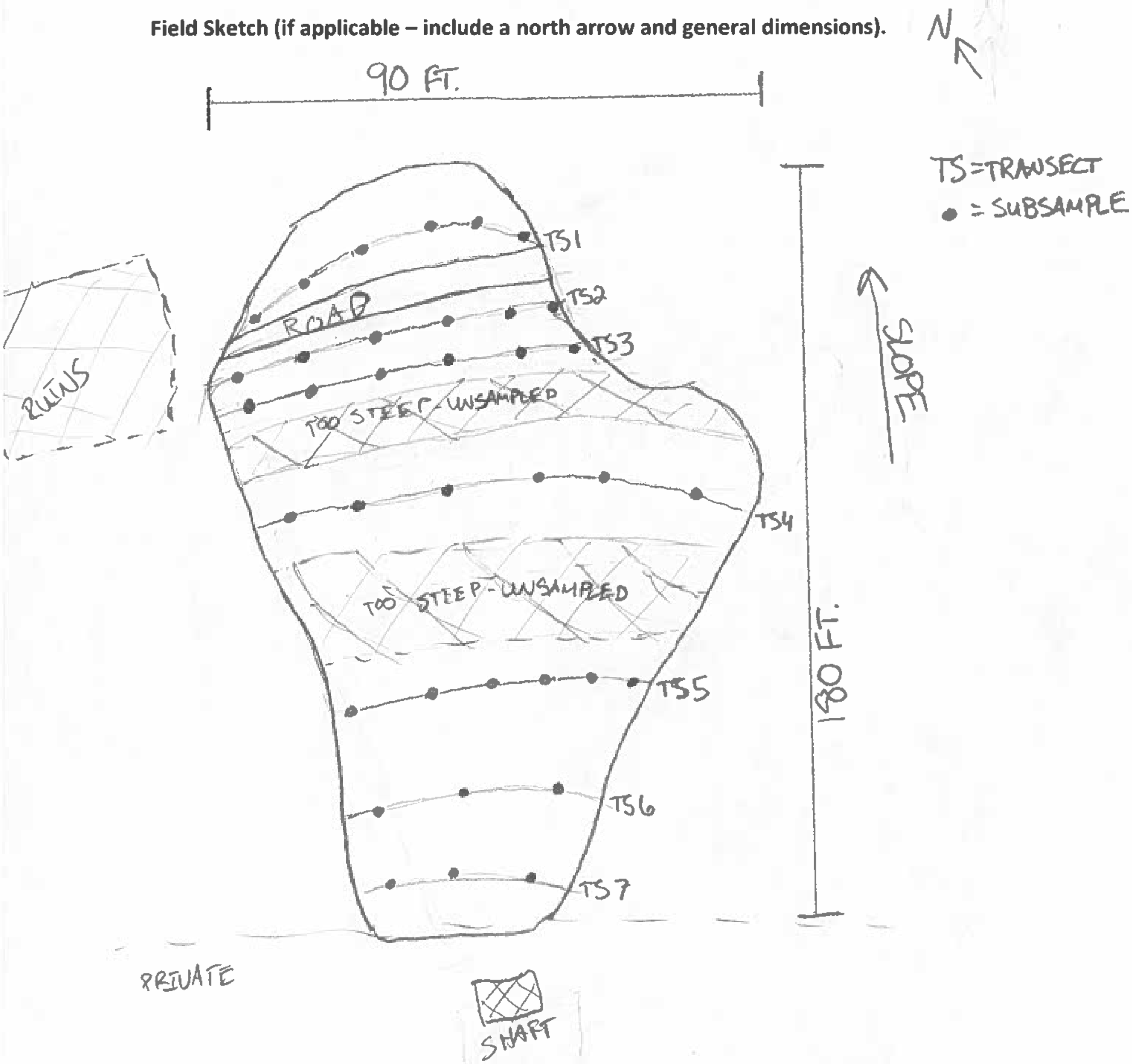
SAMPLES (from original USGS text and summarized here).

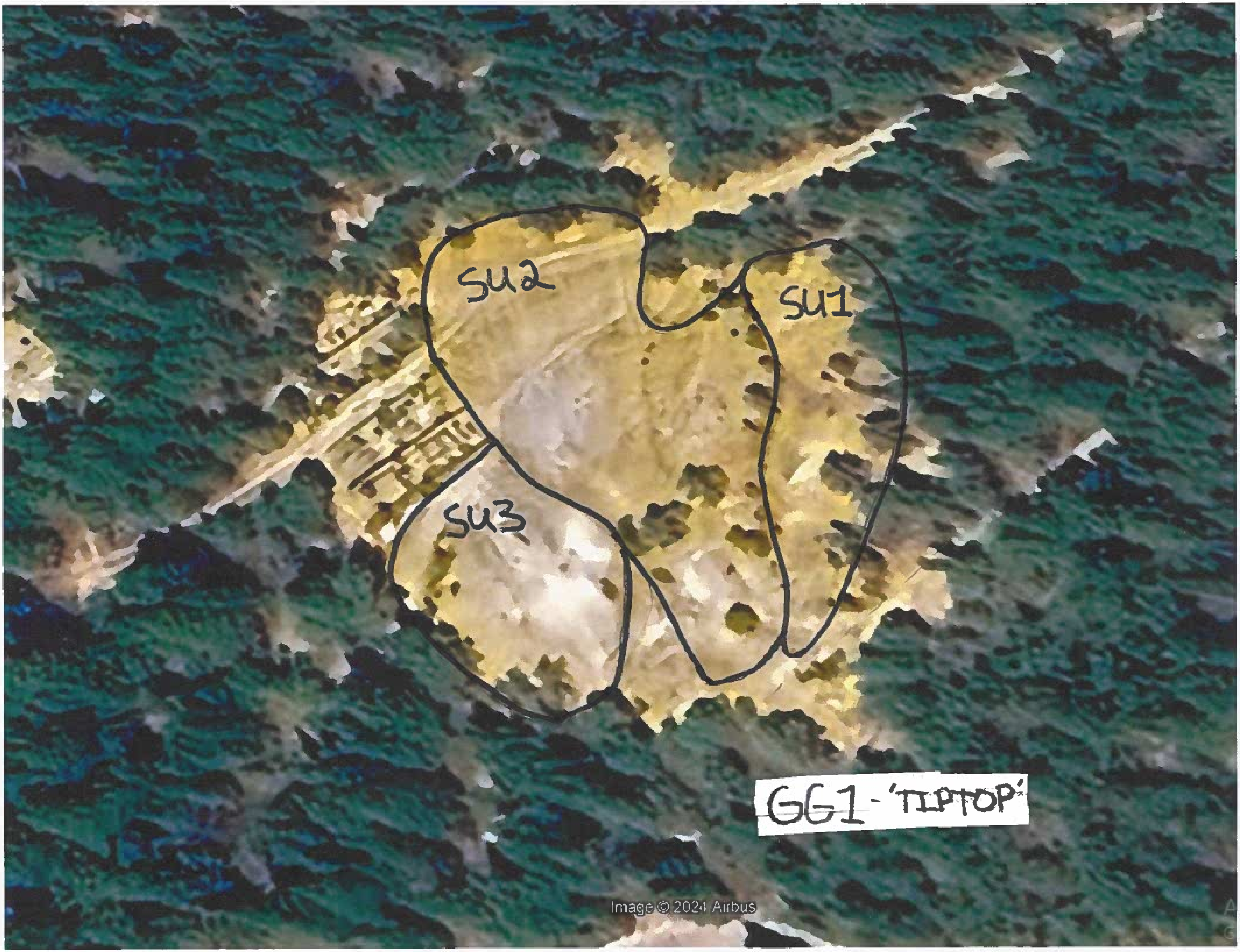
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-GG1-SU2-Composite
Date 6-17-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU2
SU1
SU3
GG1 - 'TIPTOP'
Image © 2021 Airbus

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-GG1-SU3-COMPOSITE-FINE; 24-GG1-SU3-COMPOSITE-COARSE

Site and Sample Unit GAMBLE GULCH - TIP-TOP

Date and Time:
6-17-24 - 12 PM

Collected by: A. GIEBEL, G. KING, C. VILLARRUEL, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) located along FS road. Moderately steep slope w/ mill ruins at base of pile. Collapsed shaft of private ground at head of pile ~15' ~~[illegible]~~ at thickest crest.
See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Reddish brown to tan surface, becoming more tan with subsurface. Mainly fine to very fine material, sand to ~~[illegible]~~ very fine sand. Lesser coarse component up to ~1". Material was likely crushed. ~~[illegible]~~ Foundation ruins at base of pile, likely some form of mill.

Sieving notes:

Dry material, sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected with plastic trowels, in plastic buckets, all rinsed w/ DI water and dried prior to collection.

Conifers ~8-10' along pile crest and flanks. Minor erosional/drainage features along flanks, do not affect pile stability.
No nearby surface waters.
Material appears to have been predominantly granitic or other felsic intrusives.
Minor argillic alteration scattered pyrites present.

Sample ID ~~GG~~ 24-GG1-SU3-Composite
Date 6-17-24

Weather notes: current conditions? Recent precipitation?

Clear- Sunny- ~70°

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile centered at 39.87104, -105.53332, 10,080'. Three parallel transects along pile flanks of 12, 10, and 8 subsamples as pile narrows to crest. 4 subsamples along crest for a total of 34 subsamples collected at a depth of 5cm. See attached sketch

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV collected at Pile center using an iPhone GPS.

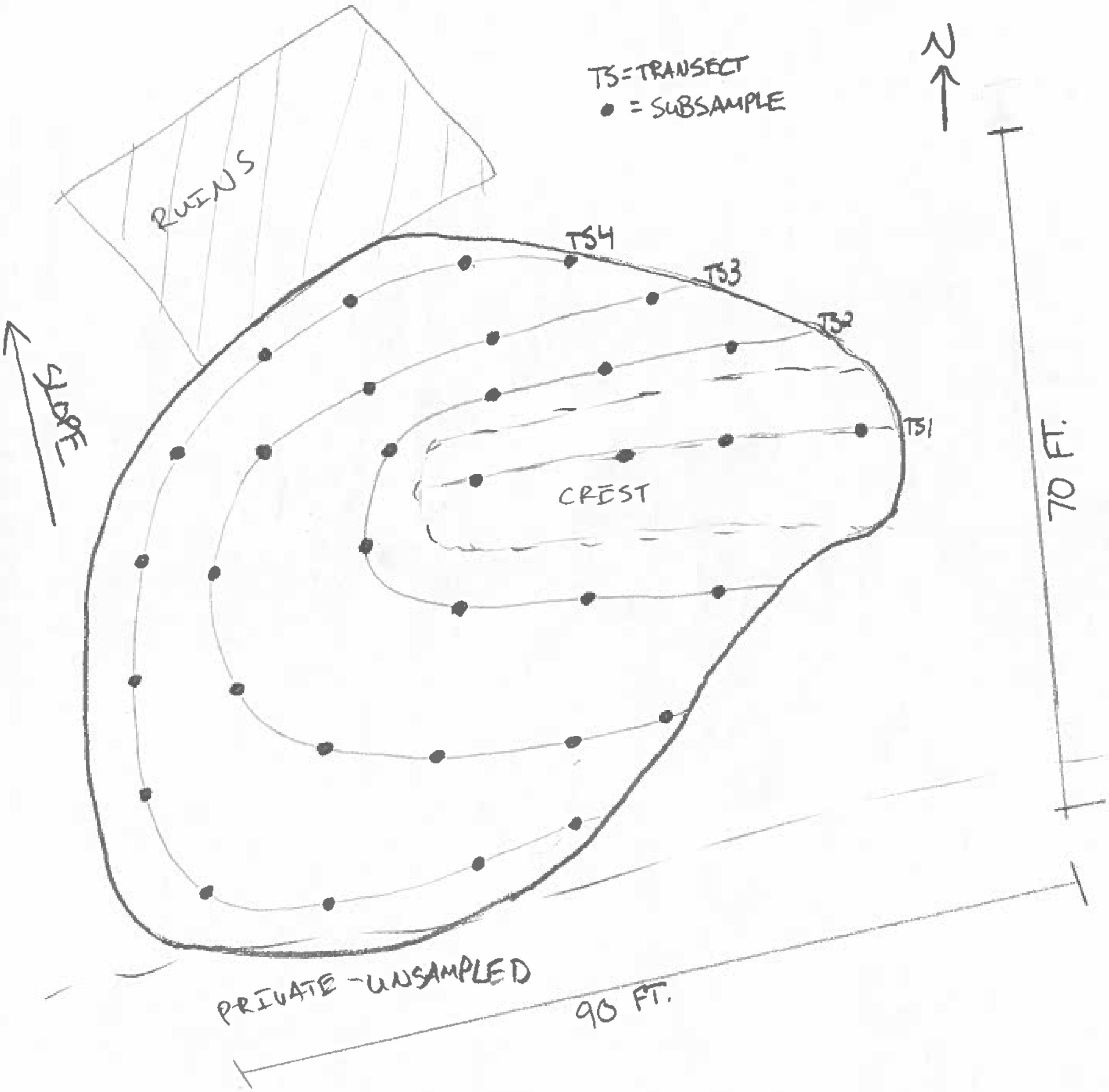
SAMPLES (from original USGS text and summarized here).

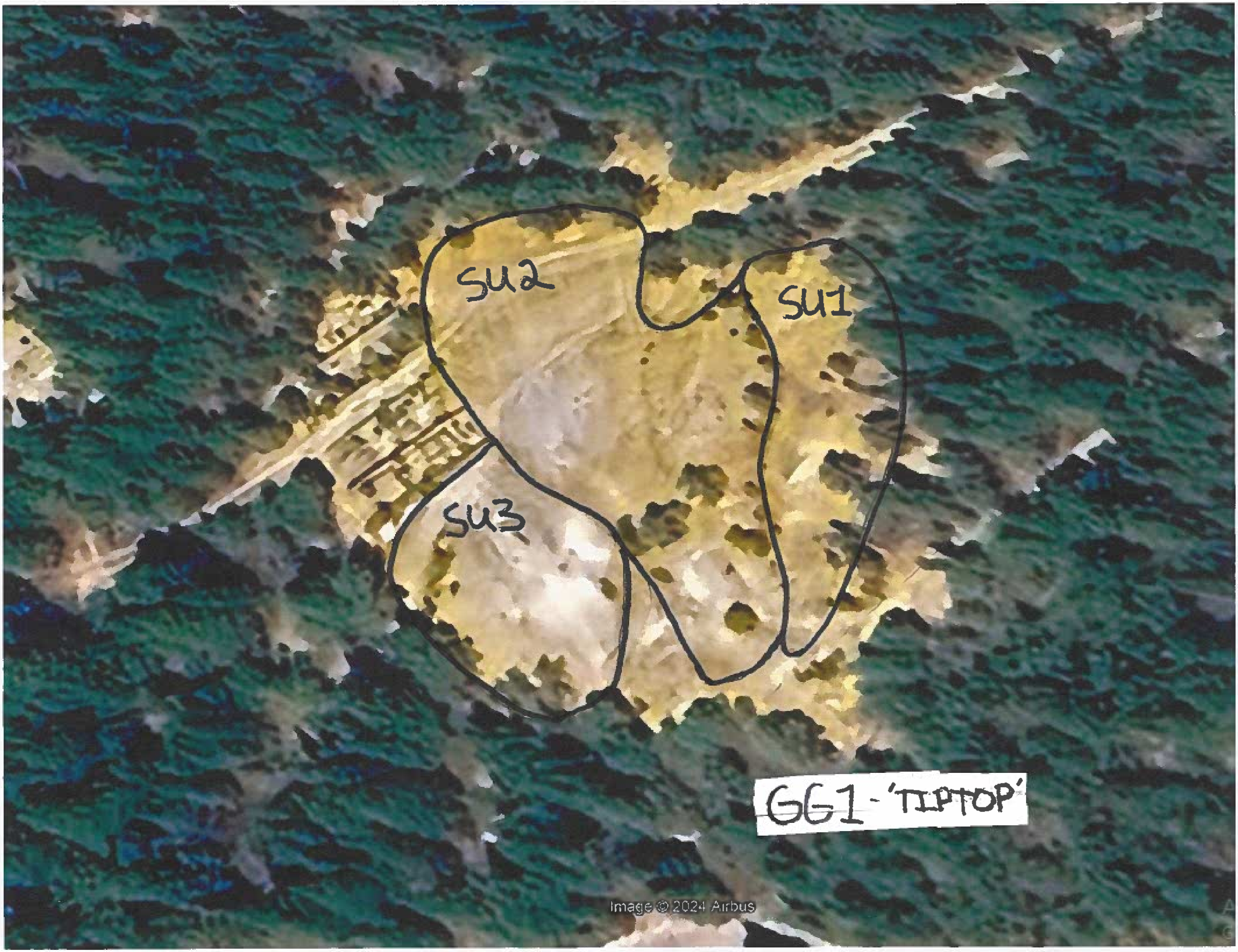
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-GG1-SU3-COMPOSITE
Date 6-17-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU2
SU1
SU3
GG1 - 'TIPTOP'
Image © 2024 Airbus

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-GG1-SU3-COMPOSITE-DUP-FINE; 24-GG1-SU3-COMPOSITE-DUP-COARSE

Site and Sample Unit GAMBLE GULCH - TIP TOP

Date and Time:
6-17-24 - 12:30 PM

Collected by: A. GIEBEL, G. KING, C. VILLARRUEL, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 24-GG1-SU3-COMPOSITE-DUP
Date 6-17-24

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

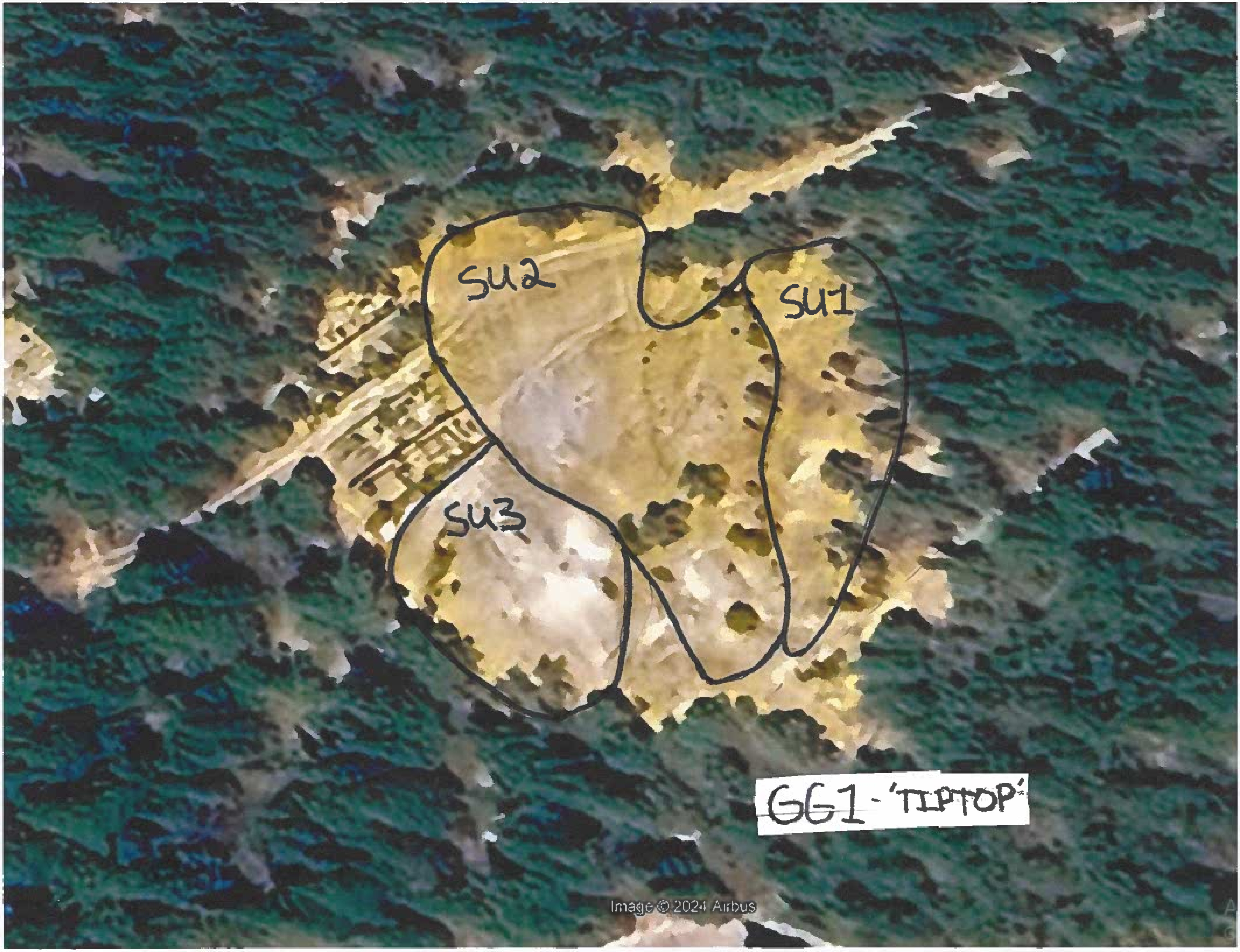
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-GG1-SU3-COMPOSITE-DUP
Date 6-17-24

Field Sketch (if applicable – include a north arrow and general dimensions).


SU2
SU1
SU3
GG1 - 'TIPTOP'
Image © 2024 Airbus

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-ALI-SUI-COMPOSITE-FINE; 24-ALI-SUI-COMPOSITE-COARSE; 24-ALI-SUI-GRAB

Site and Sample Unit SACREMENTO

Date and Time:
6-18-24 . 10:45 AM

Collected by: A. GIEBEL, G. KING, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

pile (waste rock) located along county road, moderate traffic w/some potential for dust contamination. Moderate native slope with foundation ruins at base. Pile approx ~~10-15~~ thick at crest, thinning with slope. Pile slope steeper than native slope.
SEE Attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Surface varies from reddish brown to grey (varying light and dark). Subsurface is predominantly reddish brown. Abundant sulfides leaving both reddish oxides and grey sulfide residue at surface. Dry material. Mix of coarse and fine, ranging from sand size up to 2" coarse fraction w/occasional cobble to ~6".

Sieving notes:

Dry. Sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected with plastic trowels. into plastic buckets, all rinsed w/DI water prior to collection. Samplers wore nitrile gloves. No vegitation growing in waste material itself. Low sage, aspen and conifer in native soil surrounding the pile. Erosional channels down face of pile do not affect pile stability.
No nearby surface waters.
Material is a mix felsic intrusives and quartzite w/ some ~~wea~~ relatively unaltered diorite porphyry.
Abundant sulfides- predominantly pyrite w/some sphalerite(?) and arsenopyrite(?).

Sample ID 24-AL1-SU1-COMPOSITE

Date 6-18-24

Weather notes: current conditions? Recent precipitation?

Clear, partly cloudy - ~65°, NO recent precipitation

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile centered at 39.22663, -106.05782, 10,390'. 10 parallel transects of 3 sub samples each collected up the face of pile for a total of 30 subsamples collected at a depth of ~5cm. SEE ATTACHED SKETCH.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV collected using iPhone GPS.

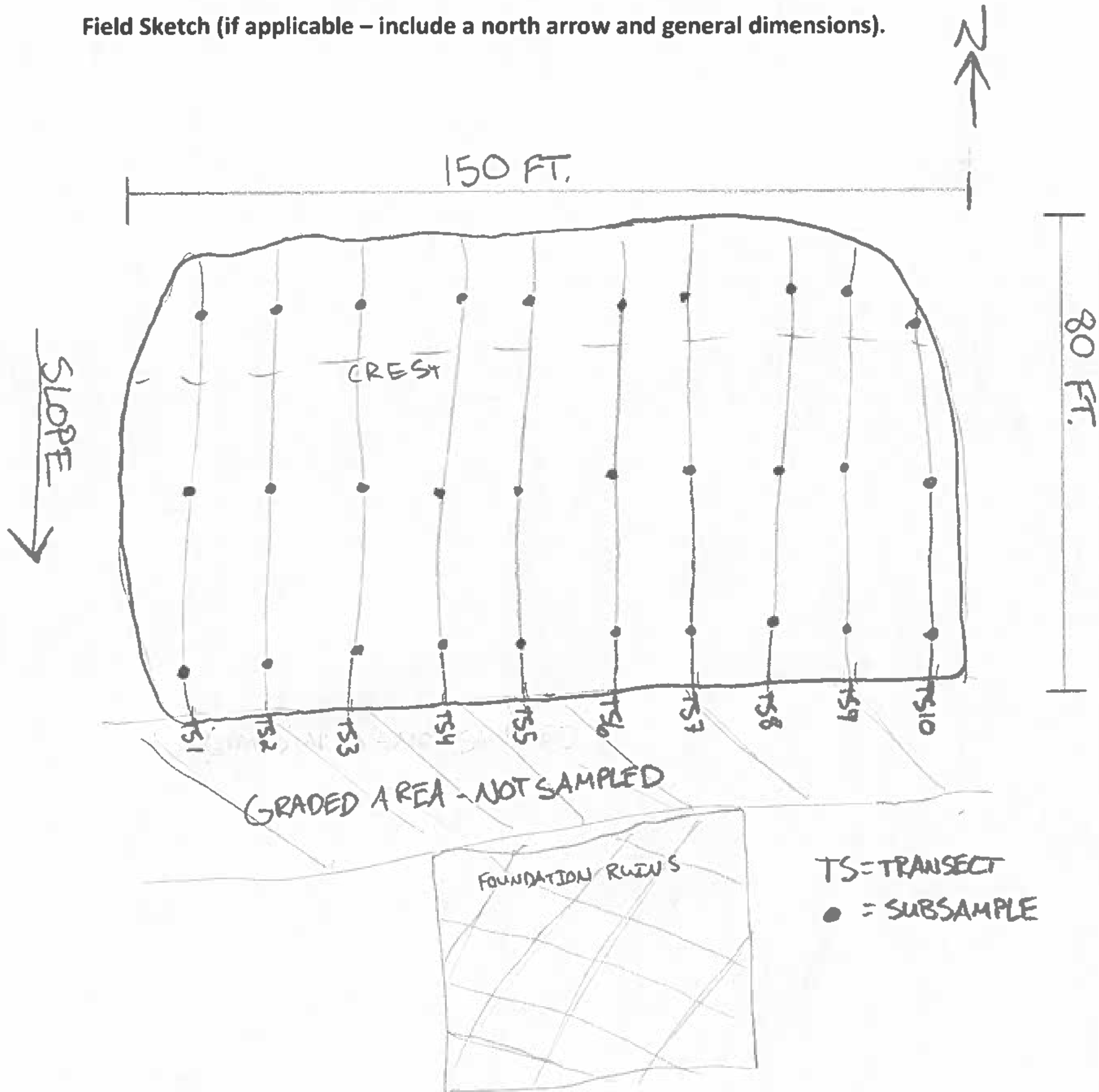
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-AL1-SU1-COMPOSITE
Date 6-18-24

Field Sketch (if applicable – include a north arrow and general dimensions).




AL1 - 'SACREMENTO'
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-AL1-SU1-COMPOSITE-DUP-FINE; 24-AL1-SU1-COMPOSITE-DUP-COARSE

Site and Sample Unit SACREMENTO

Date and Time:
6-18-24 - 11:15 AM

Collected by: A. GIEBEL, G. KING, Z. YANG

Photo(s) taken _____

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 24-AL1-SU1-COMPOSITE-DUP
Date 6-18-24

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-ALI-SU1-COMPOSITE-DUP

Date 6-18-24

Field Sketch (if applicable – include a north arrow and general dimensions).


AL1 - 'SACREMENTO'
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-ALI-SU2-COMPOSITE-FINE; 24-ALI-SU2-COMPOSITE-COARSE;

Site and Sample Unit SACREMENTO

Date and Time:
6-K6 24 - 11:45 AM

Collected by: A. GIEBEL, G. KING, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

pile (wasterock) located along county road. Moderate traffic leading to some possibility for dust contamination. Moderate native slope. Pile smaller than su1. Rectangular mound shaped, ~4-6 ft thick above native slope. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Surface is predominantly reddish brown w/some grey emminating from sulfide rind deposition. Some fresh grey material as well. Subsurface is reddish brown. Material is predominantly fine, sand size w/ coarse fraction up to ~1". Occasional cobble.

Sieving notes:

Dry. sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?

Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample was collected with plastic trowel in plastic bucket, all rinsed w/ DI water prior to collection. Samplers wore nitrile gloves. Some low sage brush growing on pile flanks. Minor erosional/drainage features, do not affect pile stability. No nearby surface waters.

Material is a mix of felsic intrusives and quartzite w/some fresh looking diorite porphyry. Abundant sulfides, predominantly pyrite w/some sphalerite(?) and arsenopyrite(?). Quartz gangue material w/and w/out sulfides present.

Sample ID 24-AL1-SU2-COMPOSITE
Date 6-18-24

Weather notes: current conditions? Recent precipitation?
Clear, partly cloudy - ~65°. No recent precipitation.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centred at 39.22668, -106.05834, 10,390'. Three parallel transects over the top and each flank of the pile consisting of 10 subsample locations each for a total of 30 subsamples collected from a depth of ~5cm. See attached sketch.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected w/ iPhone GPS

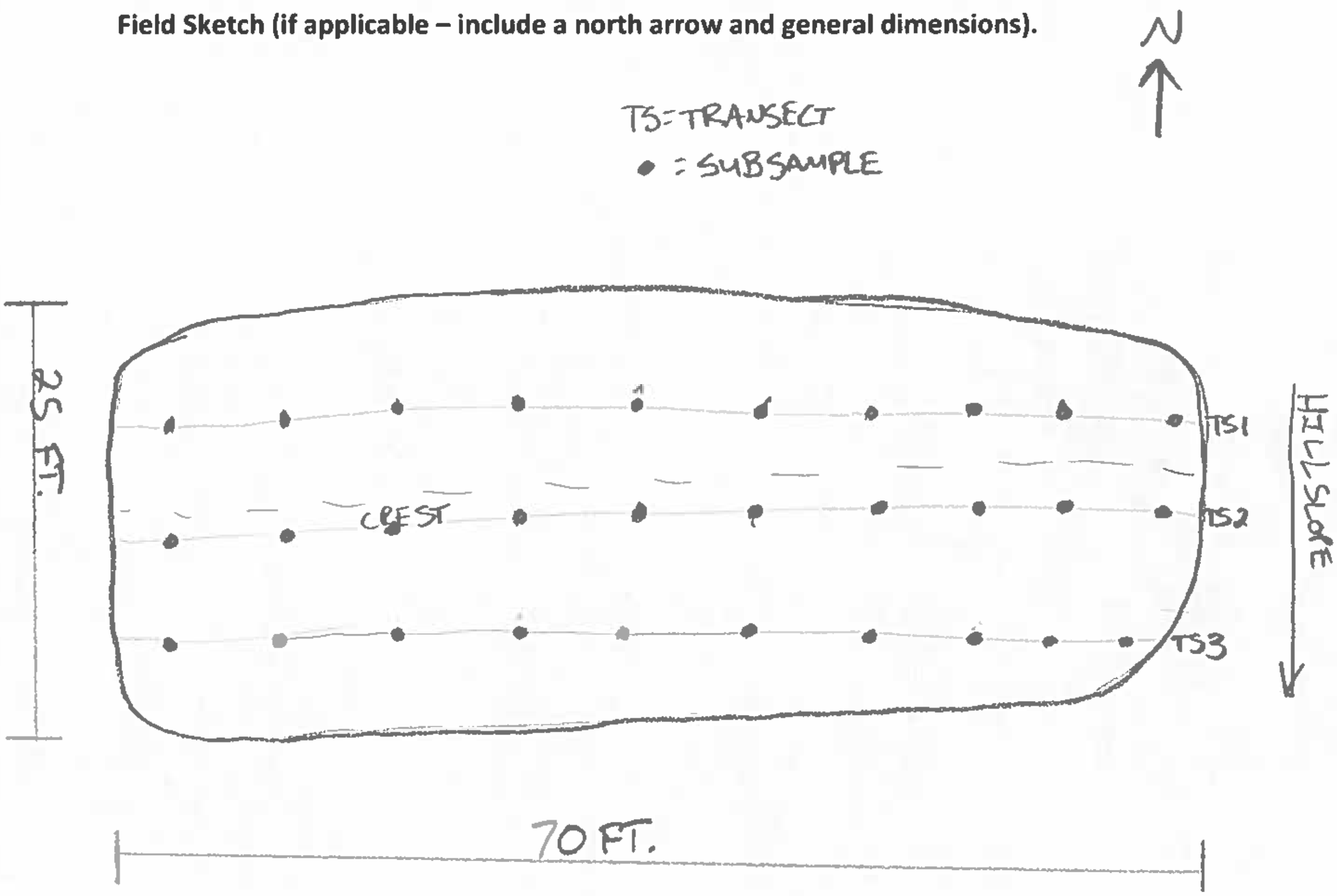
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-AL1-S42-COMPOSITE
Date 6-18-24.

Field Sketch (if applicable – include a north arrow and general dimensions).




AL1 - 'SACREMENTO'
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-AL2-SU1-COMPOSITE-FINE; 24-AL2-SU1-COMPOSITE-COARSE; 24-AL2-SU1-GRAB

Site and Sample Unit ORPHAN BOY

Date and Time:
6-18-24- 1:30 PM

Collected by: A. GIEBEL, G. KING, Z. YANG

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) located on private land up private roads accessed from county road. Pile steeper than surrounding hill slope, ~30' thick at crest. See attached map for dimensions. Draining collapsed adit flows onto top of pile. Decends through pile, exits at toe.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Pile surface is a mix of reddish brown to grey. Subsurface generally following color change at surface. A mix of fine/sand size material to coarser angular gravel size up to 1". Larger cobbles and boulders over 1' scattered over surface.

Sieving notes:
Dry. Sieved on site

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample colected w/plastic trowel in plastic buckets. All rinsed w/ DI water prior to collection. Sieved through clean stainless-steel. Samplers wore nitrile gloves.
Scattered conifers ~4-6' over top of pile. Erosional/drainage features in flanks do not affect pile stability. Draining adit ~~from~~ (collapsed) from hillside immediately above pile. This drainage flows onto pile top, then flows down into pile itself exiting at the toe.
Material is a mix of schist, felsic volcanics, and weathered argillically altered siliciclastics. Abundant sulfides present.

Sample ID 24- AL2-SU1-COMPOSITE

Date 6-18-24

Weather notes: current conditions? Recent precipitation?

Clear, Mostly Sunny ~65° - Moderately windy. No recent precipitation.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 39.27818, -106.10169, 10,745'. Pile is roughly rectangular in shape, however large sections are too steep to safely access. 5 parallel transects, excluding unsafe areas, with a total of 36 subsamples collected from a depth of ~5cm. See attached sketch.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV collected w/ iPhone GPS

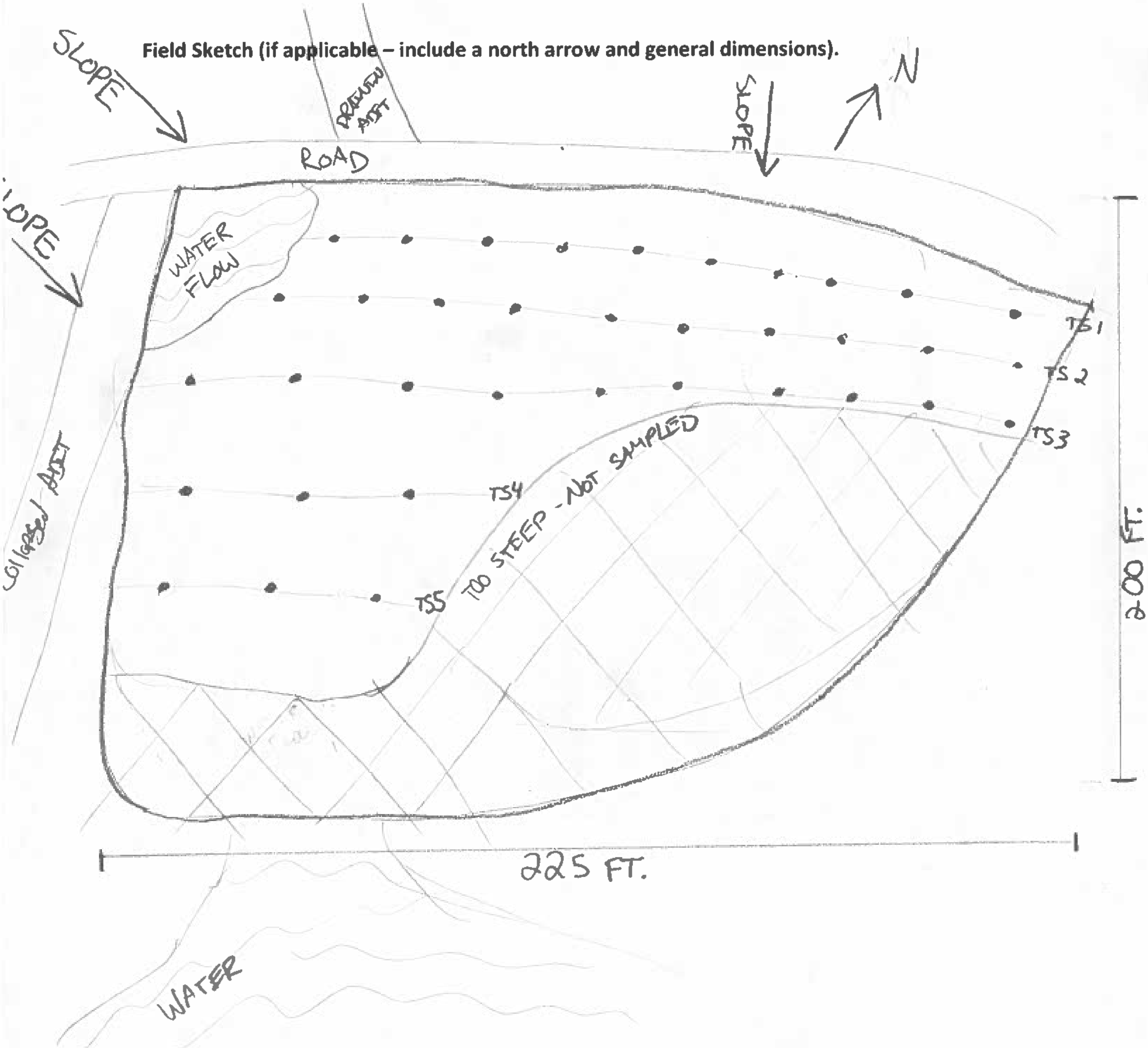
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-AL2-SU1-COMPOSITE
Date 6-18-24

Field Sketch (if applicable – include a north arrow and general dimensions).




AL2 - 'ORPHAN BOY'
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-PA1-SU1-COMPOSITE-FINE; 24-PA1-SU1-COMPOSITE-COARSE

Site and Sample Unit WALDORF - UNKNOWN 1

Date and Time:
6-27-24; 10:00 AM

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) is located in alpine tundra (above tree line) below forest service road. Lower slope, pile is ~6-10' at thickest point. Pile is roughly rectangular. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Material is light tan to light reddish brown. Subsurface generally matching. Dominantly fine fraction w/ coarse material up to ~1".

Sieving notes:

Material is moderately damp. Sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?

Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample was collected w/ plastic trowel in plastic bucket, sieved w/ stainless steel. All rinsed w/ DI water prior to collection. Sampler wore nitrile gloves.

Low forbs scattered over pile w/ some scrub/tree line conifers and alpine willow encroaching on flanks from surrounding vegetation. No nearby surface waters.

Material is primarily weathered and decomposing granite and other felsic intrusives. Some massive qtz. vein material present. Few sulfides present. Some oxidizing pyrite scattered throughout.

Sample ID 24-PA1-SU1-COMPOSITE

Date 6-27-24

Weather notes: current conditions? Recent precipitation?

Mostly Cloudy, winds gusting 25-30 mph. Recent Precip from afternoon T-storms.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 39.64963, -105.7629, 11,765'.
three parallel transects consisting of 10 subsamples each for a total of 30 subsamples collected at a depth of ~5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

Lat/LONG/Elev data collected using an iPhone GPS.

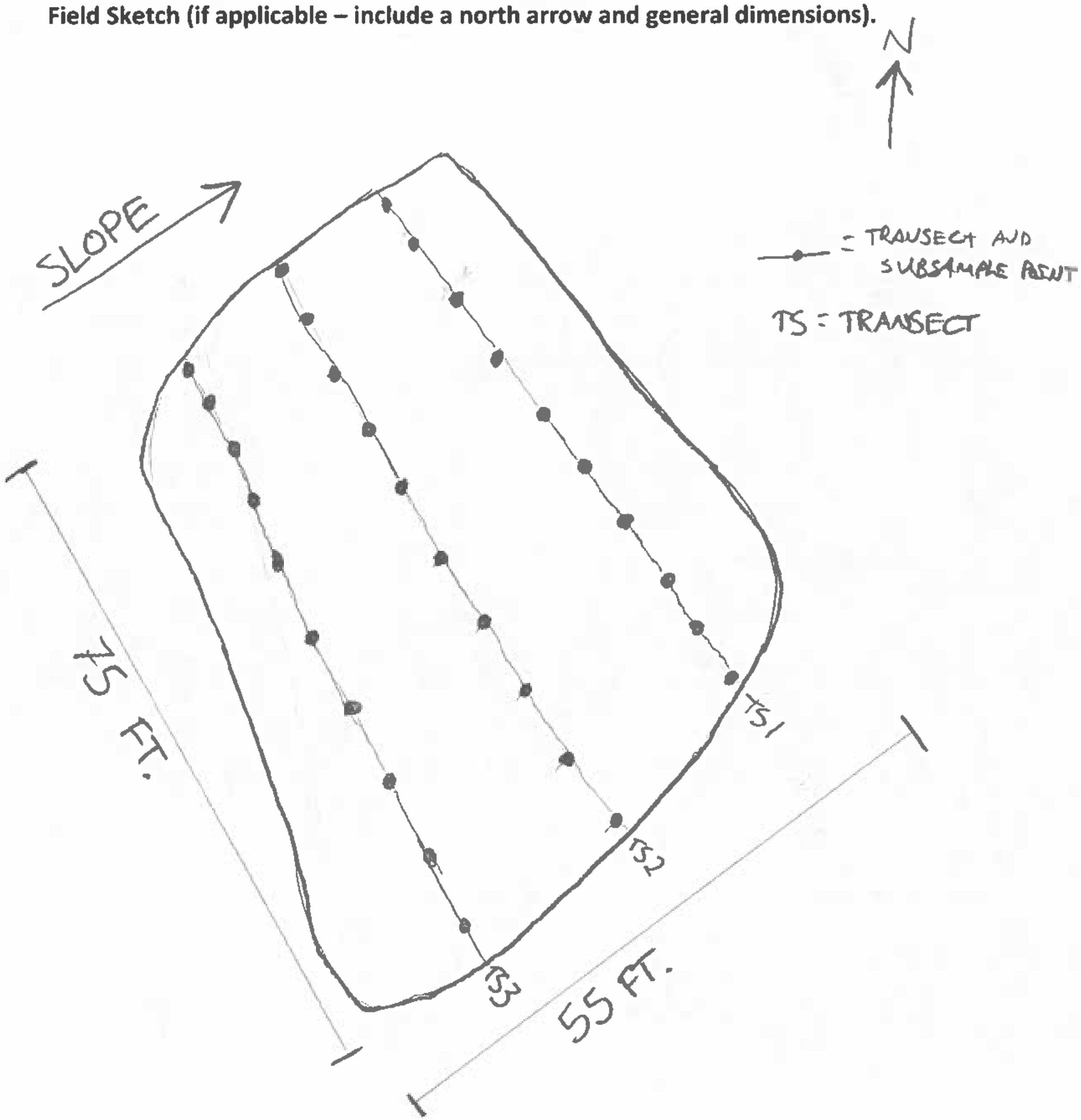
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-PA1-SU1-COMPOSITE
Date 6-27-24

Field Sketch (if applicable – include a north arrow and general dimensions).




PA1
Su1
Su2

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-PA1-SU1-COMPOSITE-~~[illegible]~~ DUP -~~[illegible]~~ FINE; 24-PA1-SU1-COMPOSITE-DUP-COARSE

Site and Sample Unit WALDORF AREA - UNKNOWN 1

Date and Time:
6-27-24 · 11:30

Collected by: A. GIEBEL; G. KING

Photo(s) taken _____

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 24-PA1-SU1-COMPOSITE-DUPLICATE
Date 6-27-24

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24- PA1-SU1-COMPOSITE-DUPLICATE
Date 6-27-24

Field Sketch (if applicable – include a north arrow and general dimensions).

PA1
Su2
Su1

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-PA1-SU2-COMPOSITE-FINE; 24-PA1-SU2-COMPOSITE-COARSE

Site and Sample Unit WALDORF AREA- UNKNOWN 1

Date and Time:
6-27-24- 11:45AM

Collected by: A. GIEBEL; G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (waste rock) is located in alpine tundra at or above treeline below FS road. Moderate slope, somewhat circular to subrectangular in shape. ~15' tall a thickest point in center. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is reddish brown to grey ~~w~~ w/subsurface gerally somewhat darker following surface color. Material is a mix of fine/sand size to pea gravel w/coarse fraction up to 1".

Sieving notes:
Material is moderatly moist, sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel in plastic bucket, sieved w/stainless steel. All rinsed w/DI water prior to collection. Sampler wore nitrile gloves. Little vegetation, few low forbs scattered around pile. No nearby surface waters. minor erosional/drainage features along pile flanks. Do not affect pile stability.
Material is predominantly granitic w/minor schist scattered throughout. Some massive qtz vein material. Few sulfides evident. w/some very fine grained pyrite scattered throughout.

Sample ID 24-PA1-SU2-COMPOSITE
Date 6-27-24

Weather notes: current conditions? Recent precipitation?

Mostly cloudy w/winds gusting 25-30mph. ~50°. Recent precip in the form of afternoon thunder showers.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 39.64981, -105.76248, 11,735'.

Five parallel transects from toe to crest, each containing 6 sub sample points for a total of 30 subsamples collected at ~ 5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV data collected using iPhone GPS.

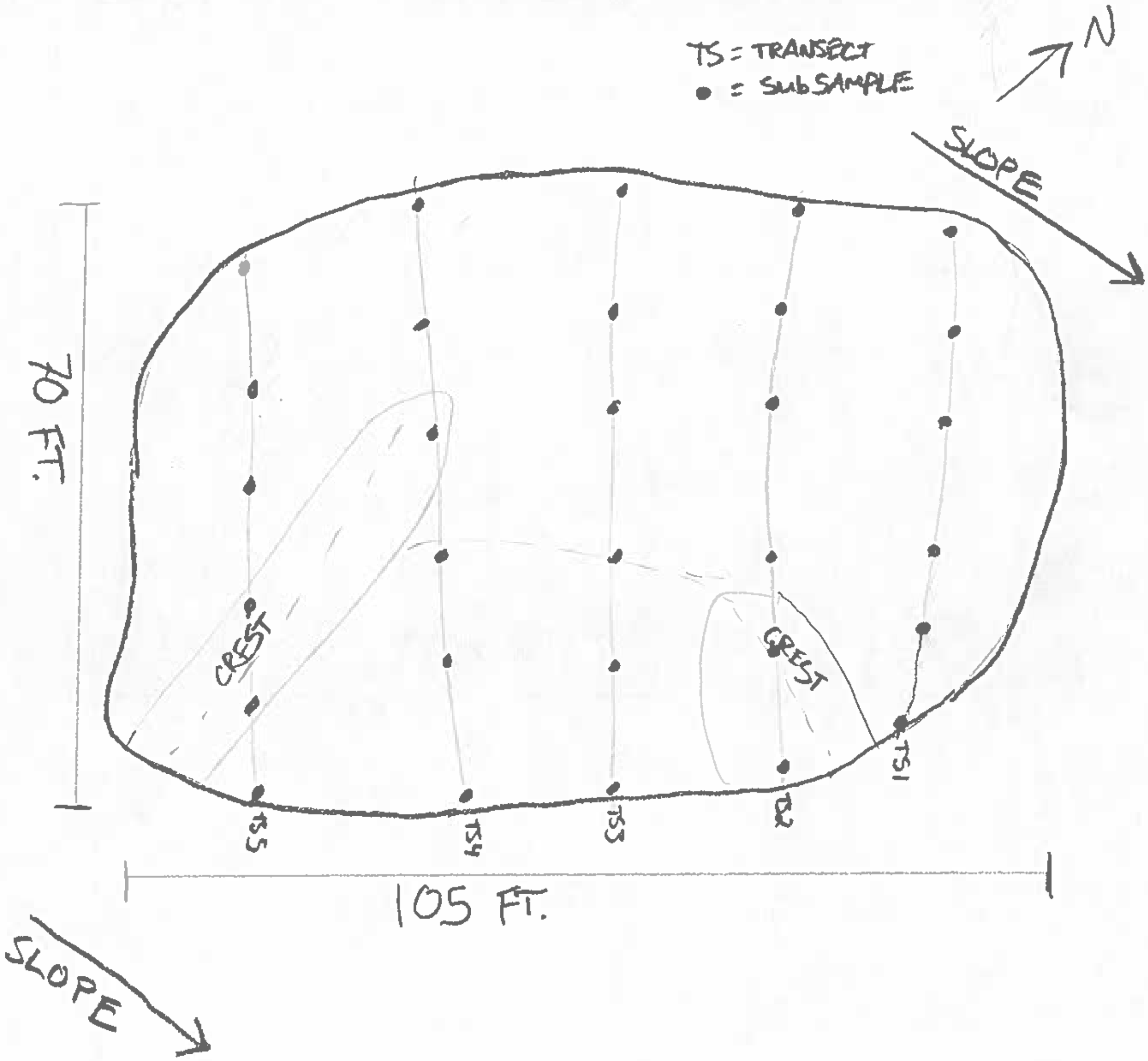
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-PA1-SU2-COMPOSITE
Date 6-27-24

Field Sketch (if applicable – include a north arrow and general dimensions).




PA1
SU2
SU1

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-PA2-SU1-COMPOSITE-FINE; 24-PA2-SU1-COMPOSITE-COARSE

Site and Sample Unit WALDORF AREA- UNKNOWN 2

Date and Time:
6-27-24; 12:45 PM

Collected by: A. GIEBEL; G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is located in alpine tundra above tree line, adjacent to FS roads. Moderate surrounding slope, pile is steeper than surrounding slope. Conical pile from end of crest leading back to grated shaft. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Material is light tan to reddish brown. Deeply weathered. Subsurface generally follows surface color. A mix of sand size up to ~1" gravel w/occasional ~3-4" cobble.

Sieving notes:
Material is moderately moist. Sieved on site w/clumps broken up manually

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected in plastic bucket w/ plastic trowel. Sieved in stainless steel. All rinsed w/DI water prior to collection.
No vegetation on pile. No nearby surface waters. Pile is stable

Material is predominantly deeply weathered/argilized granitic intrusive material w/ some schist. Few sulfides present.

Sample ID 24-PA2-SU1-COMPOSITE

Date 6-27-24

Weather notes: current conditions? Recent precipitation?

Mostly cloudy, cool ~50°, winds gusting 25-30mph. Recent precipitation in the form of afternoon thunder showers.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 39.64729, -105.76433, ~~11~~, 11,965'. Pile is lobate w/a conical nose leading off of a central ridge. Two parallel traverses around the base and center of pile flanks, and one traverse down the center ridge. A total of 30 subsamples collected at a depth of ~5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV data collected using iPhone GPS.

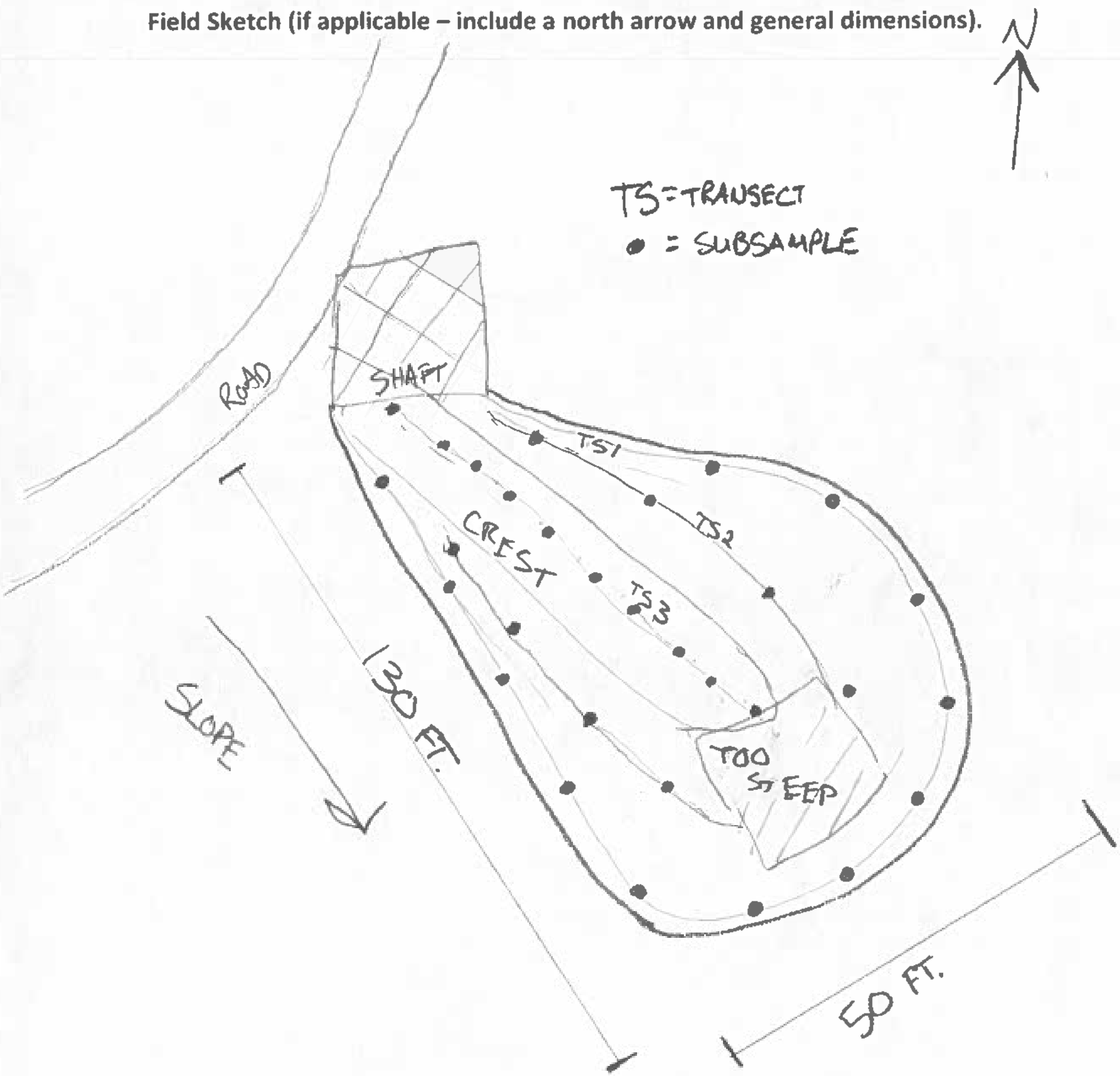
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24- PA2- SU1 - COMPOSITE
Date 6-27-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU1
PA2

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-PA3-SU1-COMPOSITE-FINE; 24-PA3-SU1-COMPOSITE-COARSE

Site and Sample Unit SYDNEY

Date and Time:
6-27-24- 2:15 PM

Collected by: A GIEBEL; G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is located on timbered hillside off of FS road. Sample represents approx 1/2 of material present (one of two lobes). Other half has been capped and revegetated, and therefore not sampled. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
surface is dominantly light tan, subsurface matching. Mostly fine fraction, sand to coarse sand size, w/ coarse fraction up to ~1".

Sieving notes:
Material mostly dry, sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/ plastic trowel in plastic bucket, sieved in stainless steel. All rinsed w/ DI water prior to collection. Sampler wore nitrile gloves. Draining adit above pile channelized between piles, flowing to main drainage Leavenworth Creek ~100 yards to the east. Pile appears stable.
Material is predominantly deeply weathered and argilized felsic intrusives. Abundant massive qtz vein material. Minor pyrite scattered. Few other obvious sulfides.

Sample ID 24-PA3-SU1-COMPOSITE
Date 6-27-24

Weather notes: current conditions? Recent precipitation?

Partly cloudy, cool ≈55°, winds 5-10 mph. Recent precip in the form of afternoon thundershowers.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 39.66253, -105.74135, 10,785'.
5 parallel transects over flanks and crest of pile, comprised of 6 subsamples each for a total of 30 subsamples collected at a depth of ~5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV data collected w/ iPhone GPS.

SAMPLES (from original USGS text and summarized here).

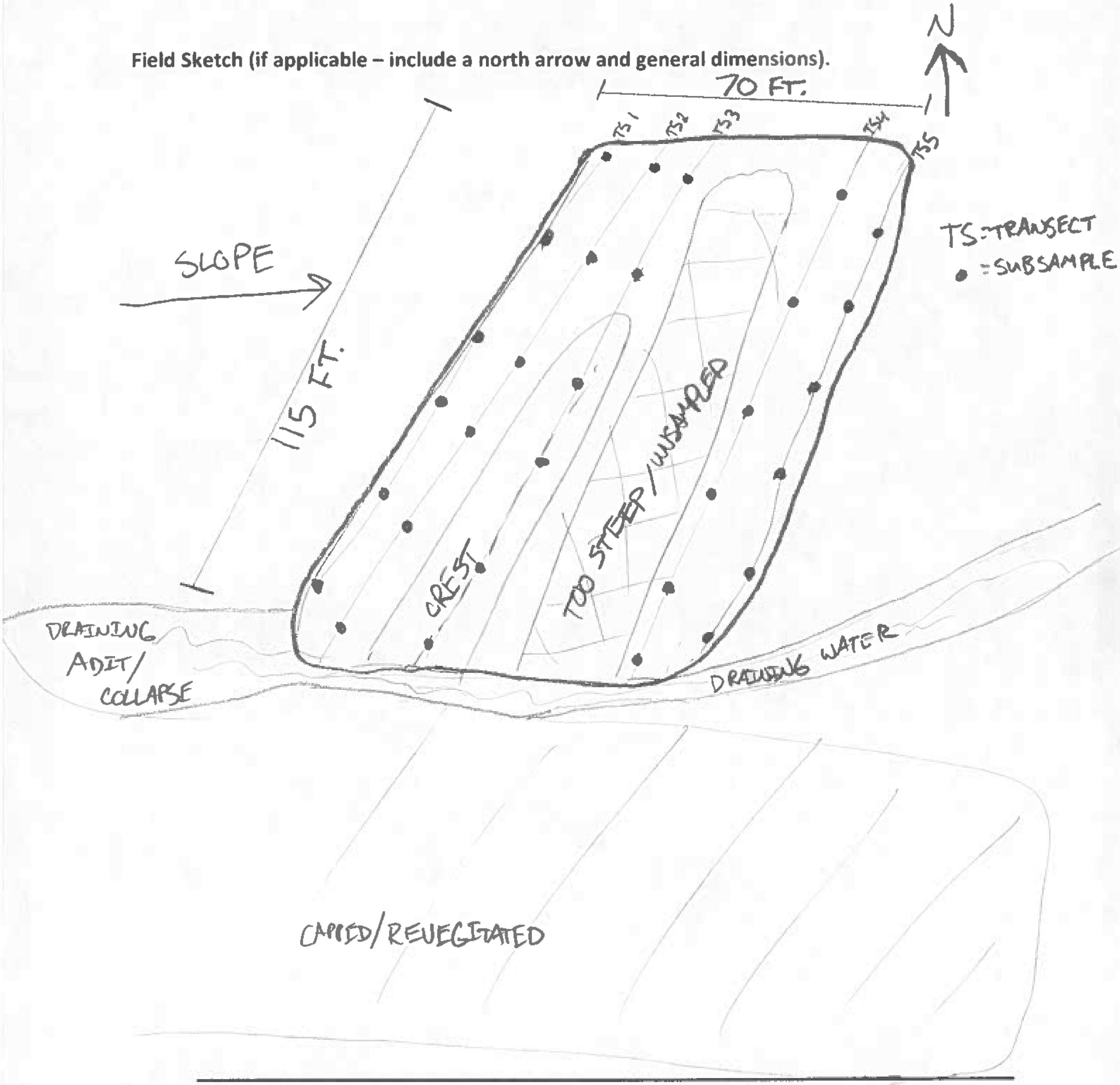
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

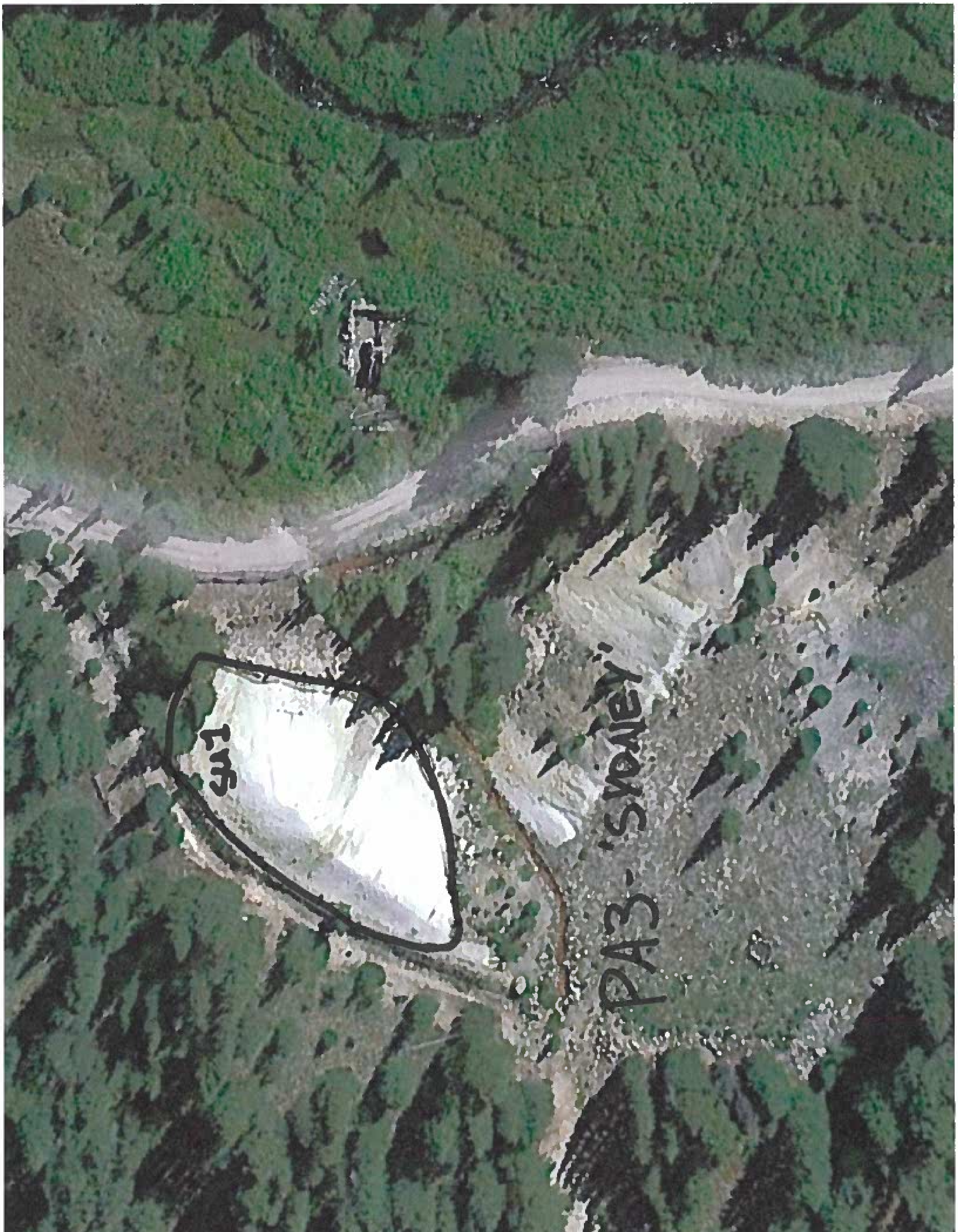
22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-PA3-SW1-COMPOSITE

Date 6-27-24

Field Sketch (if applicable – include a north arrow and general dimensions).




PA3-'Smokey'
Eng

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP1-SU1-COMPOSITE-FINE; 24-LP1-SU1-COMPOSITE-COARSE

Site and Sample Unit COLUMBUS

Date and Time:
7-10-24; 10:00 AM

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Pile (wasterock) is located in a high basin, above tree line, off of FS road. Elongated lobe radiating from grated shaft on mostly level ground. Pile is ~15-20 ft thick at central ridge. See attached ~~photo~~ map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Dominantly tan w/ subsurface matching. Sizing is a mix of fine to coarse sand, w/ coarse gravel fraction up to ~2". Material is dry.

Sieving notes:

Dry. Sieved on site.

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/ plastic trowel in plastic bucket, sieved w/ stainless steel. All rinsed w/ DI water prior to collection. Samplers wore nitrile gloves. No vegitation on pile. Stable pile w/ few erosional features. Surface water stream draining basin flowes past toe of pile.

Material is predominantly siliciclastics w/ quartzite and silicified silt/mudstones. Minor massive qtz vein material present. Minor sulfides, predominantly pyrite scattered throughout. ~~possible~~ small amount of possible tellurides (?) scattered on predominantly coarser material.

Sample ID 24-LP1-SU1-COMPOSITE
Date 7-10-24

Weather notes: current conditions? Recent precipitation?
CLEAR, FULL SUN, ~65°, light wind. No recent precip.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 37.42792, -108.01705, 11,735'. Five parallel transects consisting of six subsamples each, for a total of 30 subsamples collected at a depth of ~5cm.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected using iPhone GPS.

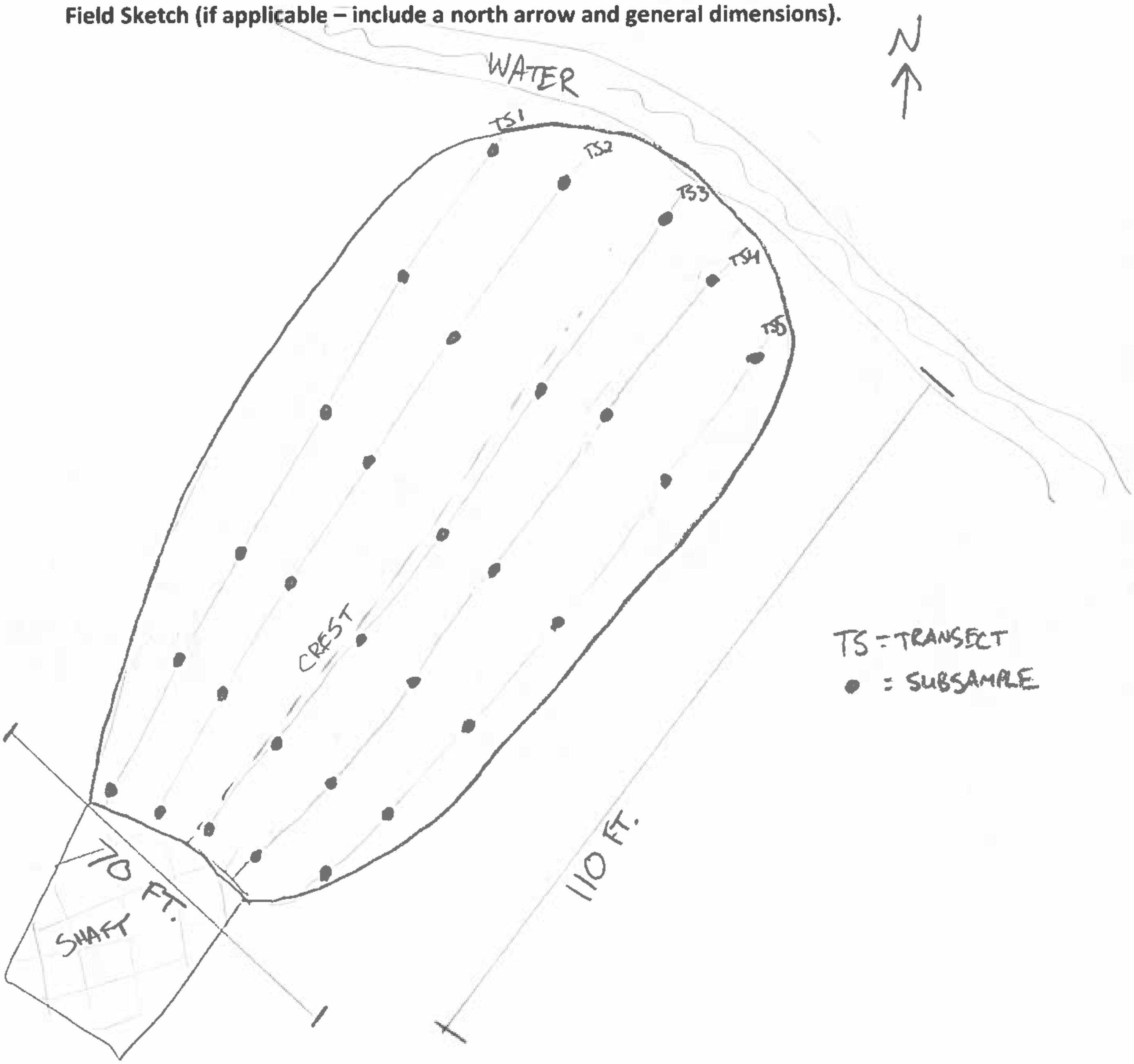
SAMPLES (from original USGS text and summarized here).

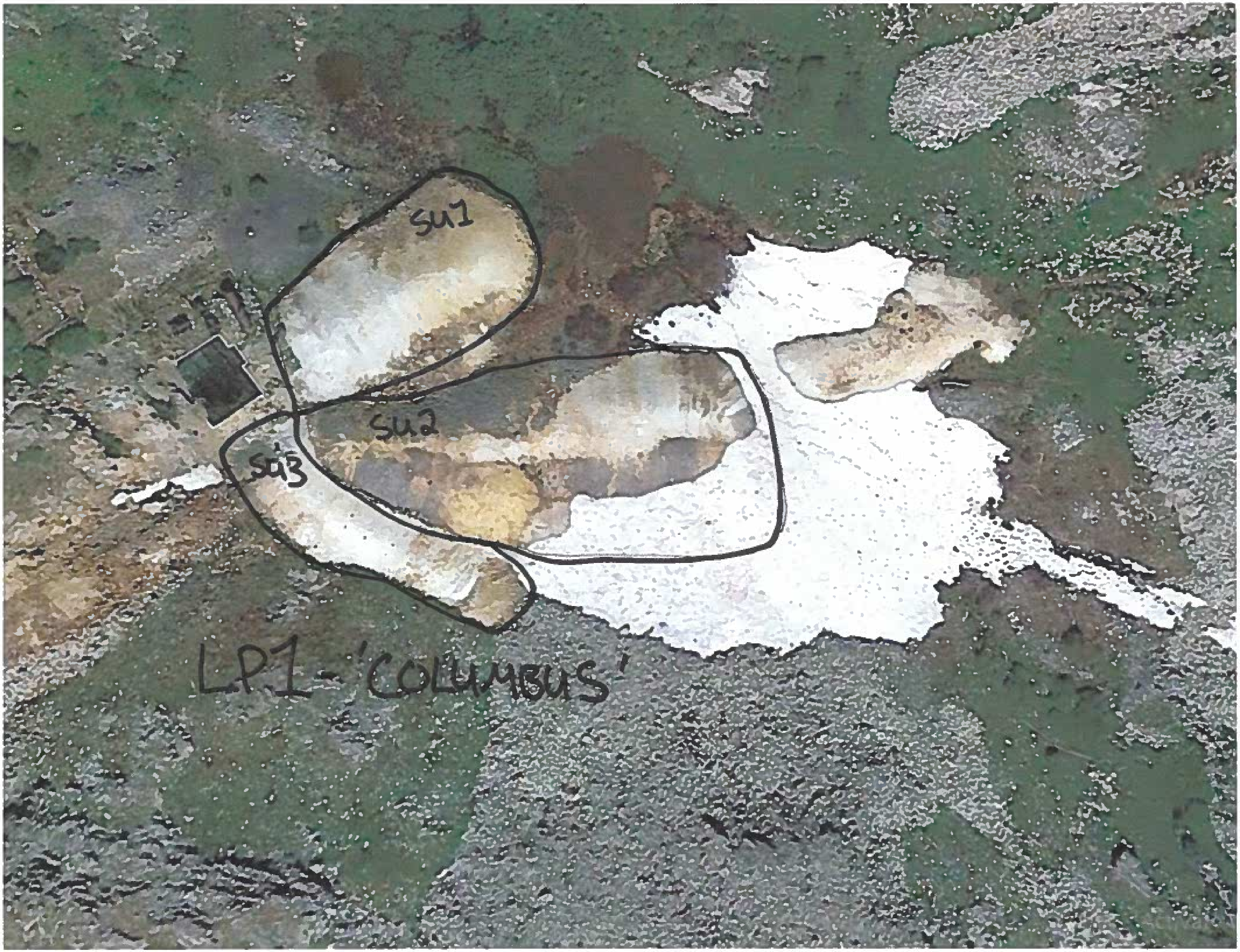
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP1-SU1-COMPOSITE
Date 7-10-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU1
SU2
SU3
LP1 - 'COLUMBUS'

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP1-SU2-COMPOSITE-FINE; 24-LP1-SU2-COMPOSITE-COARSE

Site and Sample Unit COLUMBUS

Date and Time:
7-10-24; 10:40 AM

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is located in a high basin above treeline on mostly flat ground. Access off of FS road. Elongated lobe radiating from grated shaft. ~10-15' thick at center crest. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface varies from tan to reddish brown to dark grey. Subsurface generally matching. Material ranges from coarse sand to cobbles up to ~6".

Sieving notes:
Dry. Sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/ plastic trowel in plastic bucket, sieved in stainless steel. All rinsed w/ DI water prior to sample collection. Sampler wore nitrile gloves. Scattered low bunch grasses on pile. Few erosional features generally stable pile. Surface water in the form of small ~~creek~~ stream draing basin flows past toe of pile.

Material is primarily siliciclastic in nature, quartzite and silicified mud/siltstone. Minor diorite porphyry and ~~syenite~~ syenite(?), primarily as larger, coarser material at surface. Minor argillization of diorite porphyry. Syenite(?) generally unaltered. Minor pyrite scattered/oxidizing in fine grained material.

Sample ID 24-LP1-SU2-COMPOSITE
Date 7-10-24

Weather notes: current conditions? Recent precipitation?
CLEAR, FULL SUN - ~65°, WINDS LIGHT AND variable
NO recent precipitation

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 37.4277, -108.01685, 11,720'.
Three parallel transects consisting of 10 subsample locations for a total of 30 subsamples collected at a depth of ~5 cm.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected w/ iPhone GPS.

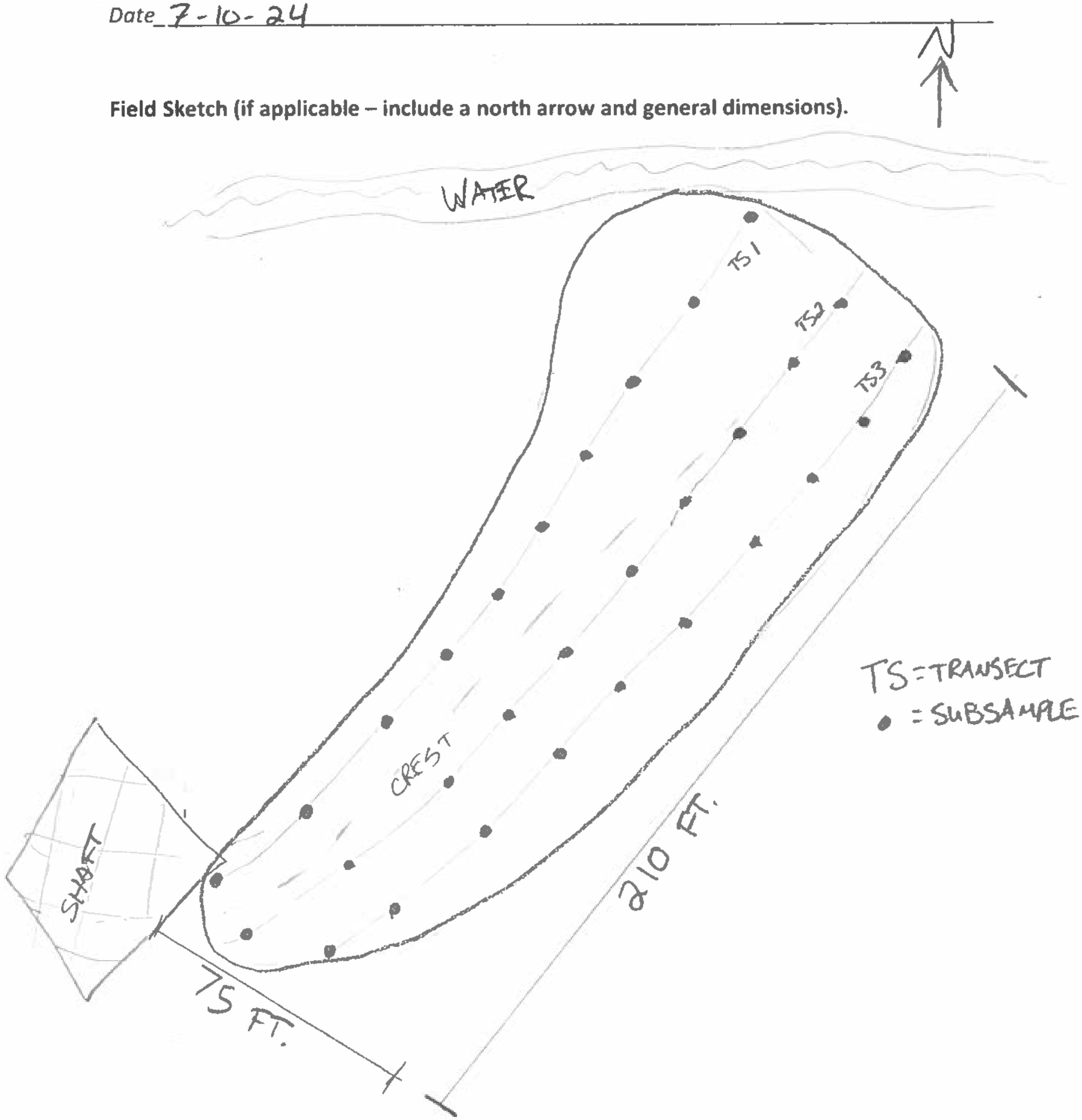
SAMPLES (from original USGS text and summarized here).

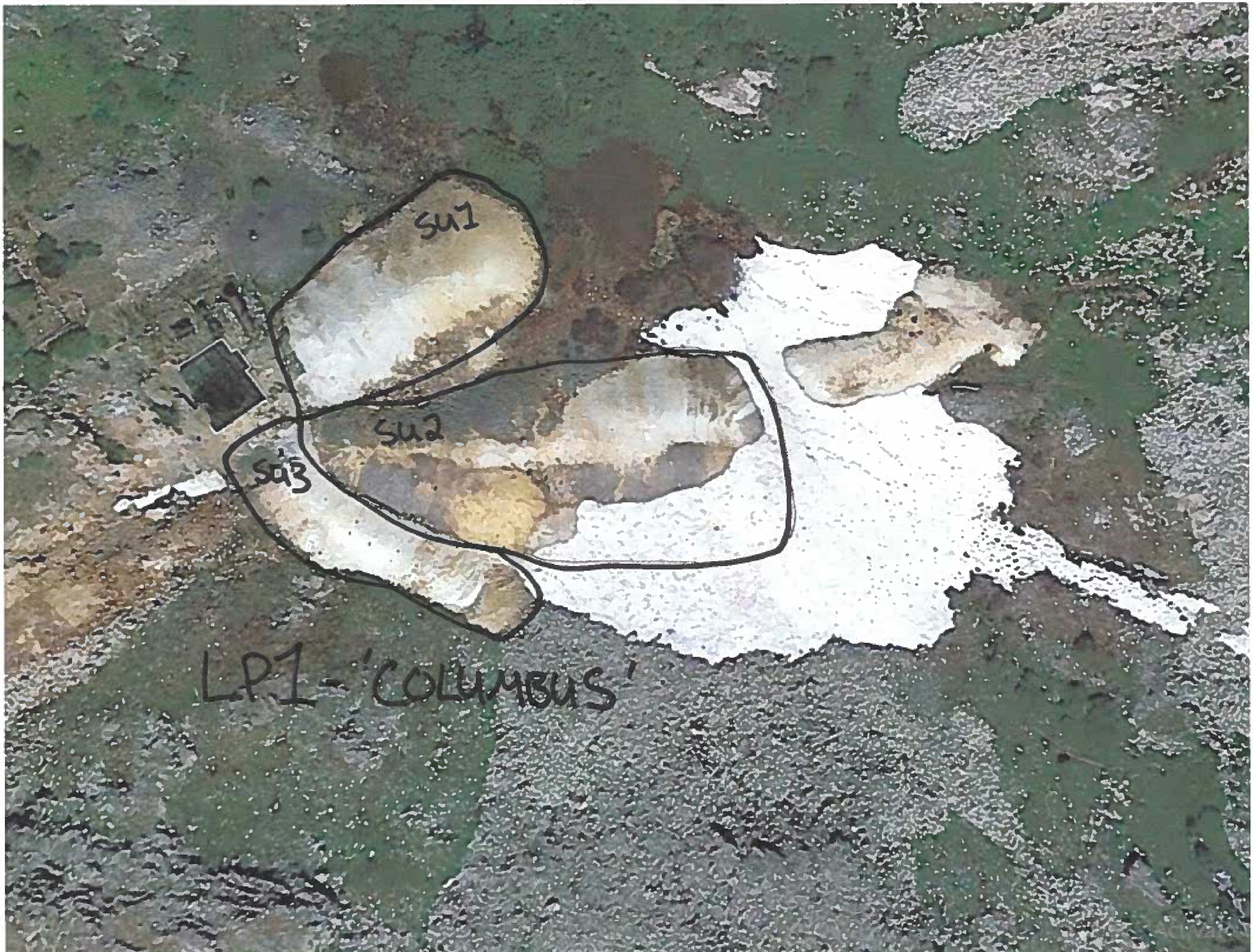
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP1-SU2-COMPOSITE
Date 7-10-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU1
SU2
SU3
LP1 - 'COLUMBUS'

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP1-SU3-COMPOSITE-FINE; 24-LP1-SU3-COMPOSITE-COARSE

Site and Sample Unit COLUMBUS

Date and Time:
7-10-24

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (TAILINGS (?)), is located in a high basin above treeline. Access off of FS road. Elongated lobe radiating from grated shaft. ~6' at thickest part of pile.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Light tan to reddish brown surface. Subsurface is lighter grey to reddish brown. Material is dominantly fine grained, coarse to fine sand size. Much less coarse faction up to ~1/".

Sieving notes:
Dry sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample was collected w/plastic trowel in plastic bucket, sieved w/stainless steel. All rinsed w/DI water prior to collection. Sampler wore nitrile gloves.

No vegetation on pile. Minor erosional features. Stable pile. Nearby stream drains basin, does not contact pile.

Material appears to have been predominantly siliciclastic in origin, though is so fine grained/decomposed, exact provinance is unknown. Minor sulfides in the form of oxidized pyrite present.

Sample ID 24-LP1-SU3-COMPOSITE
Date 7-10-24

Weather notes: current conditions? Recent precipitation?
CLEAR, FULL SUN, ~65°. Winds light and variable.
No recent precipitation.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 37.42762, -108.01711, 11,715'. Three parallel transects consisting of 10 subsamples each for a total of 30 subsamples collected at a depth of ~5cm.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected w/ iPhone GPS.

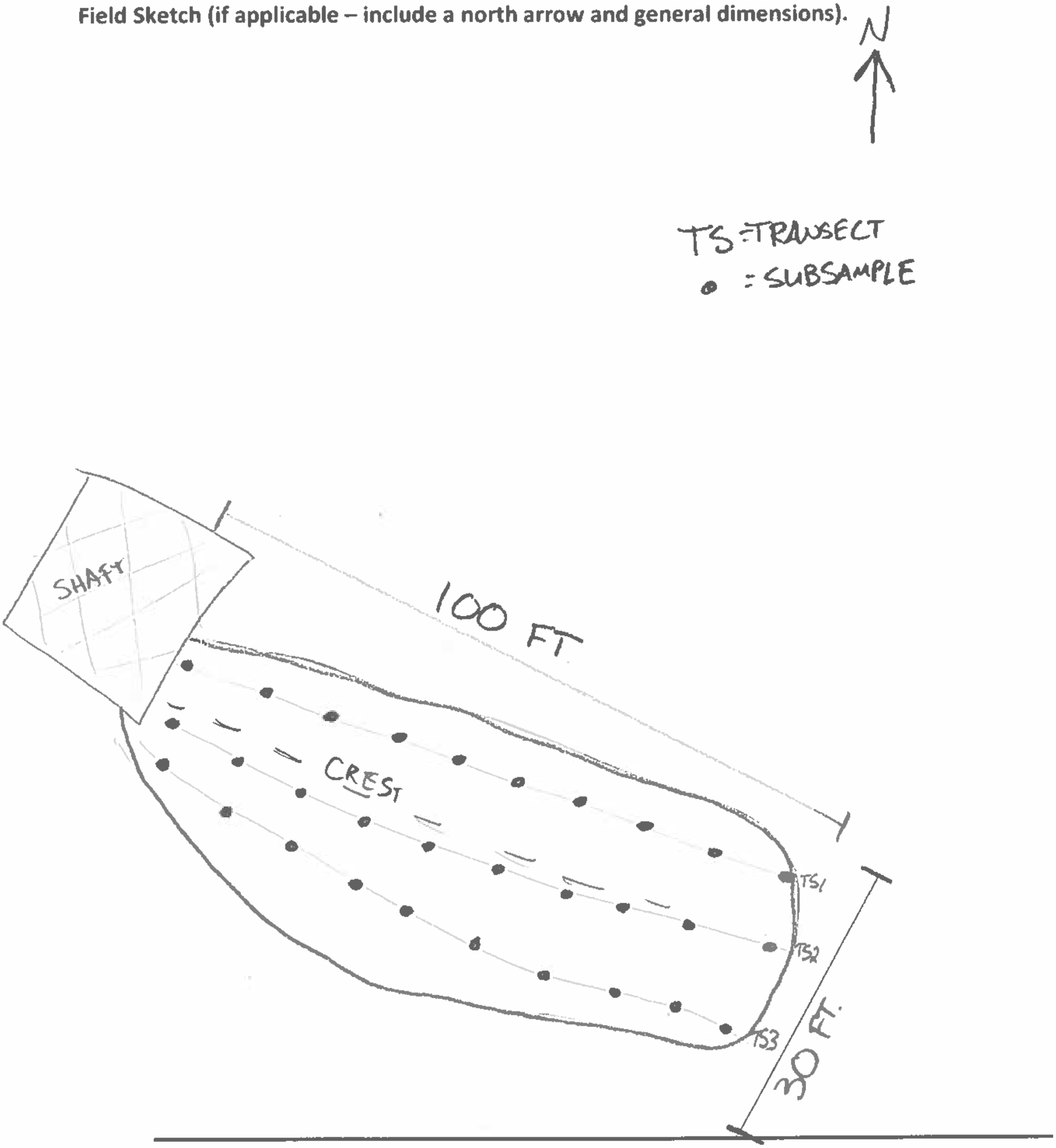
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP1-SU3-COMPOSITE
Date 7-10-24

Field Sketch (if applicable – include a north arrow and general dimensions).




SU1
SU2
SU3
LP1 - 'COLUMBUS'

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP2-SU1-COMPOSITE-FINE; 24-LP2-SU1-COMPOSITE-COARSE

Site and Sample Unit DOYLE #2 - Northstar

Date and Time:
7-11-24. 10:45 AM

Collected by: A. GIEBEL, G. KING, K. BROWN

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (wasterock) is located in upper basin near tree line. Access off of FS road. Rough/narrow, high clearance small vehicle required. Generally rectangular in shape w/conical point on west side. Moderately steep native slope. ~30' at thickest point. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Tan and light grey to light reddish brown surface. Subsurface generally matching. Material ranges from coarse sand to angular gravel of ~1", some cobbles up to 6".

Sieving notes:
Dry. Sieved on site

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected in plastic bucket w/plastic trowel. Sieved in stainless steel. All rinsed w/DI water prior to collection. No vegetation on pile. Minor erosional features do not affect pile stability. Small pond/marsh ~50 yards beyond toe of pile.

Material is primarily composed of fine to very fine crystalline limestone. Abundant pyrite occurring both as fine grained disseminated and massive.

Sample ID 24-LP2-SU1-COMPOSITE
Date 7-11-24

Weather notes: current conditions? Recent precipitation?
CLEAR, FULL SUN, ~65°. Winds light and variable.
No recent precipitation

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 37.42366, -108.10332, 11,450'. Central face of pile is too steep to access safely on foot. Remaining toe, crest, and flanks were traversed in even arcs, collecting a total of 30 subsamples from a depth of ~5cm. See attached sketch for sample locations.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected using iPhone GPS.

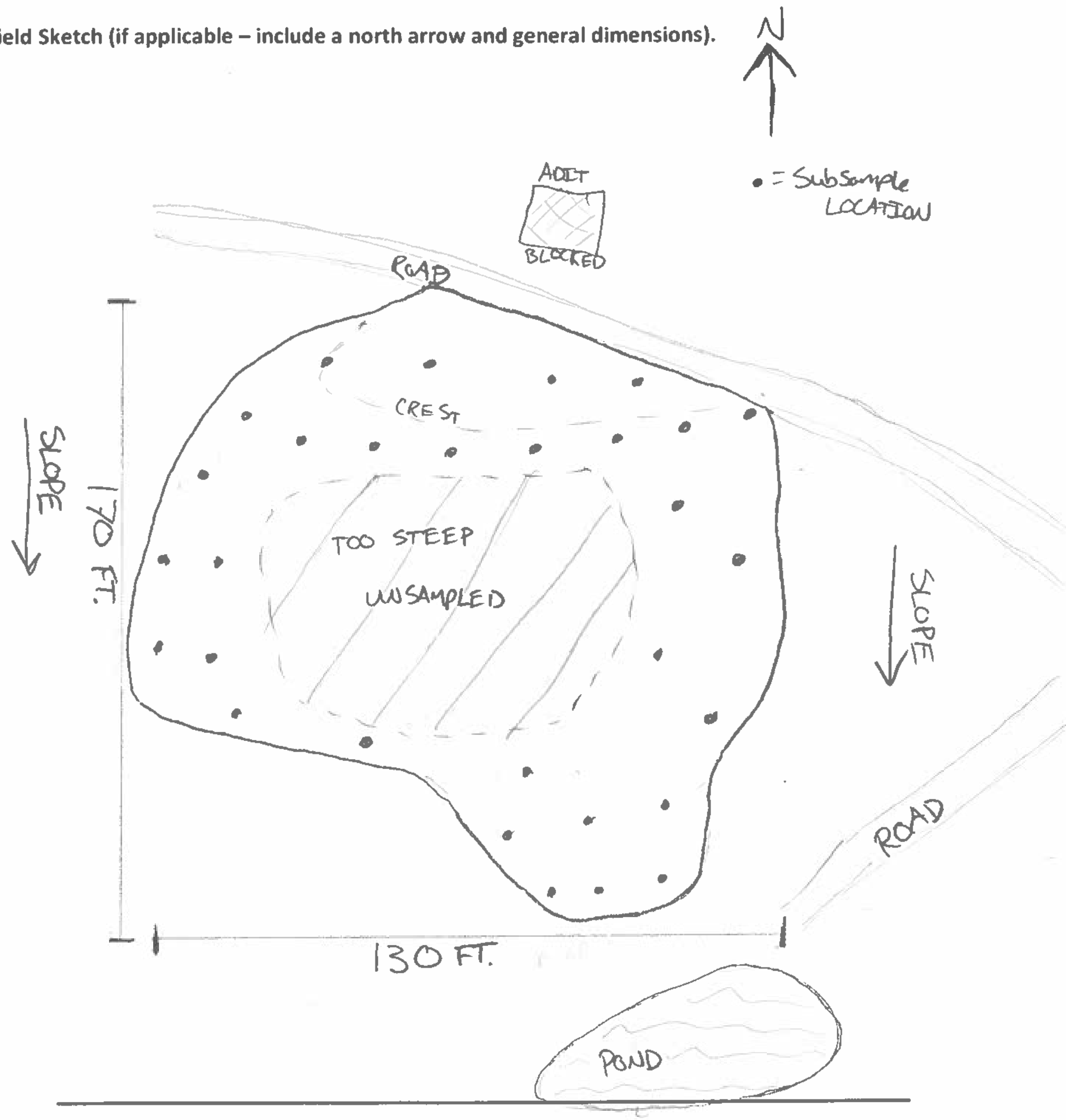
SAMPLES (from original USGS text and summarized here).

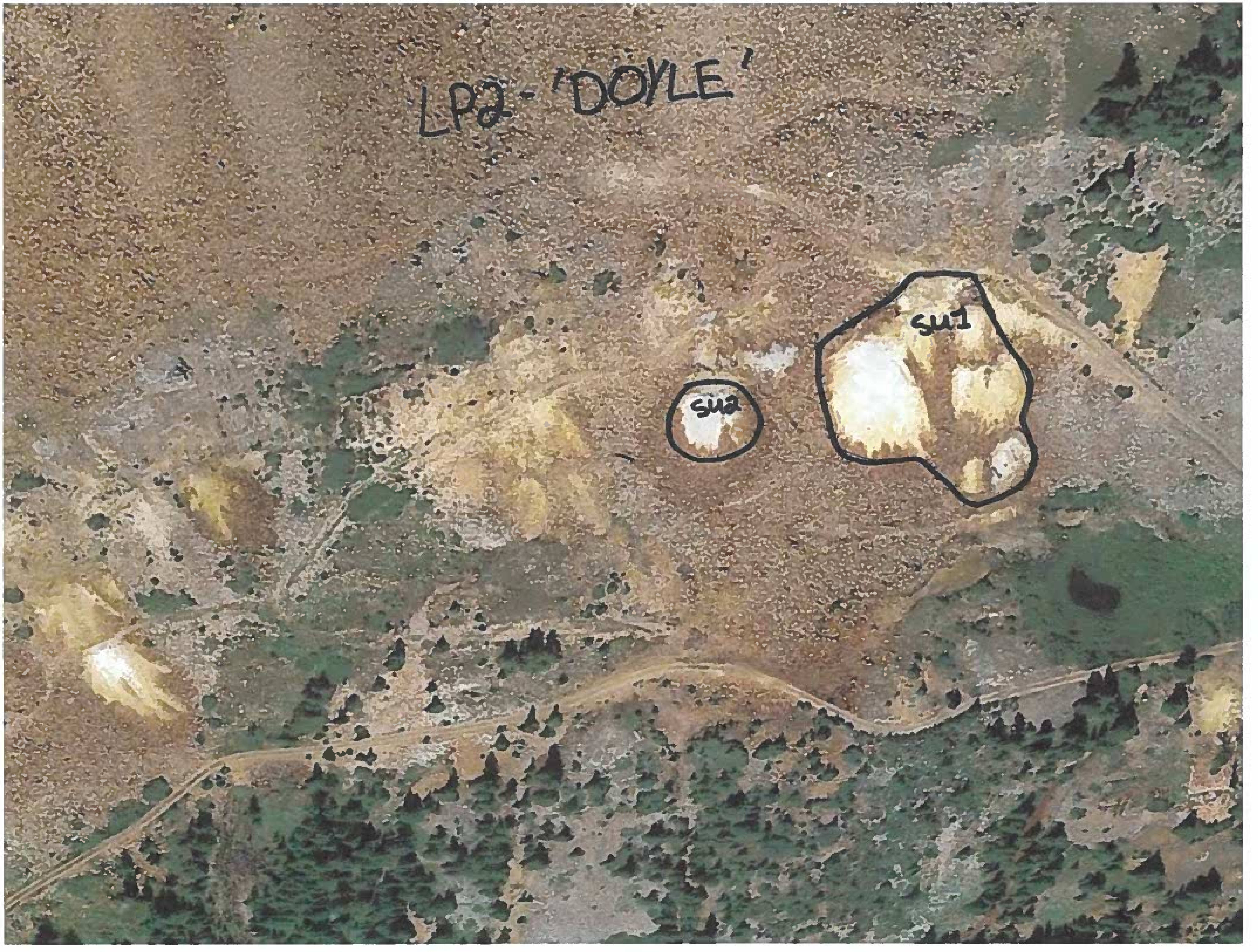
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP2-SU-COMPOSITE
Date 7-11-24

Field Sketch (if applicable – include a north arrow and general dimensions).




LP2 - 'DOYLE'
SU1
SU2

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP2-SU2-COMPOSITE-FINE; 24-LP2-SU2-COMPOSITE-COARSE; 24-LP2-SU2-GRAB

Site and Sample Unit Doyle #3 - Northstar and sundown shared Portal

Date and Time:
7-11-24- 11:30 AM

Collected by: A. GIEBEL

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
pile (wasterock) is located in high basin just below tree line. steep/rough FS road access, high clearance and small vehicle required. Conical pile 20-30' thick at center. See attached map for ~~dimensions~~ dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Light grey to tan surface. Subsurface generally following. Coarse sand to angular gravel up to 2". Some larger cobbles up to ~6". Dry.

Sieving notes:
Dry. Sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected w/plastic trowel in plastic bucket, sieved in stainless steel. All rinsed w/DI water prior to collection. Sampler wore nitrile gloves.
No vegetation on pile, small pond/marsh ~100 yards SE of pile.
Steeper flanks, though generally stable.
Material is primarily fine to very fine crystalline limestone.
Abundant pyrite throughout, both disseminated and massive.

Sample ID 24-LP2-SU2-COMPOSITE
Date 7-11-24

Weather notes: current conditions? Recent precipitation?
CLEAR, Full Sun, ~65°. Winds light and variable.
No recent precipitation.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 37.42361, -108.10381, 11,440'.
three parallel transects forming concentric circles around the cone shaped pile. A total of 30 subsamples collected at a depth of 5 cm. see attached sketch.

Additional data collected (paste pH, pXRF, etc):
N/A.

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected using iPhone GPS.

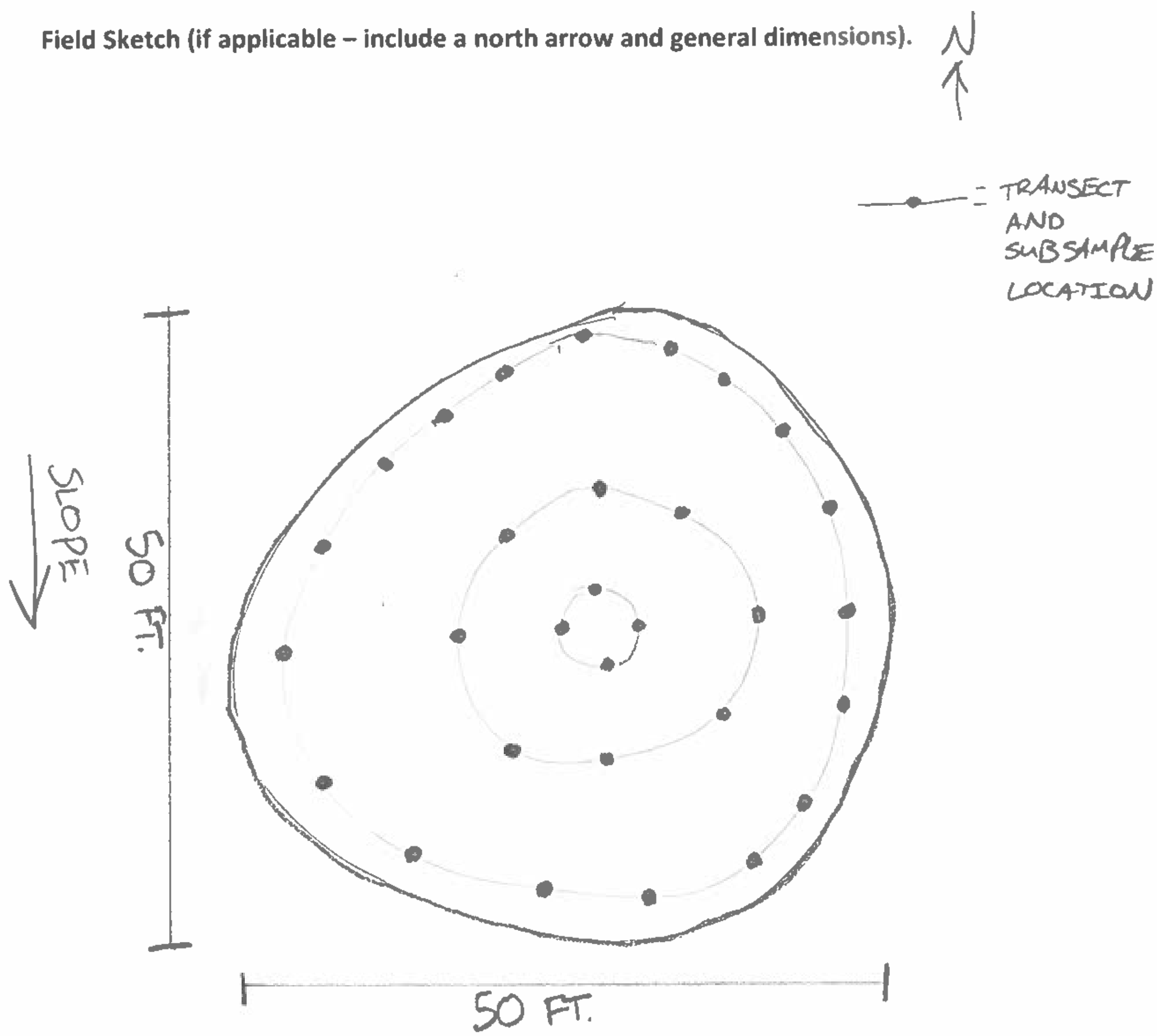
SAMPLES (from original USGS text and summarized here).

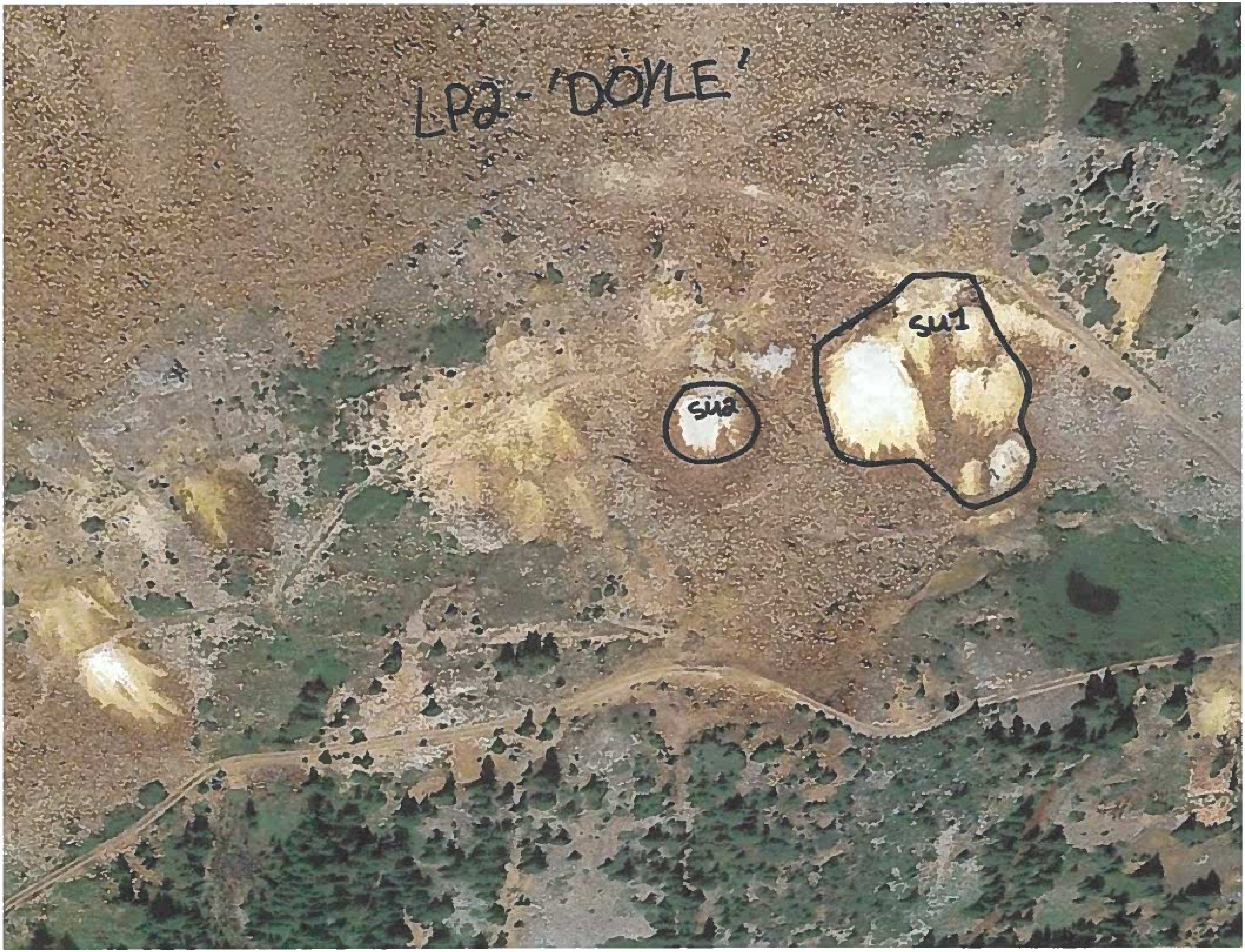
- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP2-SU2-COMPOSITE
Date 7-11-24

Field Sketch (if applicable – include a north arrow and general dimensions).




LP2 - 'DOYLE'
SU1
SU2

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP3-SU1-COMPOSITE-FINE', 24-LP3-SU1-COMPOSITE-COARSE

Site and Sample Unit THUNDER

Date and Time:
7-11-24; 1:45 PM

Collected by: A. GIEBEL, G. KING, K. BROWN

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
pile (wasterock) is located ~200 yards up atv trail off of FS road on steep native slope. Pile slope generally matching native slope. ~10-15' thick at crest. see attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is grey to reddish brown, subsurface generally matching. Size varies from fine sand to coarse sand, up to angular gravel up to 1". Larger cobbles scattered over surface, though less in subsurface. Dry Material.

Sieving notes:
Dry. Sieved on side

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected with plastic trowel in plastic bucket, sieved w/stainless steel. All rinsed w/DI water prior to collection. Sampler wore nitrile gloves. No vegetation on pile. Stable pile. Small stream draining from collapsed adit above pile, drains accross the top and away from pile. Material is predominantly sandstone. Abundant sulfides including fine grained pyrite and abundant massive/bladed arsenopyrite.

Sample ID 24-LP3-SU1-COMPOSITE
Date 7-11-24

Weather notes: current conditions? Recent precipitation?

Scattered thunderstorms. Associated scattered showers. ~65° winds light and variable. No recent major precip, only scattered drizzle from aforementioned storms.

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Pile is centered at 37.39701, -108.12774, 10,515'.
Five parallel traverses accross face of pile, avoiding areas that are too steep to safely sample at midslope and at toe. A total of 30 subsamples collected at a depth of ~15cm. See attached sketch for locations.

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):

LAT/LONG/ELEV data collected w/ iPhone GPS.

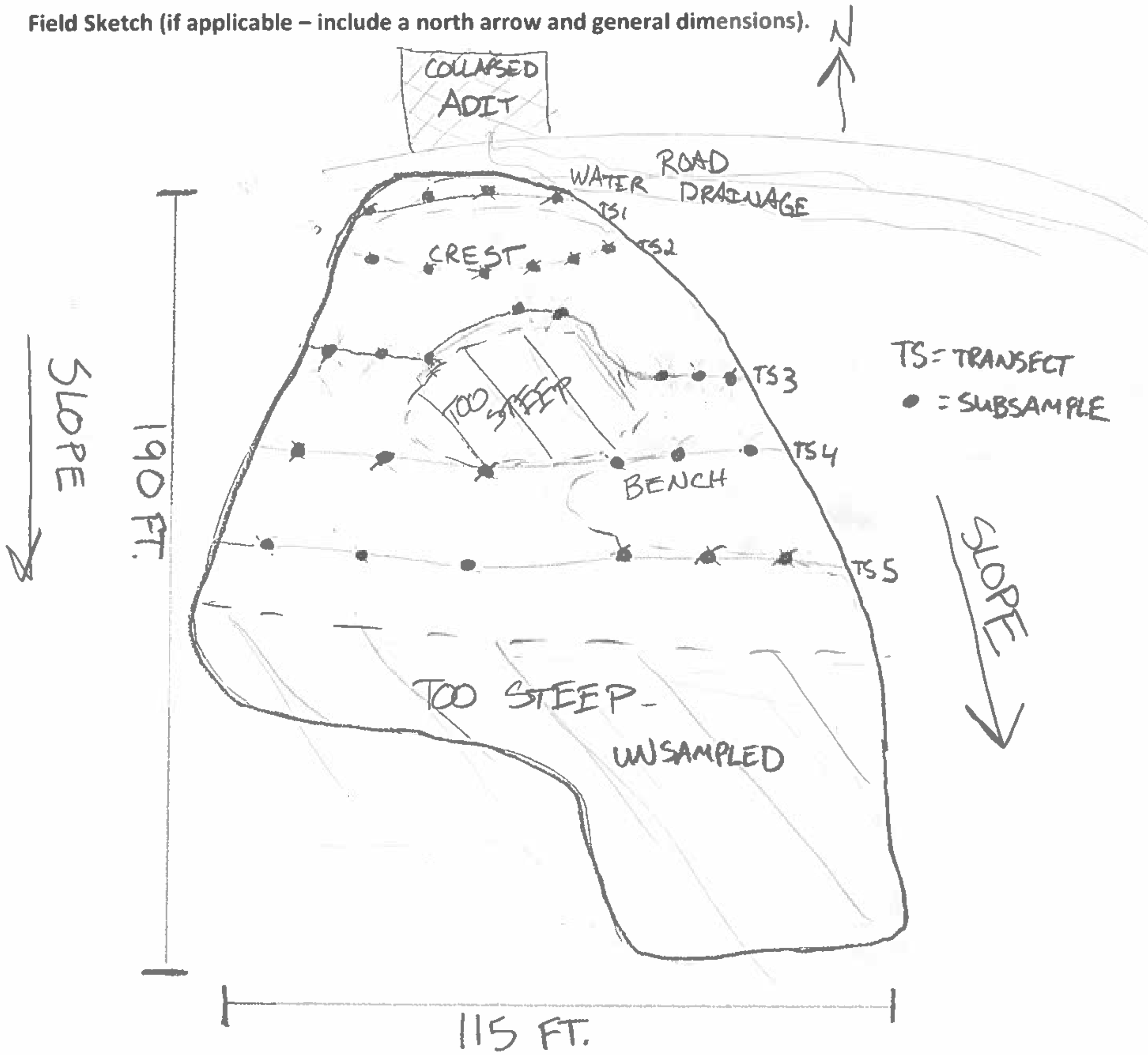
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP3-SU1-COMPOSITE
Date 7-11-24

Field Sketch (if applicable – include a north arrow and general dimensions).



Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-LP3-SU1-COMPOSITE-DUP1-FINE; ~~[illegible]~~ 24-LP3-SU1-COMPOSITE-DUP-COARSE

Site and Sample Unit THUNDER

Date and Time:
7-11-24; 2:30 PM

Collected by: A. GIEBEL, G. KING, K. BROWN

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 24-LP3-SU1-COMPOSITE-DUPLICATE
Date 7-11-24

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-LP3-SU1-COMPOSITE-DUPLICATE
Date 7-11-24

Field Sketch (if applicable – include a north arrow and general dimensions).

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-NGI-SUI-COMPOSITE-FINE; 24-NGI-SUI-COMPOSITE-COARSE; 24-NGI-SUI-GRAB

Site and Sample Unit Northgate.

Date and Time:
7-16-24- 9:45AM

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (waste rock), located on private land off of State highway (127). Pile is an elongated triangle w/center having been pushed down. Located on moderate slope, ~30' thick at center. Flanks steeper than surrounding slope.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Light grey to reddish brown. surface. Subsurface grading to medium brown. Material ranging from very fine/silt up to coarse cobble ~6". Material is moist.

Sieving notes:
Moist. Collected in cloth bag for drying and sieving at later time.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

sample was collected w/ Plastic trowel in plastic bucket. Samplers wore nitrile gloves. All equipment rinsed w/ DI water prior to sample collection. Minor erosional features do not affect pile stability. Low brush and conifers up to ~6' scattered around pile. No nearby surface waters.
Material is primarily granitic w/minor schist and gneissic material. Abundant flourite. Moderate argillic alteration, giving rise clayey matrix among finest grained fraction.

Sample ID 24-NG1-SU1-COMPOSITE
Date 7-16-24

Weather notes: current conditions? Recent precipitation?
Clear, full sun, ~65°. Recent precip in the form of heavy afternoon thunderstorm the prior afternoon.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 40.92808, -106.27881, 8,430'.
Three parallel transects accross top, mid, and base. 10 subsamples at mid and base, 20 accross top for a total of 40 subsamples collected from a depth of ~5cm. See attached sketch.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected using iPhone GPS.

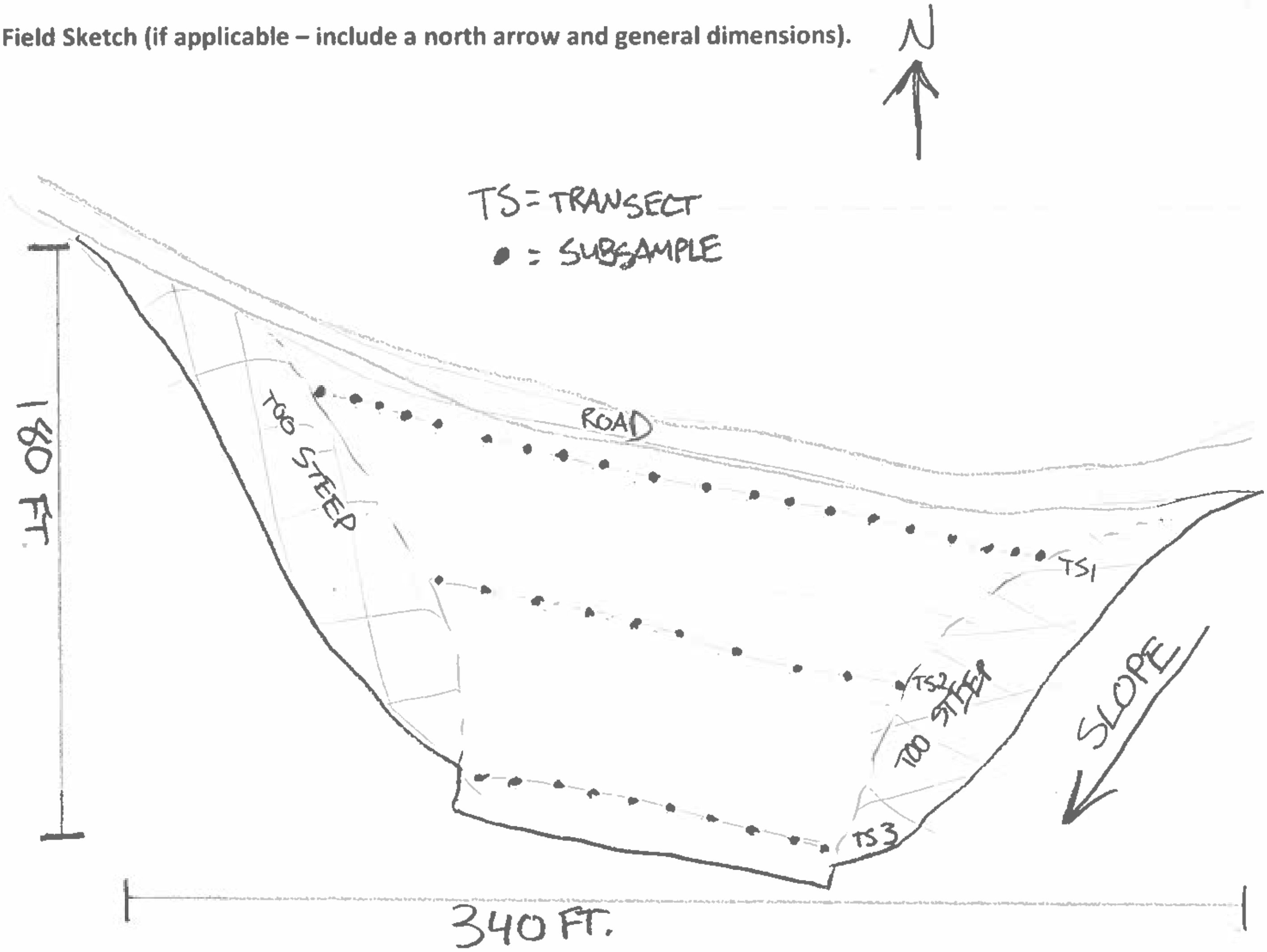
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-NGI-SUI-COMPOSITE
Date 7-16-24

Field Sketch (if applicable – include a north arrow and general dimensions).




49
su1
NGI-
'NORTHGATE'
su2
su3
Dean Peak
Image © 2024 Airbus
127
Imagery Date: 10/15/2023 lat 40.926873° lon -106.28

Earth MRI Mine Waste Characterization – Field Data Sheet
Colorado Geological Survey

Tailings composite sample

Sample ID 24-NGI-SU2-COMPOSITE-FINE

Site and Sample Unit Northgate

Date and Time:
7-16-24, 11:30AM

Collected by: A. GOEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
Pile (tails) is located on private land accessed off of State highway (127). Pile is located on flat ground as an impoundment behind tailings dam. 30-40' thick based on dam height. See attached map for dimensions.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Surface is generally light grey, turning grey to reddish brown in the subsurface. Material has some moisture content. Dominantly fine to medium grained sand. Almost no coarse fraction except scattered pebbles over the surface. Pile is largely vegetated w/marshey areas. Exposed/Dry portion sampled.

Sieving notes:
Material has some moisture content but sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?
Material was collected w/plastic trowel in plastic bucket. Sieved in stainless steel. All rinsed w/DI water prior to collection. Sampler wore nitrile gloves. Extensive vegetation in the form of grasses cover majority of pile. Conifers up to 12' scattered. Material was likely granitic in origin based on mineral assemblages present. Exact protolith is unknown. Stable pile. Surface waters forming marshy areas over pile.

Sample ID 24-NG1-SU2-COMPOSITE
Date 7-16-24

Weather notes: current conditions? Recent precipitation?
Scattered thunderstorms. ~80°. Recent precip from afternoon t-storms the prior day.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile is centered at 40.92034, -106.27589, 8,130'.
Exposed portion of pile was crossed w/three parallel transects forming a rectangular shape. 10 subsamples per transect for a total of 30 subsamples collected at a depth of ~5cm. See attached sketch.

Additional data collected (paste pH, pXRF, etc):
N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV collected using iPhone GPS.

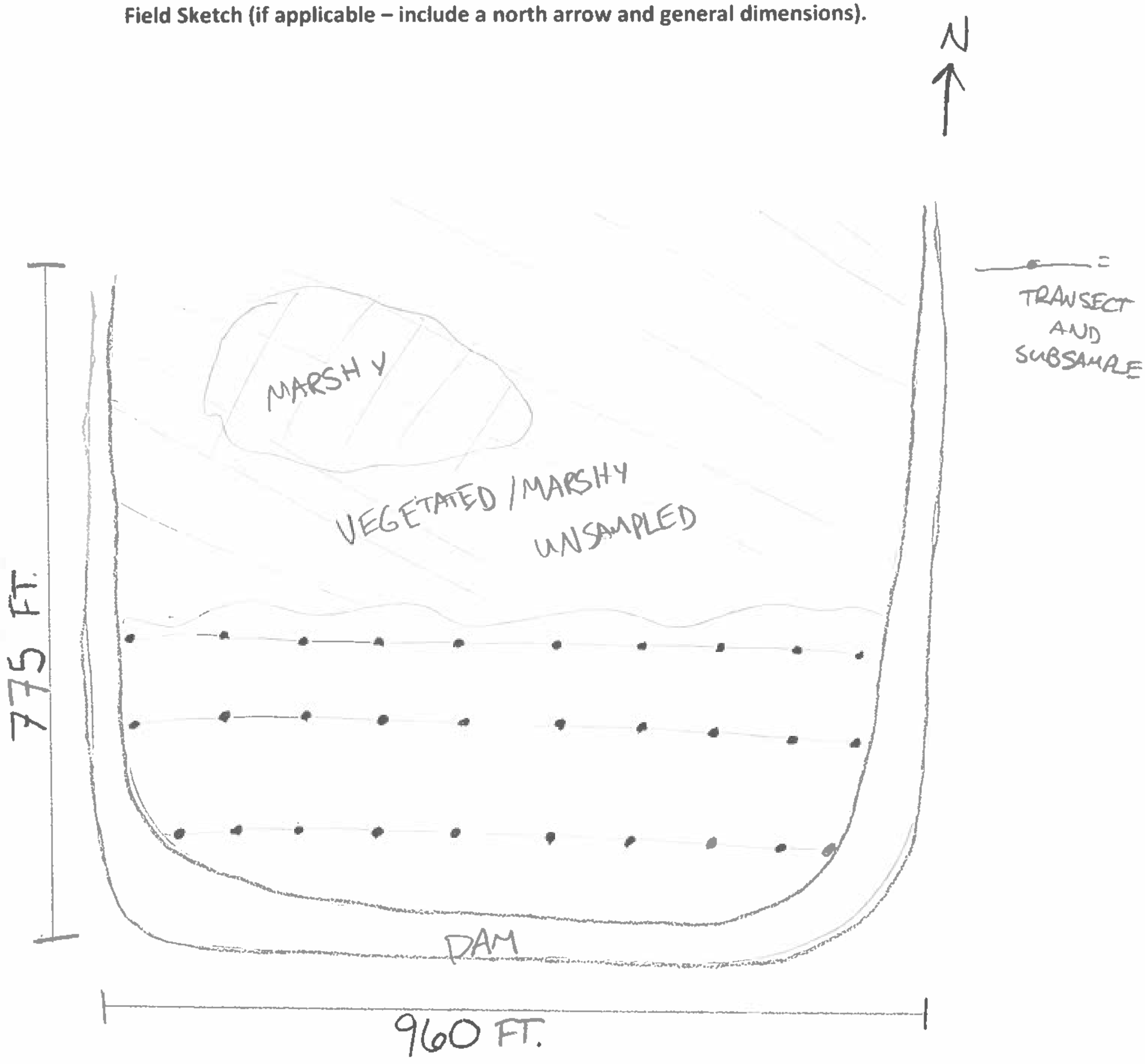
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-NGI-SW2-COMPOSITE
Date 7-16-24

Field Sketch (if applicable – include a north arrow and general dimensions).



49
su1
NGI-
'NORTHGATE'
su2
su3
Dean Peak
Image © 2024 Airbus
127
Imagery Date: 10/15/2023 lat 40.926873° lon -106.28

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-NG1-SW2-COMPOSITE-DUP-FINE

Site and Sample Unit Northgate

Date and Time:
7-16-24

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?

Sieving notes:

Detailed site description and site notes:

Sampling equipment used; other notes: Vegetation? Efflorescent salts? Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample ID 24-NG1-SU2-COMPOSITE-DUP
Date 7-16-24

Weather notes: current conditions? Recent precipitation?

Latitude/longitude of subsamples (description of how data collected and/or data collected):

Additional data collected (paste pH, pXRF, etc):

Geospatial data (description of measurements if made in the field):

SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-NG1-SU2-COMPOSITE-DUP
Date 7/16/24

Field Sketch (if applicable – include a north arrow and general dimensions).

NGI-
'NORTHGATE'
su1
su2
su3
49
Dean Peak
Image © 2024 Airbus
127
Imagery Date: 10/15/2023 lat 40.926873° lon -106.28

Earth MRI Mine Waste Characterization – Field Data Sheet

Colorado Geological Survey

Tailings composite sample

Sample ID 24-NG1-SU3-COMPOSITE-FINE

Site and Sample Unit Northgate

Date and Time:
7-16-24- 12:30 PM

Collected by: A. GIEBEL, G. KING

Photo(s) taken Y

Description of site and sample unit (include estimate of volume or sketch of heights, dimensions):
pile (tailings) is located on private land, Accessed of of State highway (127). Pile is located within large rectangular impoundment formed by tailings dam. Much of the area is covered in thick/marshy vegetation and standing water. Exposed area sampled. See attached map.

Description of tailings: surface and subsurface color? Moisture content? Material size and variability?
Tailings are a light grey to tan at surface, becoming reddish orange in subsurface. Fine to coarse sand. Generally dry, though some surface moisture from recent precipitation.

Sieving notes:
Sieved on site.

Detailed site description and site notes:
Sampling equipment used; other notes: Vegetation? Efflorescent salts?
Seeps/drainage/erosional features? Notes on geology/mineralogy? Pile stability? Nearby water bodies?

Sample collected in plastic bucket, w/plastic trowel. Sieved in stainless steel. All rinsed w/DI water prior to sample collection. Pile extensively vegetated w/brush, dune and marsh grasses. Flat lying, appears stable behind tailings dam. Surface ponds and marshy areas on pile.
Material appears granitic in origin, though exact protolith is unknown. Abundant Plagioclase.

Sample ID 24-NGI-SU3-COMPOSITE
Date 7-16-21

Weather notes: current conditions? Recent precipitation?
Light showers, scattered thunderstorms ~60°. Winds light and variable. Current light precip. Recent heavier precip from afternoon storms.

Latitude/longitude of subsamples (description of how data collected and/or data collected):
Pile centered at 40.92031, -106.27047, 8,130'. Three parallel transects each consisting of 10 subsamples for a total of 30 subsamples collected at a depth of ~5cm. Transects form a rectangle over exposed portion of pile. See attached map

Additional data collected (paste pH, pXRF, etc):

N/A

Geospatial data (description of measurements if made in the field):
LAT/LONG/ELEV data collected w/ iPhone GPS

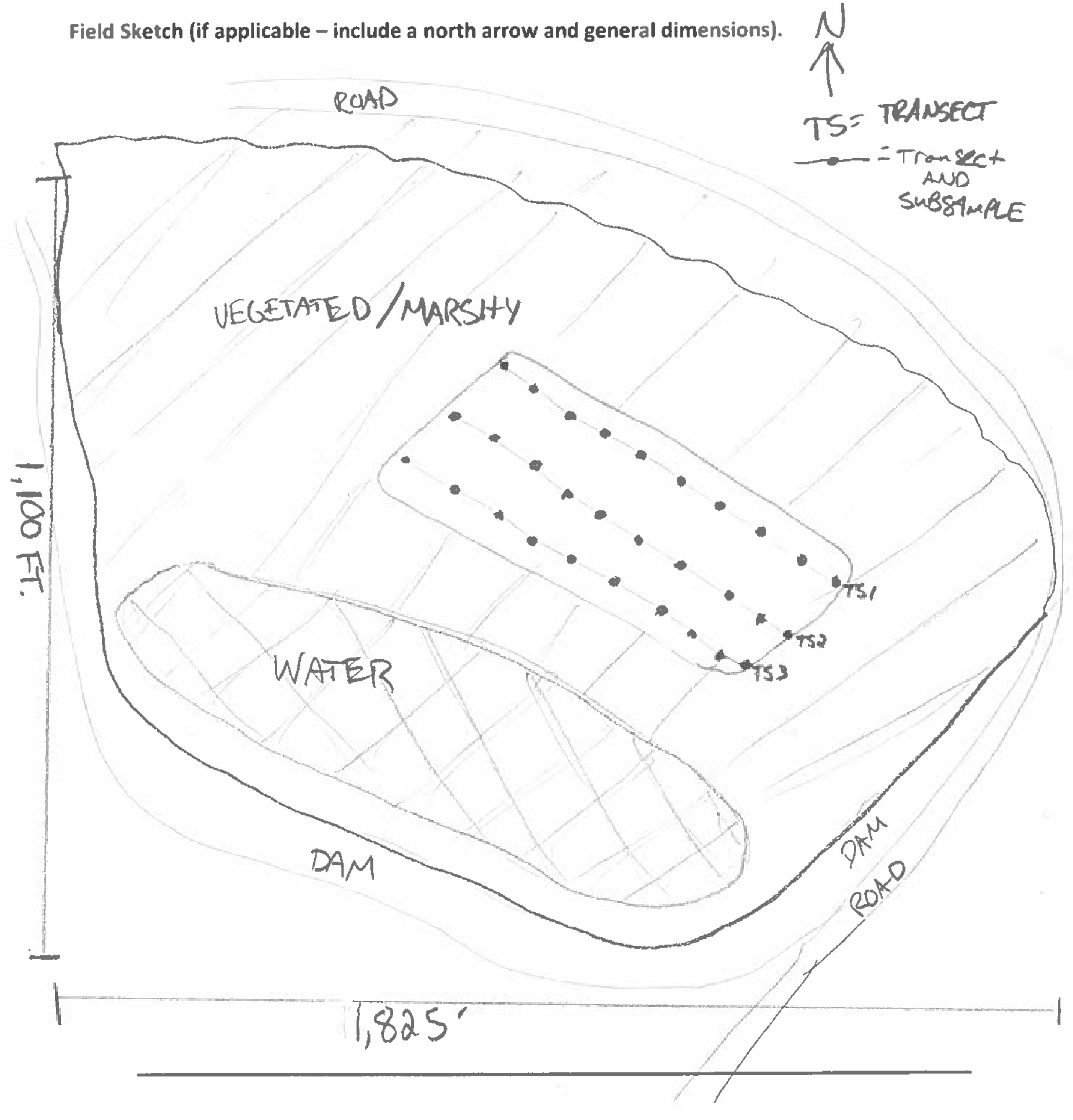
SAMPLES (from original USGS text and summarized here).

- Sieved samples should be secured in a plastic bag or other spill-proof container and labeled with indelible ink.
- Double- or triple-bagging is recommended to prevent loss of sample during transport.
- Samples can be stored at room temperature. Samples should be inventoried and submitted to USGS Sample Control (see section on sample submission in USGS sample procedures).
- The sample label should contain a unique site and sampling unit ID, date of collection and size fraction (< 2 mm) once sieved. Including a project ID that indicates the program (Earth MRI-Mine Waste Characterization) and state also highly recommended.
- Duplicate samples should be labeled to have a unique ID.
- Unique IDs will need to be tailored for the particular site and sample type, but we suggest using a consistent format. For example, if the sample is from a site called "Example Tailings Site" in State YY and is a composite sample from sample unit 1 collected on November 1, 2022 at 15:00, the unique sample ID could be: "22_ETS_SU1_composite", with details about the exact date and time recorded in the field sheet and on the label. A duplicate sample could be labeled "22_ETS_SU1_composite_dup" to differentiate it from the first sample. An example label is below.
- Samples are labeled with the Unique ID number, Date/time, Project ID.

22_ETS_SU1_composite
1 Nov 2022 15:00
<2mm
EMRI-MWC-YY

Sample ID 24-NGI-SU3-COMPOSITE
Date 7-16-24

Field Sketch (if applicable – include a north arrow and general dimensions).




NGI-
'NORTHGATE'
su1
su2
su3
Dean Peak
49
127
Image © 2024 Airbus
Imagery Date: 10/15/2023 lat 40.926873° lon -106.28

APPENDIX B (electronic copy)

APPENDIX C

Table - Summary of relative percent differences between original sample and resample laboratory results.

Sample Area	Field No.	Subpile	Unit	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	K2O (%)	MgO (%)	MnO (%)	CaO (%)	TiO2 (%)	Na2O (%)	P2O5 (%)	SrO (%)	BaO (%)	Cr2O3 (%)	V2O5 (%)	Au (ppb)	Ag (ppm)	Al (ppm)	As (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Bi (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)
Tip Top	24-GG1-SU3-Fine/Coarse Average	1	SU3	68.37	12.37	6.34	3.31	0.575	0.01	0.665	0.305	1.895	0.125	0.025	0.07	0.01	0.01	1443.5	1.41	62900	10	20	679.5	5	5.15	0.2	3	15	0.95	40
	24-GG1-SU3-Duplicate Fine/Coarse Average	1	SU3	67.85	12.73	6.25	3.07	0.655	0.01	0.755	0.345	2.255	0.14	0.025	0.075	0.01	0.015	2165	1.315	64900	10	20	668.5	5	4.9	0.2	2.5	19	1	43
	RPD			0.76	2.83	1.43	7.37	13.01	0.00	12.68	12.31	17.35	11.32	0.00	6.90	0.00	40.00	39.99	6.97	3.13	0.00	0.00	1.63	0.00	4.98	0.00	18.18	23.53	5.13	7.23
Sacramento	24-AL1-SU1-Fine/Coarse Average	1	SU1	42.67	4.14	15.08	0.64	3.575	0.535	7.595	0.2	0.08	0.155	0.01	0.025	0.01	0.01	6725	44.59	21250	10	20	300.5	5	68.4	101.5	5	15	1.45	668.5
	24-AL1-SU1-Duplicate Fine/Coarse Average	1	SU1	41.48	4.17	15.68	0.67	3.67	0.525	7.545	0.205	0.035	0.16	0.01	0.045	0.01	0.01	6915	50.36	21500	10	20	411	5	74.8	110	5.5	18.5	1.5	709
	RPD			2.83	0.84	3.90	3.83	2.62	1.89	0.66	2.47	78.26	3.17	0.00	57.14	0.00	0.00	2.79	12.15	1.17	0.00	0.00	31.06	0.00	8.94	8.04	9.52	20.90	3.39	5.88
Santiago 1	24-PA1-SU1-Fine/Coarse Average	1	SU1	70.62	13.97	4.16	4.03	0.605	0.085	0.085	0.5	0.135	0.125	0.01	0.075	0.01	0.01	68.5	38.215	73000	10	20	674	5	0.9	3.85	2.5	60.5	9.4	19.5
	24-PA1-SU1-Duplicate Fine/Coarse Average	1	SU1	69.86	14.49	4.40	4.17	0.64	0.085	0.09	0.54	0.14	0.135	0.01	0.075	0.01	0.01	58.5	31.915	72650	10	20	696.5	5	0.75	1.35	4	52	9.95	20.5
	RPD			1.08	3.62	5.61	3.29	5.62	0.00	5.71	7.69	3.64	7.69	0.00	0.00	0.00	0.00	15.75	17.97	0.48	0.00	0.00	3.28	0.00	18.18	96.15	46.15	15.11	5.68	5.00
Thunder	24-LP3-SU1-Fine/Coarse Average	3	SU1	83.35	3.19	6.83	1.24	0.165	0.01	0.07	0.14	0.06	0.035	0.02	0.01	0.01	0.01	300.5	5.06	16100	344.5	20	106.5	5	3	0.3	2	10	1.85	95.5
	24-LP3-SU1-Duplicate Fine/Coarse Average	3	SU1	83.46	3.19	6.85	1.28	0.17	0.01	0.07	0.14	0.06	0.035	0.02	0.01	0.01	0.01	317.5	4.96	15450	361	20	103.5	5	2.35	0.25	2	11.5	1.75	128
	RPD			0.13	0.16	0.22	2.78	2.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	2.00	4.12	4.68	0.00	2.86	0.00	24.30	18.18	0.00	13.95	5.56	29.08
Northgate	24-NG1-SU2-COMPOSITE-FINE	1	SU2	74.65	11.65	1.67	4.17	0.19	0.06	2.2	0.11	2.92	0.01	< 0.01	0.05	< 0.01	< 0.01	< 1	0.07	61,700	126	< 20	424	< 5	< 0.3	< 0.2	< 2	10	10	21
	24-NG1-SU2-COMPOSITE-DUP-FINE	1	SU2	74.13	11.49	1.77	4.16	0.21	0.08	2.61	0.11	2.89	0.02	< 0.01	0.04	< 0.01	< 0.01	< 1	0.05	62,100	138	< 20	449	5	0.4	< 0.2	3	19	11.2	24
	RPD			0.70	1.38	5.81	0.24	10.00	28.57	17.05	0.00	1.03	66.67	0.00	22.22	0.00	0.00	0.00	33.33	0.65	9.09	0.00	5.73	0.00	28.57	0.00	40.00	62.07	11.32	13.33
Wellington	23-BK1-SU4-Fine/Coarse Average	1	SU4	51.52	11.55	12.00	2.52	0.915	0.385	2.445	0.55	0.3	0.26	0.02	0.065	0.01	0.02	434	25.5	63200	161	45	667	5	8.85	125.5	8.9	32.5	10.6	372.5
	23-BK1-SU4-Duplicate Fine/Coarse Average	1	SU4	52.38	11.19	11.58	2.44	0.72	0.205	2.355	0.515	0.215	0.23	0.02	0.05	0.01	0.03	206.5	28.5	61100	168	46	510.5	5	7.6	94.75	6.2	37	10.2	325.5
	RPD			1.66	3.21	3.56	3.23	23.85	61.02	3.75	6.57	33.01	12.24	0.00	26.09	0.00	40.00	71.04	11.11	3.38	4.26	2.20	26.58	0.00	15.20	27.92	35.76	12.95	3.85	13.47
Wellington	23-BK1-SU6-Fine/Coarse Average	1	SU6	57.68	13.99	9.40	3.39	1.12	0.25	2.7	0.73	0.37	0.37	0.02	0.125	0.01	0.03	161.5	7	75400	87	35.5	1190	5	3.35	17.4	10.2	26.5	12.4	67.5
	23-BK1-SU6- Duplicate Fine/Coarse Average	1	SU6	55.90	13.86	10.15	3.34	1.145	0.35	2.76	0.725	0.3	0.385	0.015	0.1	0.01	0.025	57.5	7.5	74550	98	37	905	5	5	43.2	11.5	26	13.05	90
	RPD			3.13	0.97	7.68	1.49	2.21	33.33	2.20	0.69	20.90	3.97	28.57	22.22	0.00	18.18	94.98	6.90	1.13	11.89	4.14	27.21	0.00	39.52	85.15	11.98	1.90	5.11	28.57
Little Prince	23-LV1-SU1-Fine/Coarse Average	1	SU1	65.38	12.71	11.36	2.85	0.27	0.05	0.17	0.165	0.255	0.175	0.02	0.075	0.01	0.01	952	29	68150	122.5	29	659.5	5	91.2	3.25	1.95	10	5.25	416.5
	23-LV1-SU1-Duplicate Fine/Coarse Average	1	SU1	62.36	13.09	12.99	2.76	0.325	0.075	0.19	0.16	0.27	0.185	0.015	0.095	0.01	0.01	1076	43	70750	173	33	900	5	321.5	4.05	1.65	12.5	5.2	405
	RPD			4.73	2.99	13.39	3.03	18.49	40.00	11.11	3.08	5.71	5.56	28.57	23.53	0.00	0.00	12.23	38.89	3.74	34.18	12.90	30.84	0.00	111.61	21.92	16.67	22.22	0.96	2.80
Ballard	23-LV4-SU1-Fine/Coarse Average	4	SU1	58.61	9.96	18.42	0.93	0.205	0.235	0.085	0.29	0.165	0.37	0.05	0.105	0.01	0.01	1465	38.5	54400	1072.5	45	852.5	5	691	10.3	8.4	32	3.45	1339.5
	23-LV4-SU1-Duplicate Fine/Coarse Average	4	SU1	57.59	8.23	20.52	0.79	0.235	0.015	0.105	0.275	0.22	0.39	0.05	0.14	0.01	0.01	2810	59	44900	1724.5	51	1282	5	1540	12.9	2.2	38.5	4.05	1246
	RPD			1.76	18.97	10.79	16.28	13.64	176.00	21.05	5.31	28.57	5.26	0.00	28.57	0.00	0.00	62.92	42.05	19.13	46.62	12.50	40.24	0.00	76.11	22.41	116.98	18.44	16.00	7.23

Notes:

Highlights are associated with RPDs over 25%.

Green highlights are RPDs over 25% but at low concentrations and the results are similar.

Orange highlights are RPDs over 25% but the concentrations are relatively similar.

Yellow highlights are RPDs over 25% were there is significant discrpencies between values.

Red highlighted analytes are critical minerals or related to them (e.g., Ba is not a critical mineral, it is barite which is a barium sulfate mineral).

B and Re results are for informational purposes only.

Duplicates are not splits from the same sample (see text for explanation).

Duplicates are resamples of the same pile, along a similar grid, and subsamples were collected next to the originals.

ppb - parts per billion

ppm - parts per million

RPD - calculated relative percent difference between the average fine/coarse original samples and the average/fine coarse of the duplicate sample.

< - is less than reporting limit.

Table - Summary of relative percent differences between original sample and resample laboratory results.

Sample Area	Field No.	Subpile	Unit	Fe (%)	Ga (ppm)	Gd (ppm)	Ge (ppm)	Hf (ppm)	In (ppm)	Li (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	Pb (ppm)	Rb (ppm)	Re (ppm)	Sb (ppm)	Se (ppm)	Sn (ppm)	Sr (ppm)	Ta (ppm)	Tb (ppm)	Te (ppm)	Th (ppm)	Ti (ppm)	Ti (%)
Tip Top	24-GG1-SU3-Fine/Coarse Average	1	SU3	4.39	21	5.95	1.5	7.5	0.2	10	3.205	84	14	9.5	20	204.5	90.5	0.02	1	1	10.5	184.5	0.7	0.9	1.6	5.3	1855	0.186
	24-GG1-SU3-Duplicate Fine/Coarse Average	1	SU3	4.135	21	6.2	2	7	0.2	10	3.705	98.5	14	8.5	20	230.5	85	0.02	1	1	5	187	0.6	1.1	1.4	5.8	1920	0.192
	RPD			5.98	0.00	4.12	28.57	6.90	0.00	0.00	14.47	15.89	0.00	11.11	0.00	11.95	6.27	0.00	0.00	0.00	70.97	1.35	15.38	20.00	13.33	9.01	3.44	3.44
Sacramento	24-AL1-SU1-Fine/Coarse Average	1	SU1	10.01	7.5	1.55	1.5	4.5	18.25	15.5	20.8	4015	9	5.5	20	5850	42	0.02	2	1	5	49	0.5	0.25	2.4	4.55	1242	0.124
	24-AL1-SU1-Duplicate Fine/Coarse Average	1	SU1	9.805	8	1.4	1.5	4	20.6	16	21.75	3745	11.5	5	20	7180	43.5	0.02	4	1	5	50	0.5	0.2	2.1	4.85	1235	0.124
	RPD			2.07	6.45	10.17	0.00	11.76	12.10	3.17	4.47	6.96	24.39	9.52	0.00	20.41	3.51	0.00	66.67	0.00	0.00	2.02	0.00	22.22	13.33	6.38	0.57	0.57
Santiago 1	24-PA1-SU1-Fine/Coarse Average	1	SU1	2.86	18.5	5.6	2	5.5	0.5	10.5	3.38	643	3	13.5	20	2575	188	0.02	2	1	5	59.5	0.85	0.8	11.4	17.1	2995	0.3
	24-PA1-SU1-Duplicate Fine/Coarse Average	1	SU1	2.945	20	5.35	2	5.5	0.45	10	3.58	670.5	19	13	20	2600	196.5	0.02	2.5	1	5	59	0.9	0.75	10.75	17.1	3190	0.319
	RPD			2.93	7.79	4.57	0.00	0.00	10.53	4.88	5.75	4.19	145.45	3.77	0.00	0.97	4.42	0.00	22.22	0.00	0.00	0.84	5.71	6.45	5.87	0.00	6.31	6.31
Thunder	24-LP3-SU1-Fine/Coarse Average	3	SU1	4.59	3.5	1.1	1.5	3	0.2	10	0.851	53	5	5	20	126.5	38	0.02	28	1	5	108.5	0.5	0.2	1.1	1.95	803	0.08
	24-LP3-SU1-Duplicate Fine/Coarse Average	3	SU1	4.645	3	0.9	1	3	0.2	10	0.8675	74	7	5	20	102	38	0.02	24.5	1	5	101	0.5	0.2	1.75	1.65	790	0.079
	RPD			1.19	15.38	20.00	40.00	0.00	0.00	0.00	1.92	33.07	33.33	0.00	0.00	21.44	0.00	0.00	13.33	0.00	0.00	7.16	0.00	0.00	45.61	16.67	1.63	1.63
Northgate	24-NG1-SU2-COMPOSITE-FINE	1	SU2	1.11	23	3.9	2	5	< 0.2	23	1.02	488	31	19	< 20	39	288	< 0.02	2	< 1	7	58	4	0.9	< 0.5	11.8	618	0.06
	24-NG1-SU2-COMPOSITE-DUP-FINE	1	SU2	1.21	24	4.4	3	5	< 0.2	24	1.15	664	31	20	< 20	31	291	< 0.02	3	< 1	6	61	4.4	0.9	< 0.5	11.4	639	0.06
	RPD			8.62	4.26	12.05	40.00	0.00	0.00	4.26	11.98	30.56	0.00	5.13	0.00	22.86	1.04	0.00	40.00	0.00	15.38	5.04	9.52	0.00	0.00	3.45	3.34	3.34
Wellington	23-BK1-SU4-Fine/Coarse Average	1	SU4	8.575	16.5	4.26	2	4.5	15.7	28.5	0.555	3018.5	3.5	14	17.5	15750	109	0.02	19.55	1.5	32.5	153.5	0.8	0.605	0.185	12.25	3450	0.345
	23-BK1-SU4-Duplicate Fine/Coarse Average	1	SU4	8.31	16	3.755	2	4	14.7	31.5	0.415	1624.5	5	14	14	23850	106.5	0.02	21.55	2	10	127	0.75	0.53	0.185	11.8	3200	0.32
	RPD			3.14	3.08	12.60	0.00	11.76	6.58	10.00	28.87	60.05	35.29	0.00	22.22	40.91	2.32	0.00	9.73	28.57	105.88	18.89	6.45	13.22	0.00	3.74	7.52	7.52
Wellington	23-BK1-SU6-Fine/Coarse Average	1	SU6	6.68	20	5.68	2	5.5	4.7	26.5	0.66	1983.5	2	20.5	16	2456.5	141.5	0.02	4.7	1	5.5	198	1.05	0.745	0.15	14.95	4500	0.45
	23-BK1-SU6- Duplicate Fine/Coarse Average	1	SU6	7.155	20	5.215	2	5	7	24.5	0.67	2738	3	19	15.5	2149	140.5	0.02	4.65	1	5.5	159.5	1.05	0.715	0.255	13.9	4400	0.44
	RPD			6.87	0.00	8.54	0.00	9.52	39.32	7.84	1.50	31.96	40.00	7.59	3.17	13.35	0.71	0.00	1.07	0.00	0.00	21.54	0.00	4.11	51.85	7.28	2.25	2.25
Little Prince	23-LV1-SU1-Fine/Coarse Average	1	SU1	7.94	23	4.77	3	3.5	3.6	29	0.155	443.5	5	24	7	857.5	108.5	0.02	47.9	1	17.5	152.5	1.6	0.69	4.005	15.4	1000	0.1
	23-LV1-SU1-Duplicate Fine/Coarse Average	1	SU1	9.22	25	4.72	3.5	3.5	4.45	29.5	0.195	579	5	23	6.5	1219.5	110	0.02	66.25	1	18.5	160.5	1.6	0.73	5.095	16.35	1000	0.1
	RPD			14.92	8.33	1.05	15.38	0.00	21.12	1.71	22.86	26.50	0.00	4.26	7.41	34.86	1.37	0.00	32.15	0.00	5.56	5.11	0.00	5.63	23.96	5.98	0.00	0.00
Ballard	23-LV4-SU1-Fine/Coarse Average	4	SU1	13	18.5	3.925	5	4.5	10.4	36.5	0.105	1781	15.5	9	20.5	6660	40.6	0.02	164	1.5	15.5	415.5	0.55	0.55	17.4	6.7	1800	0.18
	23-LV4-SU1-Duplicate Fine/Coarse Average	4	SU1	14.725	19.5	3.845	6	3.5	10.2	37.5	0.115	138.5	25	8	24	8885	31.25	0.02	334	2	18	434	0.5	0.545	27.79	6.35	1750	0.175
	RPD			12.44	5.26	2.06	18.18	25.00	1.94	2.70	9.09	171.14	46.91	11.76	15.73	28.63	26.03	0.00	68.27	28.57	14.93	4.36	9.52	0.91	45.98	5.36	2.82	2.82

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< - is less than reporting limit.

Table - Summary of relative percent differences between original sample and resample laboratory results.

Sample Area	Field No.	Subpile	Unit	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Zn (ppm)	Zr (ppm)	Sc (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Y (ppm)
Tip Top	24-GG1-SU3-Fine/Coarse Average	1	SU3	1	2.5	42	63	83	272.5	5.5	34.5	71.5	8.5	32.5	5.9	1.35	5.95	0.9	6.4	1.415	4.45	0.625	4.3	0.7	38.35
	24-GG1-SU3-Duplicate Fine/Coarse Average	1	SU3	1	2.5	41.5	51.5	81	273	5.5	35	70	8.55	33.5	6.6	1.35	6.2	1.1	7.05	1.505	4.7	0.71	4.9	0.7	42.75
	RPD			0.00	0.00	1.20	20.09	2.44	0.18	0.00	1.44	2.12	0.59	3.03	11.20	0.00	4.12	20.00	9.67	6.16	5.46	12.73	13.04	0.00	10.85
Sacramento	24-AL1-SU1-Fine/Coarse Average	1	SU1	1	2	29.5	9	15500	170.5	5	11	26.5	2.65	10	2	0.35	1.55	0.25	1.5	0.33	1	0.17	1.25	0.2	9.05
	24-AL1-SU1-Duplicate Fine/Coarse Average	1	SU1	1	2	29.5	9.5	15700	180.5	5	11.5	27.5	2.8	10.5	1.9	0.35	1.4	0.2	1.5	0.305	0.95	0.16	1.2	0.2	8.45
	RPD			0.00	0.00	0.00	5.41	1.28	5.70	0.00	4.44	3.70	5.50	4.88	5.13	0.00	10.17	22.22	0.00	7.87	5.13	6.06	4.08	0.00	6.86
Santiago 1	24-PA1-SU1-Fine/Coarse Average	1	SU1	2.5	4.5	56.5	2.5	682	239.5	9	57.5	109.5	12.8	45.5	7.7	1.25	5.6	0.8	4.65	0.905	2.6	0.385	2.5	0.4	24.9
	24-PA1-SU1-Duplicate Fine/Coarse Average	1	SU1	2.5	4.5	59.5	3	378.5	240.5	9.5	57.5	108.5	12.65	45.5	7.6	1.2	5.35	0.75	4.2	0.785	2.05	0.33	2.1	0.35	21.15
	RPD			0.00	0.00	5.17	18.18	57.24	0.42	5.41	0.00	0.92	1.18	0.00	1.31	4.08	4.57	6.45	10.17	14.20	23.66	15.38	17.39	13.33	16.29
Thunder	24-LP3-SU1-Fine/Coarse Average	3	SU1	86	2.5	19.5	23.5	90.5	135.5	5	9	16	1.9	7	1.15	0.35	1.1	0.2	1.05	0.205	0.65	0.095	0.65	0.1	5.5
	24-LP3-SU1-Duplicate Fine/Coarse Average	3	SU1	80	2	19	2.5	98.5	134	5	8	14.5	1.7	6	1.05	0.3	0.9	0.2	0.95	0.19	0.6	0.095	0.7	0.1	5.4
	RPD			7.23	22.22	2.60	161.54	8.47	1.11	0.00	11.76	9.84	11.11	15.38	9.09	15.38	20.00	0.00	10.00	7.59	8.00	0.00	7.41	0.00	1.83
Northgate	24-NG1-SU2-COMPOSITE-FINE	1	SU2	4	8	18	13	30	118	< 5	10	20	2.5	9	2.9	< 0.3	3.9	0.9	6.1	1.36	4.5	0.79	5.8	0.9	42
	24-NG1-SU2-COMPOSITE-DUP-FINE	1	SU2	4	9	21	15	26	104	< 5	10	20	2.6	10	3.1	0.3	4.4	0.9	6.5	1.42	4.6	0.8	5.8	0.9	43.6
	RPD			0.00	11.76	15.38	14.29	14.29	12.61	0.00	0.00	0.00	3.92	10.53	6.67	0.00	12.05	0.00	6.35	4.32	2.20	1.26	0.00	0.00	3.74
Wellington	23-BK1-SU4-Fine/Coarse Average	1	SU4	2.7	4.335	118.5	12	22550	155.5	12	43.75	77.35	9.15	33.45	5.55	1.14	4.26	0.605	3.53	0.705	2.095	0.29	2.05	0.305	19.5
	23-BK1-SU4-Duplicate Fine/Coarse Average	1	SU4	4.1	4.42	130	12.5	16950	139.5	10.5	43.45	76	8.74	31.85	5.05	1.02	3.755	0.53	3.03	0.61	1.755	0.26	1.8	0.27	16.85
	RPD			41.18	1.94	9.26	4.08	28.35	10.85	13.33	0.69	1.76	4.58	4.90	9.43	11.11	12.60	13.22	15.24	14.45	17.66	10.91	12.99	12.17	14.58
Wellington	23-BK1-SU6-Fine/Coarse Average	1	SU6	2	4.16	144.5	19.5	3277	197.5	13.5	64.35	115.5	13.48	49.7	7.85	1.69	5.68	0.745	3.965	0.765	2.17	0.305	2	0.3	20.7
	23-BK1-SU6- Duplicate Fine/Coarse Average	1	SU6	2.05	4.14	145.5	21	7190	171.5	14	58.8	105	12.255	45.4	7.1	1.59	5.215	0.715	3.885	0.75	2.155	0.31	2	0.3	20.85
	RPD			2.47	0.48	0.69	7.41	74.77	14.09	3.64	9.01	9.52	9.52	9.04	10.03	6.10	8.54	4.11	2.04	1.98	0.69	1.63	0.00	0.00	0.72
Little Prince	23-LV1-SU1-Fine/Coarse Average	1	SU1	4.3	12.86	24	15.5	677	90.7	5	29.1	57.2	7.155	27.4	5.55	1.125	4.77	0.69	3.905	0.76	2.12	0.305	2.05	0.295	21.8
	23-LV1-SU1-Duplicate Fine/Coarse Average	1	SU1	5.05	12.81	22.5	18.5	718	89.8	5	26	52.85	6.725	26.5	5.55	0.995	4.72	0.73	4.13	0.79	2.255	0.325	2.15	0.31	22.75
	RPD			16.04	0.39	6.45	17.65	5.88	1.00	0.00	11.25	7.91	6.20	3.34	0.00	12.26	1.05	5.63	5.60	3.87	6.17	6.35	4.76	4.96	4.26
Ballard	23-LV4-SU1-Fine/Coarse Average	4	SU1	27.6	20.27	37	22	1354.5	159.5	5.5	21.15	43.35	5.125	20.2	3.8	1.06	3.925	0.55	3.04	0.565	1.545	0.24	1.6	0.235	14.65
	23-LV4-SU1-Duplicate Fine/Coarse Average	4	SU1	46.45	15.94	39	30	947.5	122.5	5.5	18.4	39.7	4.65	18	3.7	0.895	3.845	0.545	2.89	0.55	1.485	0.205	1.45	0.205	13.8
	RPD			50.91	23.92	5.26	30.77	35.36	26.24	0.00	13.91	8.79	9.72	11.52	2.67	16.88	2.06	0.91	5.06	2.69	3.96	15.73	9.84	13.64	5.98

Notes:

Highlights are associated with RPDs over 20%.

Green highlights are RPDs over 20% but at low concentrations and the results are similar.

Orange highlights are RPDs over 20% but the concentrations are relatively similar.

Yellow highlights are RPDs over 20% were there is significant discrpencies between values.

Red highlighted analytes are critical minerals or related to them (e.g., Ba is not a critical mineral, it is barite which is a barium sulfate mineral).

B and Re results are for informational purposes only.

Duplicates are not splits from the same sample (see text for explanation).

Duplicates are resamples of the same pile, along a similar grid, and subsamples were collected next to the originals.

ppb - parts per billion

ppm - parts per million

RPD - calculated relative percent difference between the average fine/coarse original samples and the average/fine coarse of the duplicate sample.

< - is less than reporting limit.

APPENDIX D

Table - Breece Hill Area Summary of Laboratory Results.

Sample Name	23-LV1-SU1	23-LV2-SU1	23-LV2-SU2	23-LV2-SU3	23-LV3-SU1	23-LV3-SU2	23-LV3-SU3	23-LV4-SU1	23-LV4-SU2	23-LV4-SU3	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock				
Area	Little Prince	President	President	President	Penn 3	Penn 3	Penn 3	Ballard	Ballard	Ballard				
Sample Unit	SU1	SU1	SU2	SU3	SU1	SU2	SU3	SU1	SU2	SU3				
Lat	39.2505	39.2488	39.24891	39.24906	39.24851	39.24872	39.24903	39.25038	39.25049	39.25051				
Long	-106.24724	-106.24331	-106.2431	-106.24324	-106.24541	-106.24544	-106.2454	-106.24343	-106.24338	-106.24288				
Elevation (ft amsl)	11140	11390	11380	11400	11280	11280	11270	11375	11375	11375				
Volume (m^3) Est.[2]	6,552	3,511	704	7,887	41,224	19,263	13,521	5,852	5,707	13,274				
SiO_2 (%)	65.38	60.07	65.62	56.19	52.10	57.19	45.74	58.61	62.15	60.83	--	--	60.6	66.6
Al_2O_3 (%)	12.71	13.43	14.79	14.33	10.73	11.31	9.19	9.96	10.13	7.10	--	--	15.9	15.4
Fe_2O_3 (%)	11.36	11.64	8.47	17.13	24.75	18.60	32.63	18.42	16.70	19.82	--	--	na	na
K_2O (%)	2.85	3.04	2.12	2.55	1.96	2.20	1.32	0.93	0.93	0.95	--	--	1.81	2.8
MgO (%)	0.27	1.52	0.54	0.53	0.34	0.62	0.52	0.21	0.22	0.23	--	--	4.66	2.48
MnO (%)	0.05	0.03	0.01	0.055	0.02	0.025	0.055	0.235	0.39	0.02	--	--	0.1	0.1
CaO (%)	0.17	0.095	0.07	0.065	0.05	0.065	0.145	0.085	0.095	0.115	--	--	6.41	3.59
TiO_2 (%)	0.165	0.36	0.29	0.355	0.35	0.36	0.3	0.29	0.345	0.305	--	--	0.72	0.64
Na_2O (%)	0.255	0.065	0.05	0.095	0.12	0.105	0.1	0.165	0.07	0.16	--	--	3.07	3.27
P_2O_5 (%)	0.175	0.305	0.26	0.275	0.26	0.315	0.22	0.37	0.325	0.39	--	--	0.13	0.15
SrO (%)	0.02	0.05	0.035	0.04	0.035	0.035	0.035	0.05	0.05	0.035	--	--	na	na
BaO (%)	0.075	0.115	0.17	0.115	0.185	0.115	0.195	0.105	0.07	0.08	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	--	--	na	na
LOI (%)	6.590	8.954	7.549	8.145	8.749	8.689	9.100	18.251	6.575	8.639	--	--	na	na
Au (ppm)	0.952	1.555	2.62	1.379	5.22	4.64	2.365	1.465	3.748	2.555	0.02	0.03	0.003	0.0018
Ag (ppm)	29	12	22	17.5	39.5	39.5	39	38.5	28.5	55.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	1	1.5	1	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	68,150	71,950	79,100	77,850	58,200	62,700	49,750	54,400	54,800	38,800	420,500	841,000	84,100	80,400
F (%)	0.069	0.127	0.124	0.114	0.082	0.113	0.078	0.073	0.072	0.055	0.28	0.553	0.0553	na
Fe (ppm)	79,400	82,100	59,200	120,900	176,650	132,950	228,400	130,000	118,650	142,150	353,500	707,000	70,700	35,000
Fe (%)	7.94	8.21	5.92	12.09	17.67	13.30	22.84	13	11.87	14.22	35.35	70.7	7.07	3.5
Mg (ppm)	1,550	9,250	3,250	3,100	1,900	3,700	3,050	1,050	1,200	1,150	160,000	320,000	32,000	13,300
Ti (ppm)	1,000	2,150	1,700	2,150	2,150	2,300	1,800	1,800	2,100	1,950	27,000	54,000	5,400	3,900
Ti (%)	0.10	0.22	0.17	0.22	0.22	0.23	0.18	0.18	0.21	0.20	2.7	5.4	0.5	0.39
As (ppm)	122.5	77.5	100	137.5	751.5	504	936.5	1,073	679.5	1,571	5.0	10	1	1.5
B (ppm)	29	30	23.5	37.5	62	47.5	63	45	50.5	48	50	100	10	15
Ba (ppm)	659.5	1,149	1,529	1,013	1,561	1,120	2,065	852.5	649	782.5	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	91.2	69.25	84.8	182	462	490.5	373.5	691	343.5	1,795	0.3	0.6	0.06	0.127
Cd (ppm)	3.25	0.95	0.75	1.3	2.25	2.1	3.8	10.3	12.6	15.65	0.49	0.98	0.098	0.098
Co (ppm)	1.95	1.95	1.45	2.3	1.15	1.65	3.3	8.4	9.55	2.3	145	290	29	17
Cr (ppm)	<10	10	16	12.5	26.5	21.5	28	32	35.5	25	925	1,850	185	85
Cs (ppm)	5.25	4.8	3.85	3.85	4.4	4.85	4.05	3.45	3.55	4	7.5	15	1.5	4.8
Cu (ppm)	416.5	726	714.5	930.5	1,088	885	1,997	1,340	1,368	876.5	375	750	75	25
Ga (ppm)	23	28.5	34	34.5	40	38	43.5	18.5	22.5	25	90	180	18	17
Ge (ppm)	3	2	3	3	4	4	4	5	4.5	6.5	8	16	1.6	1.6
Hf (ppm)	3.5	6.5	5	4.5	4	5	3	4.5	4.5	5	15	30	3.0	5.8
In (ppm)	3.6	4.65	7.25	5.3	9.3	7.45	20.25	10.4	7.35	7.8	0.25	0.5	0.05	0.05
Li (ppm)	29	15	21	18	21	22.5	22	36.5	41.5	37	65	130	13	20
Mn (ppm)	443.5	267.5	157.5	404.5	164.5	275	462	1,781	3,034	204.5	7,000	14,000	1,400	600
Mo (ppm)	5	6.5	5.5	8	9	11.5	6.5	15.5	12	26.5	5	10	1.0	1.5
Nb (ppm)	24	15	16	14	12.5	13	7.5	9	9	9	55	110	11	12.5
Ni (ppm)	7	6.5	18.5	7.5	8.5	7.5	11.5	20.5	16.5	11	640	1,280	128	50
Pb (ppm)	857.5	721	1,316	1,203	3,210	2,967	1,407	6,660	4,884	6,921	40	80	8.0	16
Rb (ppm)	108.5	128.5	103.4	112.5	75.6	89.0	56	40.6	39.7	36.8	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	47.9	10.5	24.6	28.75	181	145	172.5	164	116.75	357	1	2	0.2	0.2
Se (ppm)	1	2	1.5	1	<1	2	1	1.5	1	1.5	250	500	50	50
Sn (ppm)	17.5	19	19.5	23	52	34.5	57.5	15.5	7.5	18.5	13	25	2.5	5.5
Sr (ppm)	152.5	397	382	327.5	240	317	257	415.5	436.5	356.5	1,300	2,600	260	350
Ta (ppm)	1.6	1	1.1	0.9	0.8	0.85	<0.5	0.55	0.55	0.55	5	10	1.0	1.1
Te (ppm)	4.01	30.06	36.67	28.84	36.72	33.62	26.79	17.40	15.09	23.62	1.50	3	0.3	0.003
Th (ppm)	15.4	12.9	11.05	12.8	10.1	12.3	9.3	6.7	7.4	7.35	21	42	4.2	10.7
Tl (ppm)	4.3	1.75	2.2	2.3	5.9	5.8	9.9	27.6	9.7	31.55	1.8	3.6	0.36	0.75
U (ppm)	12.9	12.2	9.2	10.1	13.3	13.5	15.3	20.3	19.9	12.1	5.5	11	1.1	2.8
V (ppm)	24	41	33	38.5	46	42	50	37	36	36.5	1,150	2,300	230	110
W (ppm)	15.5	32	25	43	51	39.5	54	22	19	43.5	5	10	1	2
Zn (ppm)	677	532	179.5	200.5	311.5	280.5	331.5	1,355	1,699	1,008	400	800	80	71
Zr (ppm)	90.7	206	153.5	148.5	129	157.5	101.7	159.5	162	185	500	1,000	100	190
Sc (ppm)	5	5.5	5.5	5.5	7.5	6.5	9	5.5	5	5	150	300	30	13
La (ppm)	29.1	39.55	32.1	26.95	29.3	40	27.3	21.15	23.2	29.7	80	160	16	30
Ce (ppm)	57.2	81.75	63.5	55.4	56.95	76.2	56.6	43.35	46.5	56.65	165	330	33	64
Pr (ppm)	7.16	9.34	7.22	6.41	6.74	8.87	6.23	5.13	5.42	6.61	19.5	39	3.9	7.1
Nd (ppm)	27.4	35.9	26.85	24.75	25.35	33.65	23.3	20.2	20.5	24.55	80	160	16	26
Sm (ppm)	5.55	6.45	4.75	4.65	4.85	6.3	4.4	3.8	4.1	4.6	17.5	35	3.5	4.5
Eu (ppm)	1.13	1.95	1.34	1.20	1.14	1.52	1.02	1.06	1.17	1.06	5.5	11	1.1	0.88
Gd (ppm)	4.77	5.86	4.66	3.85	4.30	5.43	3.99	3.93	4.52	4.11	16.5	33	3.3	3.8
Tb (ppm)	0.69	0.81	0.64	0.49	0.60	0.72	0.57	0.55	0.65	0.58	3	6	0.6	0.64
Dy (ppm)	3.91	4.52	3.44	2.44	3.12	3.56	3.06	3.04	3.55	3.18	18.5	37	3.7	3.5
Ho (ppm)	0.76	0.91	0.68	0.44	0.59	0.64	0.59	0.57	0.65	0.6	3.9	7.8	0.78	0.8
Er (ppm)	2.12	2.5	1.96	1.26	1.65	1.76	1.72	1.55	1.76	1.65	11	22	2.2	2.3
Tm (ppm)	0.31	0.37	0.29	0.19	0.25	0.25	0.25	0.24	0.27	0.24	1.6	3.2	0.32	0.33
Yb (ppm)	2.05	2.55	1.85	1.35	1.7	1.75	1.75	1.6	1.8	1.55	11	22	2.2	2.2
Lu (ppm)	0.30	0.37	0.28	0.22	0.25	0.26	0.25	0.24	0.27	0.25	1.5	3	0.3	0.32
Y (ppm)	21.8	26.6	20.2	12.3	15.4	17.3	15.9	14.7	17.3	15.6	100	200	20	22
TotalREE	169.2	224.9	175.2	147.4	159.7	204.7	155.9	126.5	136.6	155.9				
TotalLREE	132.3	180.8	140.4	123.2	128.6	172.0	122.8	98.6	105.4	127.3				
TotalHREE	31.9	38.6	29.3	18.7	23.5	26.2	24.0	22.4	26.2	23.6				
%LREE	78	80	80	84	81	84	79	78	77	82				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Brooklyn Summary of Laboratory Results.

Sample Name	23-SJ3-SU1	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock				
Area	Brooklyn				
Sample Unit	SU1				
Lat	37.860974				
Long	-107.715598				
Elevation (ft amsl)	11430				
Volume (m^3) Est.[2]	34,458				
SiO_2 (%)	59.98	--	--	60.6	66.6
Al_2O_3 (%)	17.82	--	--	15.9	15.4
Fe_2O_3 (%)	5.82	--	--	na	na
K_2O (%)	4.91	--	--	1.81	2.8
MgO (%)	0.82	--	--	4.66	2.48
MnO (%)	0.06	--	--	0.1	0.1
CaO (%)	0.17	--	--	6.41	3.59
TiO_2 (%)	1.06	--	--	0.72	0.64
Na_2O (%)	0.17	--	--	3.07	3.27
P_2O_5 (%)	0.14	--	--	0.13	0.15
SrO (%)	0.015	--	--	na	na
BaO (%)	0.11	--	--	na	na
Cr_2O_3 (%)	<0.01	--	--	na	na
V_2O_5 (%)	0.035	--	--	na	na
LOI (%)	4.579	--	--	na	na
Au (ppm)	5.19	0.02	0.03	0.003	0.0018
Ag (ppm)	28.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	94,450	420,500	841,000	84,100	80,400
F (%)	0.078	0.28	0.553	0.0553	na
Fe (ppm)	40,500	353,500	707,000	70,700	35,000
Fe (%)	4.05	35.35	70.7	7.07	3.5
Mg (ppm)	4,750	160,000	320,000	32,000	13,300
Ti (ppm)	6,400	27,000	54,000	5,400	3,900
Ti (%)	0.64	2.7	5.4	0.5	0.39
As (ppm)	75	5.0	10	1	1.5
B (ppm)	47	50	100	10	15
Ba (ppm)	997	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	26.1	0.3	0.6	0.06	0.127
Cd (ppm)	1.05	0.49	0.98	0.098	0.098
Co (ppm)	2	145	290	29	17
Cr (ppm)	12.5	925	1,850	185	85
Cs (ppm)	8.15	7.5	15	1.5	4.8
Cu (ppm)	115.5	375	750	75	25
Ga (ppm)	24	90	180	18	17
Ge (ppm)	1	8	16	1.6	1.6
Hf (ppm)	6.5	15	30	3.0	5.8
In (ppm)	2	0.25	0.5	0.05	0.05
Li (ppm)	14.5	65	130	13	20
Mn (ppm)	410	7,000	14,000	1,400	600
Mo (ppm)	7	5	10	1.0	1.5
Nb (ppm)	19	55	110	11	12.5
Ni (ppm)	7	640	1,280	128	50
Pb (ppm)	2,706	40	80	8.0	16
Rb (ppm)	213.5	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	29.6	1	2	0.2	0.2
Se (ppm)	1	250	500	50	50
Sn (ppm)	7.5	13	25	2.5	5.5
Sr (ppm)	125	1,300	2,600	260	350
Ta (ppm)	1.3	5	10	1.0	1.1
Te (ppm)	10.2	1.50	3	0.3	0.003
Th (ppm)	19.35	21	42	4.2	10.7
Tl (ppm)	5.15	1.8	3.6	0.36	0.75
U (ppm)	6.02	5.5	11	1.1	2.8
V (ppm)	164	1,150	2,300	230	110
W (ppm)	6	5	10	1	2
Zn (ppm)	341.5	400	800	80	71
Zr (ppm)	230	500	1,000	100	190
Sc (ppm)	15.5	150	300	30	13
La (ppm)	48.15	80	160	16	30
Ce (ppm)	90.5	165	330	33	64
Pr (ppm)	10.69	19.5	39	3.9	7.1
Nd (ppm)	37.1	80	160	16	26
Sm (ppm)	6.05	17.5	35	3.5	4.5
Eu (ppm)	1.05	5.5	11	1.1	0.88
Gd (ppm)	4.24	16.5	33	3.3	3.8
Tb (ppm)	0.54	3	6.0	0.6	0.64
Dy (ppm)	3.49	18.5	37	3.7	3.5
Ho (ppm)	0.73	3.9	7.8	0.78	0.8
Er (ppm)	2.17	11	22	2.2	2.3
Tm (ppm)	0.34	1.6	3.2	0.32	0.33
Yb (ppm)	2.35	11	22	2.2	2.2
Lu (ppm)	0.38	1.5	3	0.3	0.32
Y (ppm)	21.55	100	200	20	22
TotalREE	244.8				
TotalLREE	197.8				
TotalHREE	31.5				
%LREE	81				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Columbus Summary of Laboratory Results.

Sample Name	24-LP1-SU1	24-LP1-SU2	24-LP1-SU3	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Tailings(?)/Waste Rock				
Area	Columbus	Columbus	Columbus				
Sample Unit	SU1	SU2	SU3				
Lat	37.42792	37.4277	37.42762				
Long	-108.01705	-108.01685	-108.01711				
Elevation (ft amsl)	11735	11720	11715				
Volume (m^3) Est.[2]	3,749	5,646	689				
SiO_2 (%)	71.37	64.59	61.65	--	--	60.6	66.6
Al_2O_3 (%)	13.14	15.44	18.27	--	--	15.9	15.4
Fe_2O_3 (%)	3.16	5.39	4.90	--	--	na	na
K_2O (%)	3.06	3.2	4.27	--	--	1.81	2.8
MgO (%)	0.35	0.84	0.52	--	--	4.66	2.48
MnO (%)	<0.01	0.065	0.05	--	--	0.1	0.1
CaO (%)	0.075	2.07	0.73	--	--	6.41	3.59
TiO_2 (%)	0.61	0.685	0.82	--	--	0.72	0.64
Na_2O (%)	0.06	1.23	0.11	--	--	3.07	3.27
P_2O_5 (%)	0.19	0.28	0.3	--	--	0.13	0.15
SrO (%)	0.12	0.095	0.135	--	--	na	na
BaO (%)	0.66	0.53	0.155	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.045	0.03	0.035	--	--	na	na
LOI (%)	6.766	4.770	7.219	--	--	na	na
Au (ppm)	3.195	0.312	1.0655	0.02	0.03	0.003	0.0018
Ag (ppm)	6.92	1.56	1.29	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	68,850	79,300	95,300	420,500	841,000	84,100	80,400
F (%)	0.202	0.152	0.265	0.28	0.553	0.0553	na
Fe (ppm)	21,750	36,600	33,450	353,500	707,000	70,700	35,000
Fe (%)	2.18	3.66	3.35	35.35	70.7	7.07	3.5
Mg (ppm)	1,780	4,670	2,860	160,000	320,000	32,000	13,300
Ti (ppm)	3,615	4,075	4,790	27,000	54,000	5,400	3,900
Ti (%)	0.362	0.408	0.479	2.7	5.4	0.5	0.39
As (ppm)	699.5	404.5	394.5	5.0	10	1	1.5
B (ppm)	88	57	164.5	50	100	10	15
Ba (ppm)	5,840	4,600	1,361	1,250	2,500	250	550
Be (ppm)	<5	<5	5.5	7.5	15	1.5	3.0
Bi (ppm)	<0.3	<0.3	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	0.4	<0.2	0.35	0.49	0.98	0.098	0.098
Co (ppm)	2	7	4.5	145	290	29	17
Cr (ppm)	<10	<10	<10	925	1,850	185	85
Cs (ppm)	20.7	17.45	37.4	7.5	15	1.5	4.8
Cu (ppm)	13.5	18.5	10.5	375	750	75	25
Ga (ppm)	17	17.5	20	90	180	18	17
Ge (ppm)	8.5	5.5	8	8	16	1.6	1.6
Hf (ppm)	3.5	3.5	3.5	15	30	3.0	5.8
In (ppm)	<0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	50	41	51	65	130	13	20
Mn (ppm)	60	524	400	7,000	14,000	1,400	600
Mo (ppm)	34	22.5	5	5	10	1.0	1.5
Nb (ppm)	8.5	10.5	9.5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	119	90.5	65.5	40	80	8.0	16
Rb (ppm)	92.5	85.5	133	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	90	50	43	1	2	0.2	0.2
Se (ppm)	1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	982.5	809	1,179	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	3.7	0.85	3.7	1.50	3	0.3	0.003
Th (ppm)	2.9	3.2	3.05	21	42	4.2	10.7
Tl (ppm)	9	7	2.5	1.8	3.6	0.36	0.75
U (ppm)	5.5	3.5	3	5.5	11	1.1	2.8
V (ppm)	254.5	163.5	191.5	1,150	2,300	230	110
W (ppm)	54.5	40	107.5	5	10	1	2
Zn (ppm)	148	93.5	109.5	400	800	80	71
Zr (ppm)	122	151	141.5	500	1,000	100	190
Sc (ppm)	5.5	7	8.5	150	300	30	13
La (ppm)	21.5	25	25.5	80	160	16	30
Ce (ppm)	41	49.5	52	165	330	33	64
Pr (ppm)	5	5.9	6.25	19.5	39	3.9	7.1
Nd (ppm)	19.5	23.5	25	80	160	16	26
Sm (ppm)	3.85	4.4	4.75	17.5	35	3.5	4.5
Eu (ppm)	1	1.2	1.4	5.5	11	1.1	0.88
Gd (ppm)	2.7	3.5	3.9	16.5	33	3.3	3.8
Tb (ppm)	0.35	0.5	0.5	3	6	0.6	0.64
Dy (ppm)	2.2	3.05	3.2	18.5	37	3.7	3.5
Ho (ppm)	0.4	0.6	0.585	3.9	7.8	0.78	0.8
Er (ppm)	1.2	1.75	1.7	11	22	2.2	2.3
Tm (ppm)	0.165	0.24	0.23	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	1.75	1.6	11	22	2.2	2.2
Lu (ppm)	0.15	0.25	0.2	1.5	3	0.3	0.32
Y (ppm)	12.1	16.8	16.15	100	200	20	22
TotalREE	117.8	144.9	151.5				
TotalLREE	94.6	113.0	118.8				
TotalHREE	17.8	24.9	24.2				
%LREE	80	78	78				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Doyle Group Summary of Laboratory Results.

Sample Name	24-LP2-SU1	24-LP2-SU2	24-LP2-SU2-GRAB	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample				
Area	Doyle	Doyle	Doyle				
Sample Unit	SU1	SU2	SU2				
Lat	37.42366	37.42361	37.42361				
Long	-108.10332	-108.10381	-108.10381				
Elevation (ft amsl)		11440	11440				
Volume (m^3) Est.[2]	12,454	3,347	na				
SiO_2 (%)	72.24	80.5	33.53	--	--	60.6	66.6
Al_2O_3 (%)	9.01	6.69	9.39	--	--	15.9	15.4
Fe_2O_3 (%)	6.985	4.32	31.93	--	--	na	na
K_2O (%)	3.78	3.99	7.84	--	--	1.81	2.8
MgO (%)	0.2	0.13	<0.01	--	--	4.66	2.48
MnO (%)	0.02	<0.01	<0.01	--	--	0.1	0.1
CaO (%)	1.435	0.31	0.03	--	--	6.41	3.59
TiO_2 (%)	0.22	0.19	0.21	--	--	0.72	0.64
Na_2O (%)	0.375	0.15	0.27	--	--	3.07	3.27
P_2O_5 (%)	0.085	0.05	0.02	--	--	0.13	0.15
SrO (%)	<0.01	0.01	<0.01	--	--	na	na
BaO (%)	0.055	0.06	0.09	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.03	0.015	0.02	--	--	na	na
LOI (%)	5.406	3.675	16.79	--	--	na	na
Au (ppm)	4.145	4.354	0.447	0.02	0.03	0.003	0.0018
Ag (ppm)	2.12	4.11	1.98	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	46,100	34,500	48,800	420,500	841,000	84,100	80,400
F (%)	0.055	0.026	0.007	0.28	0.553	0.0553	na
Fe (ppm)	48,550	28,750	227,000	353,500	707,000	70,700	35,000
Fe (%)	4.86	2.88	22.7	35.35	70.7	7.07	3.5
Mg (ppm)	1101.5	659.5	<100	160,000	320,000	32,000	13,300
Ti (ppm)	1,330	1,116	1,220	27,000	54,000	5,400	3,900
Ti (%)	0.133	0.112	0.122	2.7	5.4	0.5	0.39
As (ppm)	59.5	44.5	<10	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	497	486	820	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	17.4	24.1	8.2	0.3	0.6	0.06	0.127
Cd (ppm)	0.3	0.45	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	5.5	5	378	145	290	29	17
Cr (ppm)	12.5	20	<10	925	1,850	185	85
Cs (ppm)	5.2	2.25	<0.5	7.5	15	1.5	4.8
Cu (ppm)	82.5	28	<10	375	750	75	25
Ga (ppm)	15	8.5	9	90	180	18	17
Ge (ppm)	3.5	1.5	<1	8	16	1.6	1.6
Hf (ppm)	4.5	4	3	15	30	3.0	5.8
In (ppm)	1.6	0.4	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	14	46	<10	65	130	13	20
Mn (ppm)	185.5	56	15	7,000	14,000	1,400	600
Mo (ppm)	6	10	15	5	10	1.0	1.5
Nb (ppm)	5.5	5.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	209	640	1,280	128	50
Pb (ppm)	82	286.5	130	40	80	8.0	16
Rb (ppm)	88	88.5	163	185	370	37	112
Re (ppm)	<0.02	<0.02	0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	7.5	11	<1	1	2	0.2	0.2
Se (ppm)	7	7	26	250	500	50	50
Sn (ppm)	16.5	7.5	<5	13	25	2.5	5.5
Sr (ppm)	117.5	81.5	110	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	9.15	5	2.3	1.50	3	0.3	0.003
Th (ppm)	3.5	2	0.7	21	42	4.2	10.7
Tl (ppm)	2	1.5	<1	1.8	3.6	0.36	0.75
U (ppm)	8	6	5	5.5	11	1.1	2.8
V (ppm)	148	83	74	1,150	2,300	230	110
W (ppm)	56	19	8	5	10	1	2
Zn (ppm)	108	97.5	38	400	800	80	71
Zr (ppm)	200.5	175.5	122	500	1,000	100	190
Sc (ppm)	<5	<5	<5	150	300	30	13
La (ppm)	27.5	15	6	80	160	16	30
Ce (ppm)	42	25.5	8	165	330	33	64
Pr (ppm)	4.5	2.85	0.8	19.5	39	3.9	7.1
Nd (ppm)	17	10	3	80	160	16	26
Sm (ppm)	2.9	1.9	0.9	17.5	35	3.5	4.5
Eu (ppm)	0.95	0.55	0.3	5.5	11	1.1	0.88
Gd (ppm)	2.4	1.45	1.3	16.5	33	3.3	3.8
Tb (ppm)	0.3	0.25	0.3	3	6	0.6	0.64
Dy (ppm)	2.3	1.4	1.7	18.5	37	3.7	3.5
Ho (ppm)	0.48	0.285	0.31	3.9	7.8	0.78	0.8
Er (ppm)	1.45	0.9	0.9	11	22	2.2	2.3
Tm (ppm)	0.215	0.13	0.14	1.6	3.2	0.32	0.33
Yb (ppm)	1.65	1.05	1	11	22	2.2	2.2
Lu (ppm)	0.25	0.15	0.1	1.5	3	0.3	0.32
Y (ppm)	12.8	7.7	9.3	100	200	20	22
TotalREE	116.7	69.1	34.1				
TotalLREE	97.3	57.3	20.3				
TotalHREE	19.4	11.9	13.8				
%LREE	83	83	60				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Highland Mary Summary of Laboratory Results.

Sample Name	23-SJ4-SU1-Composite-Fine	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Tailings				
Area	Highland Mary				
Sample Unit	SU1				
Lat	37.789408				
Long	-107.578615				
Elevation (ft amsl)	10455				
Volume (m^3) Est.[2]	47,616				
SiO_2 (%)	82.47	--	--	60.6	66.6
Al_2O_3 (%)	8.06	--	--	15.9	15.4
Fe_2O_3 (%)	2.19	--	--	na	na
K_2O (%)	3.08	--	--	1.81	2.8
MgO (%)	0.52	--	--	4.66	2.48
MnO (%)	0.19	--	--	0.1	0.1
CaO (%)	0.53	--	--	6.41	3.59
TiO_2 (%)	0.33	--	--	0.72	0.64
Na_2O (%)	0.04	--	--	3.07	3.27
P_2O_5 (%)	0.12	--	--	0.13	0.15
SrO (%)	0.02	--	--	na	na
BaO (%)	0.06	--	--	na	na
Cr_2O_3 (%)	<0.01	--	--	na	na
V_2O_5 (%)	0.01	--	--	na	na
LOI (%)	7.71	--	--	na	na
Au (ppm)	0.905	0.02	0.03	0.003	0.0018
Ag (ppm)	31	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	42,400	420,500	841,000	84,100	80,400
F (%)	0.072	0.28	0.553	0.0553	na
Fe (ppm)	15,400	353,500	707,000	70,700	35,000
Fe (%)	1.54	35.35	70.7	7.07	3.5
Mg (ppm)	3,000	160,000	320,000	32,000	13,300
Ti (ppm)	2,000	27,000	54,000	5,400	3,900
Ti (%)	0.2	2.7	5.4	0.5	0.39
As (ppm)	42	5.0	10	1	1.5
B (ppm)	35	50	100	10	15
Ba (ppm)	606	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	0.1	0.3	0.6	0.06	0.127
Cd (ppm)	2.6	0.49	0.98	0.098	0.098
Co (ppm)	5.9	145	290	29	17
Cr (ppm)	15	925	1,850	185	85
Cs (ppm)	13.8	7.5	15	1.5	4.8
Cu (ppm)	159	375	750	75	25
Ga (ppm)	10	90	180	18	17
Ge (ppm)	1	8	16	1.6	1.6
Hf (ppm)	3	15	30	3.0	5.8
In (ppm)	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	101	65	130	13	20
Mn (ppm)	1,475	7,000	14,000	1,400	600
Mo (ppm)	84	5	10	1.0	1.5
Nb (ppm)	8	55	110	11	12.5
Ni (ppm)	131	640	1,280	128	50
Pb (ppm)	1,536	40	80	8.0	16
Rb (ppm)	207	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	53.3	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<1	13	25	2.5	5.5
Sr (ppm)	38	1,300	2,600	260	350
Ta (ppm)	<0.5	5	10	1.0	1.1
Te (ppm)	0.25	1.50	3	0.3	0.003
Th (ppm)	8.6	21	42	4.2	10.7
Tl (ppm)	3.8	1.8	3.6	0.36	0.75
U (ppm)	2.98	5.5	11	1.1	2.8
V (ppm)	57	1,150	2,300	230	110
W (ppm)	10	5	10	1	2
Zn (ppm)	470	400	800	80	71
Zr (ppm)	130	500	1,000	100	190
Sc (ppm)	7	150	300	30	13
La (ppm)	21.1	80	160	16	30
Ce (ppm)	38.8	165	330	33	64
Pr (ppm)	4.51	19.5	39	3.9	7.1
Nd (ppm)	15.8	80	160	16	26
Sm (ppm)	2.9	17.5	35	3.5	4.5
Eu (ppm)	0.66	5.5	11	1.1	0.88
Gd (ppm)	2.54	16.5	33	3.3	3.8
Tb (ppm)	0.33	3	6.0	0.6	0.64
Dy (ppm)	2.1	18.5	37	3.7	3.5
Ho (ppm)	0.4	3.9	7.8	0.78	0.8
Er (ppm)	1.15	11	22	2.2	2.3
Tm (ppm)	0.19	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	11	22	2.2	2.2
Lu (ppm)	0.19	1.5	3	0.3	0.32
Y (ppm)	12.1	100	200	20	22
TotalREE	111.0				
TotalLREE	86.3				
TotalHREE	17.7				
%LREE	78				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REE HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on igniti LOI - lost on ignition.

LREE - Light REEs LREE - Light REEs include La through Gd.

m3 - cubic meters m3 - cubic meters.

na - not available. na - not available.

ppb - parts per bil ppb - parts per billion.

ppm - parts per m ppm - parts per million.

TotalREE - Total R TotalREE - Total REEs include all the REEs + Sc.

Table - Mayflower Summary of Laboratory Results.

Sample Name	23-SJ1-SU1-comp1	23-SJ1-SU1-comp2	23-SJ1-SU1-Grab1	23-SJ1-SU1-Grab2	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Tailings/Fill	Tailings	Grab/Tailings	Grab/Tailings				
Area	Mayflower	Mayflower	Mayflower	Mayflower				
Sample Unit	SU1	SU1	SU1	SU1				
Lat	37.819536	37.819774	37.81859	37.819791				
Long	-107.645594	-107.647834	-107.646679	-107.644936				
Elevation (ft amsl)	9436		9372	9436				
Volume (m^3) Est.[2]	3,000,120	same waste pile	na	na				
SiO_2 (%)	68.87	67.56	83.63	67.61	--	--	60.6	66.6
Al_2O_3 (%)	8.36	9.31	6.85	2.44	--	--	15.9	15.4
Fe_2O_3 (%)	5.10	8.30	1.62	2.3	--	--	na	na
K_2O (%)	2.20	2.46	2.05	0.6	--	--	1.81	2.8
MgO (%)	0.99	0.93	0.39	0.33	--	--	4.66	2.48
MnO (%)	4.44	1.15	0.95	10.78	--	--	0.1	0.1
CaO (%)	1.80	1.14	0.24	4.12	--	--	6.41	3.59
TiO_2 (%)	0.41	0.48	0.46	0.11	--	--	0.72	0.64
Na_2O (%)	0.59	0.88	0.19	0.08	--	--	3.07	3.27
P_2O_5 (%)	0.18	0.19	0.04	0.07	--	--	0.13	0.15
SrO (%)	0.01	0.03	<0.01	<0.01	--	--	na	na
BaO (%)	0.07	0.06	0.06	0.02	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.01	0.015	0.01	<0.01	--	--	na	na
LOI (%)	5.315	5.690	1.920	4.850	--	--	na	na
Au (ppm)	0.9315	1.4975	1.33	2.03	0.02	0.03	0.003	0.0018
Ag (ppm)	29.5	17.5	17	99	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	43,950	49,500	36,200	13,400	420,500	841,000	84,100	80,400
F (%)	0.293	0.184	0.065	2.359	0.28	0.553	0.0553	na
Fe (ppm)	35,650	58,000	11,100	16,000	353,500	707,000	70,700	35,000
Fe (%)	3.57	5.8	1.11	1.6	35.35	70.7	7.07	3.5
Mg (ppm)	5,900	5,550	2,200	1,900	160,000	320,000	32,000	13,300
Ti (ppm)	2,500	2,850	2,800	600	27,000	54,000	5,400	3,900
Ti (%)	0.25	0.29	0.28	0.06	2.7	5.4	0.5	0.39
As (ppm)	34	35.5	10	32	5.0	10	1	1.5
B (ppm)	15	27	17	<10	50	100	10	15
Ba (ppm)	514.5	531	550	137	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	12.1	14.25	13.7	17.7	0.3	0.6	0.06	0.127
Cd (ppm)	36.65	31.55	7.6	105	0.49	0.98	0.098	0.098
Co (ppm)	7.7	13.6	0.6	2.4	145	290	29	17
Cr (ppm)	11	11	<10	<10	925	1,850	185	85
Cs (ppm)	4.9	5.25	4.9	2.7	7.5	15	1.5	4.8
Cu (ppm)	944.5	993.5	266	2,041	375	750	75	25
Ga (ppm)	18.5	15.5	12	20	90	180	18	17
Ge (ppm)	1	1	1	1	8	16	1.6	1.6
Hf (ppm)	3.5	3.5	3	<1	15	30	3.0	5.8
In (ppm)	3.8	4.55	1.2	5.3	0.25	0.5	0.05	0.05
Li (ppm)	41	37.5	36	42	65	130	13	20
Mn (ppm)	33,135	9,072	7,196	80,280	7,000	14,000	1,400	600
Mo (ppm)	11.5	9	10	13	5	10	1.0	1.5
Nb (ppm)	7.5	9	8	2	55	110	11	12.5
Ni (ppm)	8.5	14.5	6	<5	640	1,280	128	50
Pb (ppm)	5,555	4,138	1,986	11,900	40	80	8.0	16
Rb (ppm)	110.5	122.4	126	43.1	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	20.25	16.7	22	47.4	1	2	0.2	0.2
Se (ppm)	1.5	2	<1	2	250	500	50	50
Sn (ppm)	2	3	3	1	13	25	2.5	5.5
Sr (ppm)	142.5	193	73	37	1,300	2,600	260	350
Ta (ppm)	0.65	0.65	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	6.17	8.01	2.97	6.6	1.50	3	0.3	0.003
Th (ppm)	10.05	11.05	7.2	2.5	21	42	4.2	10.7
Tl (ppm)	2.35	2.35	3.2	1.1	1.8	3.6	0.36	0.75
U (ppm)	3.06	3.73	2.37	1.28	5.5	11	1.1	2.8
V (ppm)	69	73	68	21	1,150	2,300	230	110
W (ppm)	90.5	56.5	63	139	5	10	1	2
Zn (ppm)	7,941	7,504	2,196	28,700	400	800	80	71
Zr (ppm)	110.45	123.55	94.3	26	500	1,000	100	190
Sc (ppm)	8.5	9	8	<5	150	300	30	13
La (ppm)	21.35	26.15	12.7	6.7	80	160	16	30
Ce (ppm)	40.75	48.75	23.3	13	165	330	33	64
Pr (ppm)	4.9	5.89	2.69	1.67	19.5	39	3.9	7.1
Nd (ppm)	17.6	20.4	9.4	6.1	80	160	16	26
Sm (ppm)	3.4	3.75	1.6	1.2	17.5	35	3.5	4.5
Eu (ppm)	0.91	0.92	0.43	0.75	5.5	11	1.1	0.88
Gd (ppm)	2.8	3.15	1.26	1.27	16.5	33	3.3	3.8
Tb (ppm)	0.38	0.43	0.19	0.18	3	6.0	0.6	0.64
Dy (ppm)	2.27	2.45	1.3	1.11	18.5	37	3.7	3.5
Ho (ppm)	0.445	0.49	0.28	0.2	3.9	7.8	0.78	0.8
Er (ppm)	1.29	1.45	0.89	0.48	11	22	2.2	2.3
Tm (ppm)	0.2	0.21	0.15	0.06	1.6	3.2	0.32	0.33
Yb (ppm)	1.25	1.45	1	0.4	11	22	2.2	2.2
Lu (ppm)	0.19	0.22	0.16	0.06	1.5	3	0.3	0.32
Y (ppm)	13.55	14.95	8.7	6.9	100	200	20	22
TotalREE	119.8	139.6	72.1	40.1				
TotalLREE	91.7	109.0	51.4	30.7				
TotalHREE	19.6	21.6	12.7	9.4				
%LREE	77	78	71	77				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume, estimated volumes include the entire waste pile (only a portion was sampled).

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Montezuma Peruvian Summary of Laboratory Results.

Sample Name	23-MZ3-SU1	23-MZ3-SU2	23-MZ3-SU1-Grab	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample				
Area	Peruvian	Peruvian	Peruvian				
Sample Unit	SU1	SU2	SU1				
Lat	39.61458	39.614719	39.61458				
Long	-105.798757	-105.798623	-105.798757				
Elevation (ft amsl)	11530	11530	11530				
Volume (m^3) Est.[2]	9,900	3,847	na				
SiO_2 (%)	66.05	68.17	34.45	--	--	60.6	66.6
Al_2O_3 (%)	10.78	13.51	1.25	--	--	15.9	15.4
Fe_2O_3 (%)	5.81	5.26	12.8	--	--	na	na
K_2O (%)	3.37	4.21	0.33	--	--	1.81	2.8
MgO (%)	0.66	0.84	0.2	--	--	4.66	2.48
MnO (%)	0.06	0.05	6.29	--	--	0.1	0.1
CaO (%)	0.07	0.12	0.08	--	--	6.41	3.59
TiO_2 (%)	0.48	0.64	0.05	--	--	0.72	0.64
Na_2O (%)	0.17	0.32	0.5	--	--	3.07	3.27
P_2O_5 (%)	0.14	0.16	0.04	--	--	0.13	0.15
SrO (%)	0.11	0.035	0.21	--	--	na	na
BaO (%)	1.8	0.32	5.58	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	<0.01	0.015	<0.01	--	--	na	na
LOI (%)	6.435	7.293	na	--	--	na	na
Au (ppm)	0.182	0.181	0.29	0.02	0.03	0.003	0.0018
Ag (ppm)	175	26.5	>200	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	58,500	71,900	6,400	420,500	841,000	84,100	80,400
F (%)	0.177	0.206	0.020	0.28	0.553	0.0553	na
Fe (ppm)	40,850	36,150	90,600	353,500	707,000	70,700	35,000
Fe (%)	4.09	3.62	9.06	35.35	70.7	7.07	3.5
Mg (ppm)	3,900	4,900	1,200	160,000	320,000	32,000	13,300
Ti (ppm)	3,100	3,850	300	27,000	54,000	5,400	3,900
Ti (%)	0.31	0.385	0.03	2.7	5.4	0.5	0.39
As (ppm)	281	98.5	838	5.0	10	1	1.5
B (ppm)	33	34.5	21	50	100	10	15
Ba (ppm)	>10,000	2,789	5,444	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	54.4	15.7	80	0.3	0.6	0.06	0.127
Cd (ppm)	21.2	4.75	366	0.49	0.98	0.098	0.098
Co (ppm)	1.05	1.55	1.1	145	290	29	17
Cr (ppm)	33.5	42.5	<10	925	1,850	185	85
Cs (ppm)	10.8	12.2	2	7.5	15	1.5	4.8
Cu (ppm)	513.5	124.5	5,026	375	750	75	25
Ga (ppm)	16.5	21	9	90	180	18	17
Ge (ppm)	3.5	3	6	8	16	1.6	1.6
Hf (ppm)	7.5	8	<1	15	30	3.0	5.8
In (ppm)	5.5	1.9	60.5	0.25	0.5	0.05	0.05
Li (ppm)	14	14.5	12	65	130	13	20
Mn (ppm)	427	385	51,239	7,000	14,000	1,400	600
Mo (ppm)	9.5	3	5	5	10	1.0	1.5
Nb (ppm)	14.5	17.5	2	55	110	11	12.5
Ni (ppm)	9.5	9	8	640	1,280	128	50
Pb (ppm)	20,350	5,204	80,020	40	80	8.0	16
Rb (ppm)	199	234.5	21.1	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	661.5	104.3	1,977	1	2	0.2	0.2
Se (ppm)	<1	<1	3	250	500	50	50
Sn (ppm)	11.5	10	1	13	25	2.5	5.5
Sr (ppm)	892	364.5	1,845	1,300	2,600	260	350
Ta (ppm)	0.85	0.95	<0.5	5	10	1.0	1.1
Te (ppm)	1.24	1.62	0.46	1.50	3	0.3	0.003
Th (ppm)	18.75	16.45	4.1	21	42	4.2	10.7
Tl (ppm)	3.5	3.7	2.1	1.8	3.6	0.36	0.75
U (ppm)	2.12	2.57	1.16	5.5	11	1.1	2.8
V (ppm)	45.5	59	<5	1,150	2,300	230	110
W (ppm)	4	4	1	5	10	1	2
Zn (ppm)	4,277	1,223	119,300	400	800	80	71
Zr (ppm)	266.5	293	33.2	500	1,000	100	190
Sc (ppm)	8	11	<5	150	300	30	13
La (ppm)	74.6	78.5	14.2	80	160	16	30
Ce (ppm)	154.5	159.5	28.8	165	330	33	64
Pr (ppm)	18.93	19.19	3.51	19.5	39	3.9	7.1
Nd (ppm)	63.3	65.9	12.2	80	160	16	26
Sm (ppm)	9.65	10.25	1.9	17.5	35	3.5	4.5
Eu (ppm)	1.27	1.65	0.25	5.5	11	1.1	0.88
Gd (ppm)	6.46	7.29	1.26	16.5	33	3.3	3.8
Tb (ppm)	0.84	0.94	0.12	3	6.0	0.6	0.64
Dy (ppm)	4.72	5.36	0.65	18.5	37	3.7	3.5
Ho (ppm)	0.95	1.04	0.1	3.9	7.8	0.78	0.8
Er (ppm)	2.66	2.90	0.29	11	22	2.2	2.3
Tm (ppm)	0.40	0.4	<0.05	1.6	3.2	0.32	0.33
Yb (ppm)	2.45	2.6	0.3	11	22	2.2	2.2
Lu (ppm)	0.39	0.41	<0.05	1.5	3	0.3	0.32
Y (ppm)	27.3	30.45	3.0	100	200	20	22
TotalREE	376.4	397.4	66.6				
TotalLREE	328.7	342.3	62.1				
TotalHREE	39.7	44.1	4.5				
%LREE	87	86	93				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Montezuma Peruvian West Area Summary of Laboratory Results.

Sample Name	23-MZ1-SU1	23-MZ2-SU1	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock				
Area	Peruvian West area (MZ1)	Peruvian West area (MZ2)				
Sample Unit	SU1	SU1				
Lat	39.607883	39.607893				
Long	-105.802599	-105.803938				
Elevation (ft amsl)	11200	11320				
Volume (m^3) Est.[2]	2,908	1,444				
SiO_2 (%)	70.47	60.50	--	--	60.6	66.6
Al_2O_3 (%)	15.61	16.67	--	--	15.9	15.4
Fe_2O_3 (%)	2.61	3.91	--	--	na	na
K_2O (%)	4.78	5.12	--	--	1.81	2.8
MgO (%)	0.77	0.84	--	--	4.66	2.48
MnO (%)	0.06	0.02	--	--	0.1	0.1
CaO (%)	0.12	0.09	--	--	6.41	3.59
TiO_2 (%)	0.65	0.69	--	--	0.72	0.64
Na_2O (%)	0.25	0.36	--	--	3.07	3.27
P_2O_5 (%)	0.075	0.115	--	--	0.13	0.15
SrO (%)	0.02	0.07	--	--	na	na
BaO (%)	0.17	1.45	--	--	na	na
Cr_2O_3 (%)	0.01	0.015	--	--	na	na
V_2O_5 (%)	0.015	0.015	--	--	na	na
LOI (%)	4.540	5.589	--	--	na	na
Au (ppm)	0.034	0.1575	0.02	0.03	0.003	0.0018
Ag (ppm)	4.0	44.5	0.40	0.8	0.08	0.05
Pd (ppb)	<1	1	5.0	10	1	0.5
Pt (ppb)	<10	<10	2.5	5	0.5	0.5
Al (ppm)	84,250	89,050	420,500	841,000	84,100	80,400
F (%)	0.135	0.202	0.28	0.553	0.0553	na
Fe (ppm)	18,200	27,200	353,500	707,000	70,700	35,000
Fe (%)	1.82	2.72	35.35	70.7	7.07	3.5
Mg (ppm)	4,650	4,950	160,000	320,000	32,000	13,300
Ti (ppm)	3,950	4,200	27,000	54,000	5,400	3,900
Ti (%)	0.395	0.42	2.7	5.4	0.5	0.39
As (ppm)	19	141.5	5.0	10	1	1.5
B (ppm)	30.5	30.5	50	100	10	15
Ba (ppm)	1,537	>10,000	1,250	2,500	250	550
Be (ppm)	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	16.7	28.0	0.3	0.6	0.06	0.127
Cd (ppm)	0.2	17.3	0.49	0.98	0.098	0.098
Co (ppm)	2.0	1.7	145	290	29	17
Cr (ppm)	76	100	925	1,850	185	85
Cs (ppm)	8.9	7.4	7.5	15	1.5	4.8
Cu (ppm)	22	44.5	375	750	75	25
Ga (ppm)	20.5	27	90	180	18	17
Ge (ppm)	2.0	2.0	8	16	1.6	1.6
Hf (ppm)	8.5	8.0	15	30	3.0	5.8
In (ppm)	0.5	3	0.25	0.5	0.05	0.05
Li (ppm)	11	<10	65	130	13	20
Mn (ppm)	420.5	225	7,000	14,000	1,400	600
Mo (ppm)	2.5	4.0	5	10	1.0	1.5
Nb (ppm)	16	17	55	110	11	12.5
Ni (ppm)	7.5	9.0	640	1,280	128	50
Pb (ppm)	702	22,550	40	80	8.0	16
Rb (ppm)	236	277	185	370	37	112
Re (ppm)	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	8.6	88.25	1	2	0.2	0.2
Se (ppm)	<1	1.0	250	500	50	50
Sn (ppm)	5.0	8.0	13	25	2.5	5.5
Sr (ppm)	157	661.5	1,300	2,600	260	350
Ta (ppm)	0.9	1.15	5	10	1.0	1.1
Te (ppm)	1.26	1.86	1.50	3	0.3	0.003
Th (ppm)	13	16.3	21	42	4.2	10.7
Tl (ppm)	4.05	4.3	1.8	3.6	0.36	0.75
U (ppm)	2.8	3.6	5.5	11	1.1	2.8
V (ppm)	66.5	81	1,150	2,300	230	110
W (ppm)	6.5	13	5	10	1	2
Zn (ppm)	71.5	6,173	400	800	80	71
Zr (ppm)	283.5	275	500	1,000	100	190
Sc (ppm)	13	16	150	300	30	13
La (ppm)	67	67.8	80	160	16	30
Ce (ppm)	136	138	165	330	33	64
Pr (ppm)	16.49	17.03	19.5	39	3.9	7.1
Nd (ppm)	61.6	60.3	80	160	16	26
Sm (ppm)	10.1	11.35	17.5	35	3.5	4.5
Eu (ppm)	1.65	1.68	5.5	11	1.1	0.88
Gd (ppm)	7.09	9.00	16.5	33	3.3	3.8
Tb (ppm)	1.03	1.29	3	6.0	0.6	0.64
Dy (ppm)	5.77	7.8	18.5	37	3.7	3.5
Ho (ppm)	1.15	1.65	3.9	7.8	0.78	0.8
Er (ppm)	3.37	4.96	11	22	2.2	2.3
Tm (ppm)	0.49	0.78	1.6	3.2	0.32	0.33
Yb (ppm)	3.25	5.2	11	22	2.2	2.2
Lu (ppm)	0.51	0.80	1.5	3	0.3	0.32
Y (ppm)	31	50.45	100	200	20	22
TotalREE	359.5	394.0				
TotalLREE	299.9	305.1				
TotalHREE	46.6	72.9				
%LREE	83	77				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Northgate Summary of Laboratory Results.

Sample Name	24-NG1-SU1	24-NG1-SU2	24-NG1-SU3	24-NG1-SU1-GRAB1	24-NG1-SU1-GRAB2	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Tailings	Tailings	Rock Grab Sample	Rock Grab Sample				
Area	Northgate	Northgate	Northgate	Northgate	Northgate				
Sample Unit	SU1	SU2	SU3	SU1	SU1				
Lat	40.92808	40.92034	40.92031	40.92808	40.92808				
Long	-106.27881	-106.27589	-106.27047	-106.27881	-106.27881				
Elevation (ft amsl)	8430	8130	8130	8430	8430				
Volume (m^3) Est.[2]	45,930	1,137,925	1,973,416	na	na				
SiO_2 (%)	62.89	74.65	72.71	2.17	77.56	--	--	60.6	66.6
Al_2O_3 (%)	11.39	11.65	10.16	0.14	10.54	--	--	15.9	15.4
Fe_2O_3 (%)	3.41	1.67	2.43	0.14	1.9	--	--	na	na
K_2O (%)	3.67	4.17	3.63	0.06	4.9	--	--	1.81	2.8
MgO (%)	0.54	0.19	0.23	<0.01	0.07	--	--	4.66	2.48
MnO (%)	0.015	0.06	0.05	<0.01	<0.01	--	--	0.1	0.1
CaO (%)	8.0	2.2	5.15	>60.00	0.48	--	--	6.41	3.59
TiO_2 (%)	0.325	0.11	0.13	<0.01	0.07	--	--	0.72	0.64
Na_2O (%)	2.20	2.92	2.51	<0.01	2.25	--	--	3.07	3.27
P_2O_5 (%)	0.13	0.01	0.03	0.03	<0.01	--	--	0.13	0.15
SrO (%)	0.015	<0.01	0.02	<0.01	<0.01	--	--	na	na
BaO (%)	0.065	0.05	0.07	0.01	0.13	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.01	<0.01	<0.01	<0.01	<0.01	--	--	na	na
LOI (%)	5.540	1.470	2.520	0.570	1.810	--	--	na	na
Au (ppb)	1.5	<1	1.0	1.0	2.0		30	3	1.8
Au (ppm)	0.0015	<0.001	0.001	0.001	0.002	0.02	0.03	0.003	0.0018
Ag (ppm)	0.075	0.07	0.13	0.01	0.02	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	59,800	61,700	54,100	808	55,000	420,500	841,000	84,100	80,400
F (%)	5.14	1.25	3.26	18	0.05	0.28	0.553	0.0553	na
Fe (ppm)	23,400	11,100	16,600	837	12,800	353,500	707,000	70,700	35,000
Fe (%)	2.34	1.11	1.66	0.0837	1.28	35.35	70.7	7.07	3.5
Mg (ppm)	3,085	1,020	1,240	<100	231	160,000	320,000	32,000	13,300
Ti (ppm)	1,935	618	819	<100	382	27,000	54,000	5,400	3,900
Ti (%)	0.194	0.062	0.082	<0.01	0.038	2.7	5.4	0.5	0.39
As (ppm)	282	126	189	36	923	5.0	10	1	1.5
B (ppm)	<20	<20	<20	<20	<20	50	100	10	15
Ba (ppm)	518.5	424	599	<10	1,100	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	0.45	<0.3	<0.3	<0.3	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	0.25	<0.2	<0.2	<0.2	0.3	0.49	0.98	0.098	0.098
Co (ppm)	2.5	<2	3	<2	<2	145	290	29	17
Cr (ppm)	26	10	<10	<10	<10	925	1,850	185	85
Cs (ppm)	8.4	10	9.6	<0.5	2.5	7.5	15	1.5	4.8
Cu (ppm)	25	21	23	<10	<10	375	750	75	25
Ga (ppm)	23	23	19	<1	13	90	180	18	17
Ge (ppm)	1.0	2.0	2.0	<1	1	8	16	1.6	1.6
Hf (ppm)	3.0	5.0	4.0	<2	2	15	30	3.0	5.8
In (ppm)	<0.2	<0.2	<0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	26	23	24	<10	28	65	130	13	20
Mn (ppm)	167	488	406	<10	22	7,000	14,000	1,400	600
Mo (ppm)	164	31	34	9	290	5	10	1.0	1.5
Nb (ppm)	17	19	24	<5	20	55	110	11	12.5
Ni (ppm)	<20	<20	<20	<20	<20	640	1,280	128	50
Pb (ppm)	24.5	39	39	<10	25	40	80	8.0	16
Rb (ppm)	171.5	288	224	3	179	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	7.0	2.0	4.0	<1	4	1	2	0.2	0.2
Se (ppm)	1	<1	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	7	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	124	58	87	55	93	1,300	2,600	260	350
Ta (ppm)	1.2	4	5.2	1.4	1.5	5	10	1.0	1.1
Te (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	1.50	3	0.3	0.003
Th (ppm)	17.75	11.8	12.6	1.7	5.1	21	42	4.2	10.7
Tl (ppm)	8.0	4.0	4.0	<1	21	1.8	3.6	0.36	0.75
U (ppm)	6.5	8.0	9.0	<1	14	5.5	11	1.1	2.8
V (ppm)	49	18	24	<10	13	1,150	2,300	230	110
W (ppm)	21	13	13	2.0	3.0	5	10	1	2
Zn (ppm)	33.5	30	30	<10	<10	400	800	80	71
Zr (ppm)	103	118	<100	<100	<100	500	1,000	100	190
Sc (ppm)	7.0	<5	<5	<5	<5	150	300	30	13
La (ppm)	24	10	15	9.0	<4	80	160	16	30
Ce (ppm)	48.5	20	29	21	4.0	165	330	33	64
Pr (ppm)	5.9	2.5	3.6	3.1	<0.5	19.5	39	3.9	7.1
Nd (ppm)	21.5	9.0	13	14	2.0	80	160	16	26
Sm (ppm)	4.85	2.9	3.7	6.1	1.1	17.5	35	3.5	4.5
Eu (ppm)	0.6	<0.3	0.4	0.7	<0.3	5.5	11	1.1	0.88
Gd (ppm)	5.25	3.9	4.7	11.1	3.1	16.5	33	3.3	3.8
Tb (ppm)	0.9	0.9	0.9	2.3	0.8	3	6	0.6	0.64
Dy (ppm)	5.75	6.1	6.8	15.2	6.7	18.5	37	3.7	3.5
Ho (ppm)	1.25	1.36	1.5	3.23	1.65	3.9	7.8	0.78	0.8
Er (ppm)	3.85	4.5	4.8	8.5	5.4	11	22	2.2	2.3
Tm (ppm)	0.585	0.79	0.77	1.15	0.79	1.6	3.2	0.32	0.33
Yb (ppm)	3.95	5.8	5.7	6.9	5.2	11	22	2.2	2.2
Lu (ppm)	0.6	0.9	0.9	0.9	0.8	1.5	3	0.3	0.32
Y (ppm)	39.8	42	46.4	209	49.6	100	200	20	22
TotalREE	174.3	110.7	137.2	312.2	81.1				
TotalLREE	110.6	48.3	69.4	65.0	10.2				
TotalHREE	56.7	62.4	67.8	247.2	70.9				
%LREE	63	44	51	21	13				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume, estimated volumes include the entire waste pile (only a portion was sampled).

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - North Star Summary of Laboratory Results.

Sample Name	23-SJ2-SU1	23-SJ2-SU2	23-SJ2-SU2-Grab	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Rock Grab Sample				
Area	North Star	North Star	North Star				
Sample Unit	SU1	SU2	SU2				
Lat	37.806428	37.806614	37.806614				
Long	-107.683731	-107.683739	-107.683739				
Elevation (ft amsl)	9524	9524	9524				
Volume (m^3) Est.[2]	3,238	13,244	na				
SiO_2 (%)	67.72	65.44	59.04	--	--	60.6	66.6
Al_2O_3 (%)	14.71	15.03	4.74	--	--	15.9	15.4
Fe_2O_3 (%)	3.81	5.80	9.24	--	--	na	na
K_2O (%)	4.14	4.58	1.49	--	--	1.81	2.8
MgO (%)	0.63	0.75	0.2	--	--	4.66	2.48
MnO (%)	0.02	0.06	0.17	--	--	0.1	0.1
CaO (%)	0.09	0.11	0.07	--	--	6.41	3.59
TiO_2 (%)	0.62	0.64	0.21	--	--	0.72	0.64
Na_2O (%)	0.12	0.27	0.04	--	--	3.07	3.27
P_2O_5 (%)	0.16	0.19	0.04	--	--	0.13	0.15
SrO (%)	0.025	0.015	0.002	--	--	na	na
BaO (%)	0.1	0.095	0.025	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.02	0.015	<0.01	--	--	na	na
LOI (%)	3.010	5.835	na	--	--	na	na
Au (ppm)	0.5235	0.6605	13.13	0.02	0.03	0.003	0.0018
Ag (ppm)	89	31	>200	0.40	0.8	0.08	0.05
Pd (ppb)	<1	1	<0.01	5.0	10	1	0.5
Pt (ppb)	<10	<10	<0.01	2.5	5	0.5	0.5
Al (ppm)	79,300	79,200	25,900	420,500	841,000	84,100	80,400
F (%)	0.150	0.129	0.042	0.28	0.553	0.0553	na
Fe (ppm)	26,700	40,700	67,900	353,500	707,000	70,700	35,000
Fe (%)	2.67	4.07	6.79	35.35	70.7	7.07	3.5
Mg (ppm)	3,700	4,300	1,200	160,000	320,000	32,000	13,300
Ti (ppm)	3,800	3,800	1,300	27,000	54,000	5,400	3,900
Ti (%)	0.38	0.38	0.13	2.7	5.4	0.5	0.39
As (ppm)	262	286	1,196	5.0	10	1	1.5
B (ppm)	140.5	111.5	48	50	100	10	15
Ba (ppm)	862.5	919	230	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	19.05	41.25	45.2	0.3	0.6	0.06	0.127
Cd (ppm)	4.5	1.45	67	0.49	0.98	0.098	0.098
Co (ppm)	0.75	1.5	5	145	290	29	17
Cr (ppm)	11	15.5	<10	925	1,850	185	85
Cs (ppm)	28.75	24.3	4	7.5	15	1.5	4.8
Cu (ppm)	307.5	259	2,329	375	750	75	25
Ga (ppm)	20.5	20.5	8	90	180	18	17
Ge (ppm)	2	1.5	2	8	16	1.6	1.6
Hf (ppm)	6	6.5	2	15	30	3.0	5.8
In (ppm)	0.6	0.6	3.6	0.25	0.5	0.05	0.05
Li (ppm)	64.5	41.5	46	65	130	13	20
Mn (ppm)	214.5	442.5	1,491	7,000	14,000	1,400	600
Mo (ppm)	18.5	8.5	9	5	10	1.0	1.5
Nb (ppm)	14	15.5	4	55	110	11	12.5
Ni (ppm)	6	6	5	640	1,280	128	50
Pb (ppm)	13,700	3,133	107,200	40	80	8.0	16
Rb (ppm)	279.5	293	79.9	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	659.5	371	2,157	1	2	0.2	0.2
Se (ppm)	3.5	4	7	250	500	50	50
Sn (ppm)	2	2.5	1	13	25	2.5	5.5
Sr (ppm)	229	132	16	1,300	2,600	260	350
Ta (ppm)	0.95	0.95	<0.5	5	10	1.0	1.1
Te (ppm)	4.08	2.63	12.08	1.50	3	0.3	0.003
Th (ppm)	14.5	15.8	6.6	21	42	4.2	10.7
Tl (ppm)	5.8	5.25	1.7	1.8	3.6	0.36	0.75
U (ppm)	3.44	3.89	1.99	5.5	11	1.1	2.8
V (ppm)	90	97	39	1,150	2,300	230	110
W (ppm)	89	61	14	5	10	1	2
Zn (ppm)	956.5	386	11,800	400	800	80	71
Zr (ppm)	223	225.5	60.7	500	1,000	100	190
Sc (ppm)	8	9.5	<5	150	300	30	13
La (ppm)	41.7	45.85	18.2	80	160	16	30
Ce (ppm)	76.15	87.1	34.2	165	330	33	64
Pr (ppm)	8.85	10.21	4.06	19.5	39	3.9	7.1
Nd (ppm)	30.35	34.5	13.9	80	160	16	26
Sm (ppm)	5.1	5.85	3.5	17.5	35	3.5	4.5
Eu (ppm)	1.12	1.23	0.62	5.5	11	1.1	0.88
Gd (ppm)	3.37	4.15	1.85	16.5	33	3.3	3.8
Tb (ppm)	0.44	0.55	0.25	3	6.0	0.6	0.64
Dy (ppm)	2.77	3.25	1.48	18.5	37	3.7	3.5
Ho (ppm)	0.57	0.67	0.29	3.9	7.8	0.78	0.8
Er (ppm)	1.67	1.95	0.87	11	22	2.2	2.3
Tm (ppm)	0.26	0.29	0.12	1.6	3.2	0.32	0.33
Yb (ppm)	1.65	1.9	0.8	11	22	2.2	2.2
Lu (ppm)	0.26	0.29	0.11	1.5	3	0.3	0.32
Y (ppm)	17.35	20.3	9.2	100	200	20	22
TotalREE	199.6	227.6	89.5				
TotalLREE	166.6	188.9	76.3				
TotalHREE	25.0	29.2	13.1				
%LREE	83	83	85				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Orphan Boy Summary of Laboratory Results.

Sample Name	24-AL2-SU1	24-AL2-SU1-GRAB	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Rock Grab Sample				
Area	Orphan Boy	Orphan Boy				
Sample Unit	SU1	SU1				
Lat	39.27818	39.27818				
Long	-106.10169	-106.10169				
Elevation (ft amsl)	10745	10745				
Volume (m^3) Est.[2]	31,190	na				
SiO_2 (%)	61.43	38.91	--	--	60.6	66.6
Al_2O_3 (%)	9.17	0.45	--	--	15.9	15.4
Fe_2O_3 (%)	10.37	39.89	--	--	na	na
K_2O (%)	2.93	0.06	--	--	1.81	2.8
MgO (%)	1.13	0.05	--	--	4.66	2.48
MnO (%)	0.1	<0.01	--	--	0.1	0.1
CaO (%)	2.22	0.05	--	--	6.41	3.59
TiO_2 (%)	0.26	0.02	--	--	0.72	0.64
Na_2O (%)	0.28	<0.01	--	--	3.07	3.27
P_2O_5 (%)	0.095	<0.01	--	--	0.13	0.15
SrO (%)	<0.01	<0.01	--	--	na	na
BaO (%)	0.055	<0.01	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	<0.01	<0.01	--	--	na	na
LOI (%)	8.53	21.23	--	--	na	na
Au (ppm)	2.135	0.198	0.02	0.03	0.003	0.0018
Ag (ppm)	93.49	42.56	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	2.5	5	0.5	0.5
Al (ppm)	46,400	2,340	420,500	841,000	84,100	80,400
F (%)	0.0865	0.0071	0.28	0.553	0.0553	na
Fe (ppm)	72,600	230,000	353,500	707,000	70,700	35,000
Fe (%)	7.26	23	35.35	70.7	7.07	3.5
Mg (ppm)	6,605	217	160,000	320,000	32,000	13,300
Ti (ppm)	1,410	137	27,000	54,000	5,400	3,900
Ti (%)	0.141	0.014	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	5.0	10	1	1.5
B (ppm)	<20	<20	50	100	10	15
Ba (ppm)	493.5	12	1,250	2,500	250	550
Be (ppm)	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	93.7	31.8	0.3	0.6	0.06	0.127
Cd (ppm)	31.5	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	7	78	145	290	29	17
Cr (ppm)	10	<10	925	1,850	185	85
Cs (ppm)	3.3	<0.5	7.5	15	1.5	4.8
Cu (ppm)	411.5	<10	375	750	75	25
Ga (ppm)	12	<1	90	180	18	17
Ge (ppm)	2	<1	8	16	1.6	1.6
Hf (ppm)	4	<2	15	30	3.0	5.8
In (ppm)	6.25	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	10	<10	65	130	13	20
Mn (ppm)	778	56	7,000	14,000	1,400	600
Mo (ppm)	4.5	3	5	10	1.0	1.5
Nb (ppm)	6.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	640	1,280	128	50
Pb (ppm)	3,045	450	40	80	8.0	16
Rb (ppm)	115.5	4	185	370	37	112
Re (ppm)	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	<1	<1	1	2	0.2	0.2
Se (ppm)	<1	2	250	500	50	50
Sn (ppm)	75	<5	13	25	2.5	5.5
Sr (ppm)	68.5	<10	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	11.85	9	1.50	3	0.3	0.003
Th (ppm)	4.25	0.5	21	42	4.2	10.7
Tl (ppm)	1	<1	1.8	3.6	0.36	0.75
U (ppm)	1.5	<1	5.5	11	1.1	2.8
V (ppm)	35.5	<10	1,150	2,300	230	110
W (ppm)	3	2	5	10	1	2
Zn (ppm)	5,250	21	400	800	80	71
Zr (ppm)	148	<100	500	1,000	100	190
Sc (ppm)	<5	<5	150	300	30	13
La (ppm)	18.5	<4	80	160	16	30
Ce (ppm)	39	<3	165	330	33	64
Pr (ppm)	4.4	<0.5	19.5	39	3.9	7.1
Nd (ppm)	17	<1	80	160	16	26
Sm (ppm)	2.9	<0.5	17.5	35	3.5	4.5
Eu (ppm)	0.55	<0.3	5.5	11	1.1	0.88
Gd (ppm)	2.35	<0.5	16.5	33	3.3	3.8
Tb (ppm)	0.25	<0.2	3	6	0.6	0.64
Dy (ppm)	1.9	<0.2	18.5	37	3.7	3.5
Ho (ppm)	0.38	<0.05	3.9	7.8	0.78	0.8
Er (ppm)	1.1	<0.2	11	22	2.2	2.3
Tm (ppm)	0.16	<0.05	1.6	3.2	0.32	0.33
Yb (ppm)	1.2	<0.2	11	22	2.2	2.2
Lu (ppm)	0.15	<0.1	1.5	3	0.3	0.32
Y (ppm)	10.65	1.2	100	200	20	22
TotalREE	100.5	1.2				
TotalLREE	84.7	na				
TotalHREE	15.8	1.2				
%LREE	84	na				

NOTES:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - esimated volume, estimated volumes include the entire waste pile (only a portion was sampled).

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Summary of Laboratory Results Sacramento.

Sample Name	24-AL1-SU1	24-AL1-SU2	24-AL1-SU1-GRAB	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock / Ore Stockpile	Waste Rock / Ore Stockpile	Rock Grab Sample				
Area	Sacramento	Sacramento	Sacramento				
Sample Unit	SU1	SU2	SU1				
Lat	39.22663	39.22668	39.22663				
Long	-106.05782	-106.05834	-106.05782				
Elevation (ft amsl)	10,390	10,390	10,390				
Volume (m^3) Est.[2]	3,200	399	na				
SiO_2 (%)	42.67	47.11	61.16	--	--	60.6	66.6
Al_2O_3 (%)	4.14	5.18	4.97	--	--	15.9	15.4
Fe_2O_3 (%)	15.08	13.76	13.77	--	--	na	na
K_2O (%)	0.64	1.14	0.35	--	--	1.81	2.8
MgO (%)	3.58	4.75	1.66	--	--	4.66	2.48
MnO (%)	0.54	0.40	0.35	--	--	0.1	0.1
CaO (%)	7.60	6.38	3.56	--	--	6.41	3.59
TiO_2 (%)	0.2	0.275	0.08	--	--	0.72	0.64
Na_2O (%)	0.08	0.03	0.01	--	--	3.07	3.27
P_2O_5 (%)	0.155	0.14	0.04	--	--	0.13	0.15
SrO (%)	<0.01	0.01	<0.01	--	--	na	na
BaO (%)	0.025	0.035	<0.01	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.01	<0.01	<0.01	--	--	na	na
LOI (%)	13.34	11.96	9.61	--	--	na	na
Au (ppm)	6.725	5.735	0.672	0.02	0.03	0.003	0.0018
Ag (ppm)	44.59	37.56	78.07	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	21,250	26,650	24,600	420,500	841,000	84,100	80,400
F (%)	0.092	0.104	1.69	0.28	0.553	0.0553	na
Fe (ppm)	100,100	86,300	84,300	353,500	707,000	70,700	35,000
Fe (%)	10.01	8.63	8.43	35.35	70.7	7.07	3.5
Mg (ppm)	20,800	28,250	9,370	160,000	320,000	32,000	13,300
Ti (ppm)	1,242	1,620	529	27,000	54,000	5,400	3,900
Ti (%)	0.124	0.162	0.05	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	30	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	300.5	380.5	41	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	68.4	48.25	98.1	0.3	0.6	0.06	0.127
Cd (ppm)	101.5	61.95	24	0.49	0.98	0.098	0.098
Co (ppm)	5	4.5	3	145	290	29	17
Cr (ppm)	15	16	<10	925	1,850	185	85
Cs (ppm)	1.45	1.75	0.8	7.5	15	1.5	4.8
Cu (ppm)	669	418	31	375	750	75	25
Ga (ppm)	7.5	9	<1	90	180	18	17
Ge (ppm)	1.5	2	24	8	16	1.6	1.6
Hf (ppm)	4.5	5.5	3	15	30	3.0	5.8
In (ppm)	18.25	14.1	1	0.25	0.5	0.05	0.05
Li (ppm)	15.5	18.5	<10	65	130	13	20
Mn (ppm)	4,015	3,030	2,590	7,000	14,000	1,400	600
Mo (ppm)	9	9	4	5	10	1.0	1.5
Nb (ppm)	5.5	5.5	<5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	5,850	4,715	8,470	40	80	8.0	16
Rb (ppm)	42	59	31	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	2	<1	3	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	49	51	28	1,300	2,600	260	350
Ta (ppm)	<0.5	<0.5	<0.5	5	10	1.0	1.1
Te (ppm)	2.4	3.8	1	1.50	3	0.3	0.003
Th (ppm)	4.55	4.95	4	21	42	4.2	10.7
Tl (ppm)	<1	<1	<1	1.8	3.6	0.36	0.75
U (ppm)	2	2	<1	5.5	11	1.1	2.8
V (ppm)	29.5	38.5	<10	1,150	2,300	230	110
W (ppm)	9	9.5	170	5	10	1	2
Zn (ppm)	15,500	9,765	2,730	400	800	80	71
Zr (ppm)	170.5	220.5	128	500	1,000	100	190
Sc (ppm)	<5	<5	<5	150	300	30	13
La (ppm)	11	14.5	21	80	160	16	30
Ce (ppm)	26.5	32.5	40	165	330	33	64
Pr (ppm)	2.65	3.4	4.8	19.5	39	3.9	7.1
Nd (ppm)	10	12.5	18	80	160	16	26
Sm (ppm)	2	2.3	3.4	17.5	35	3.5	4.5
Eu (ppm)	0.35	0.35	0.7	5.5	11	1.1	0.88
Gd (ppm)	1.55	1.7	1.9	16.5	33	3.3	3.8
Tb (ppm)	0.25	0.25	0.2	3	6	0.6	0.64
Dy (ppm)	1.5	1.8	1.3	18.5	37	3.7	3.5
Ho (ppm)	0.33	0.41	0.24	3.9	7.8	0.78	0.8
Er (ppm)	1	1.3	0.6	11	22	2.2	2.3
Tm (ppm)	0.17	0.20	0.08	1.6	3.2	0.32	0.33
Yb (ppm)	1.25	1.5	0.6	11	22	2.2	2.2
Lu (ppm)	0.2	0.2	<0.1	1.5	3	0.3	0.32
Y (ppm)	9.05	10.8	6	100	200	20	22
TotalREE	67.8	83.7	98.8				
TotalLREE	54.1	67.3	89.8				
TotalHREE	13.8	16.5	9.0				
%LREE	80	80	91				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Santiago Area Summary of Laboratory Results.

Sample Name	24-PA1-SU1	24-PA1-SU2	24-PA2-SU1	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Waste Rock				
Area	Santiago 1	Santiago 1	Santiago 2				
Sample Unit	SU1	SU2	SU1				
Lat	39.64963	39.64981	39.64729				
Long	-105.7629	-105.76248	-105.76433				
Elevation (ft amsl)	11,765	11,735	11,965				
Volume (m^3) Est.[2]	1,500	3,525	1,737				
SiO_2 (%)	70.62	68.73	72.77	--	--	60.6	66.6
Al_2O_3 (%)	13.97	14.33	13.42	--	--	15.9	15.4
Fe_2O_3 (%)	4.16	4.57	3.39	--	--	na	na
K_2O (%)	4.03	4.21	3.99	--	--	1.81	2.8
MgO (%)	0.605	0.505	0.41	--	--	4.66	2.48
MnO (%)	0.085	0.145	0.16	--	--	0.1	0.1
CaO (%)	0.085	0.11	0.08	--	--	6.41	3.59
TiO_2 (%)	0.5	0.51	0.38	--	--	0.72	0.64
Na_2O (%)	0.14	0.16	0.18	--	--	3.07	3.27
P_2O_5 (%)	0.13	0.13	0.11	--	--	0.13	0.15
SrO (%)	<0.01	<0.01	<0.01	--	--	na	na
BaO (%)	0.075	0.07	0.07	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	<0.01	0.01	0.01	--	--	na	na
LOI (%)	5.254	5.779	5.036	--	--	na	na
Au (ppm)	0.0685	0.1915	0.119	0.02	0.03	0.003	0.0018
Ag (ppm)	38.22	152.98	7.22	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	73,000	75,650	69,050	420,500	841,000	84,100	80,400
F (%)	0.119	0.119	0.142	0.28	0.553	0.0553	na
Fe (ppm)	28,600	30,950	22,600	353,500	707,000	70,700	35,000
Fe (%)	2.86	3.095	2.26	35.35	70.7	7.07	3.5
Mg (ppm)	3,380	2,810	2,265	160,000	320,000	32,000	13,300
Ti (ppm)	2,995	3,145	2,185	27,000	54,000	5,400	3,900
Ti (%)	0.300	0.315	0.219	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	12.5	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	674	655.5	654	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	0.9	26	0.7	0.3	0.6	0.06	0.127
Cd (ppm)	3.85	2.05	2.15	0.49	0.98	0.098	0.098
Co (ppm)	2.5	<2	4.5	145	290	29	17
Cr (ppm)	60.5	53.5	23.5	925	1,850	185	85
Cs (ppm)	9.4	7.45	8.05	7.5	15	1.5	4.8
Cu (ppm)	19.5	19.5	20.5	375	750	75	25
Ga (ppm)	18.5	18	17.5	90	180	18	17
Ge (ppm)	2	2	2.5	8	16	1.6	1.6
Hf (ppm)	5.5	5.5	4.5	15	30	3.0	5.8
In (ppm)	0.5	0.8	1.05	0.25	0.5	0.05	0.05
Li (ppm)	10.5	<10	<10	65	130	13	20
Mn (ppm)	643	1,070	1,245	7,000	14,000	1,400	600
Mo (ppm)	3	<2	4	5	10	1.0	1.5
Nb (ppm)	13.5	15	19	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	2,575	8,885	2,070	40	80	8.0	16
Rb (ppm)	188	180.5	163.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	2	3.5	4	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	<5	<5	<5	13	25	2.5	5.5
Sr (ppm)	59.5	61.5	42.5	1,300	2,600	260	350
Ta (ppm)	0.85	0.85	0.9	5	10	1.0	1.1
Te (ppm)	11.4	23.35	<0.5	1.50	3	0.3	0.003
Th (ppm)	17.1	13.9	12.7	21	42	4.2	10.7
Tl (ppm)	2.5	2.5	2.5	1.8	3.6	0.36	0.75
U (ppm)	4.5	4	3.5	5.5	11	1.1	2.8
V (ppm)	56.5	59.5	61.5	1,150	2,300	230	110
W (ppm)	2.5	2.5	16.5	5	10	1	2
Zn (ppm)	682	478	365.5	400	800	80	71
Zr (ppm)	239.5	206.5	166.5	500	1,000	100	190
Sc (ppm)	9	9.5	7	150	300	30	13
La (ppm)	57.5	44.5	47.5	80	160	16	30
Ce (ppm)	109.5	90.5	91	165	330	33	64
Pr (ppm)	12.8	10.1	10.05	19.5	39	3.9	7.1
Nd (ppm)	45.5	36.5	35.5	80	160	16	26
Sm (ppm)	7.7	6.5	5.65	17.5	35	3.5	4.5
Eu (ppm)	1.25	1	1.1	5.5	11	1.1	0.88
Gd (ppm)	5.6	4.8	3.55	16.5	33	3.3	3.8
Tb (ppm)	0.8	0.7	0.45	3	6	0.6	0.64
Dy (ppm)	4.65	4.4	2.95	18.5	37	3.7	3.5
Ho (ppm)	0.905	0.875	0.565	3.9	7.8	0.78	0.8
Er (ppm)	2.6	2.6	1.6	11	22	2.2	2.3
Tm (ppm)	0.385	0.36	0.225	1.6	3.2	0.32	0.33
Yb (ppm)	2.5	2.45	1.6	11	22	2.2	2.2
Lu (ppm)	0.4	0.35	0.25	1.5	3	0.3	0.32
Y (ppm)	24.9	23.7	15.65	100	200	20	22
TotalREE	286.0	238.8	224.6				
TotalLREE	239.9	193.9	194.4				
TotalHREE	37.1	35.4	23.3				
%LREE	84	81	87				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Sidney Summary of Laboratory Results.

Sample Name	24-PA3-SU1				
Sample Type	Waste Rock				
Area	Sidney				
Sample Unit	SU1				
Lat	39.66253	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Long	-105.74135				
Elevation (ft amsl)	10785				
Volume (m^3) Est.[2]	6,566				
SiO_2 (%)	71.15	--	--	60.6	66.6
Al_2O_3 (%)	13.42	--	--	15.9	15.4
Fe_2O_3 (%)	3.07	--	--	na	na
K_2O (%)	3.72	--	--	1.81	2.8
MgO (%)	0.46	--	--	4.66	2.48
MnO (%)	0.02	--	--	0.1	0.1
CaO (%)	0.74	--	--	6.41	3.59
TiO_2 (%)	0.49	--	--	0.72	0.64
Na_2O (%)	0.09	--	--	3.07	3.27
P_2O_5 (%)	0.13	--	--	0.13	0.15
SrO (%)	0.01	--	--	na	na
BaO (%)	0.075	--	--	na	na
Cr_2O_3 (%)	<0.01	--	--	na	na
V_2O_5 (%)	<0.01	--	--	na	na
LOI (%)	4.930	--	--	na	na
Au (ppb)	114		30	3	1.8
Au (ppm)	0.114	0.02	0.03	0.003	0.0018
Ag (ppm)	151.80	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	68,700	420,500	841,000	84,100	80,400
F (%)	0.166	0.28	0.553	0.0553	na
Fe (ppm)	20,700	353,500	707,000	70,700	35,000
Fe (%)	2.07	35.35	70.7	7.07	3.5
Mg (ppm)	2,525	160,000	320,000	32,000	13,300
Ti (ppm)	2,905	27,000	54,000	5,400	3,900
Ti (%)	0.291	2.7	5.4	0.5	0.39
As (ppm)	31	5.0	10	1	1.5
B (ppm)	<20	50	100	10	15
Ba (ppm)	625.5	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	<0.3	0.3	0.6	0.06	0.127
Cd (ppm)	7.95	0.49	0.98	0.098	0.098
Co (ppm)	<2	145	290	29	17
Cr (ppm)	34.5	925	1,850	185	85
Cs (ppm)	7.55	7.5	15	1.5	4.8
Cu (ppm)	64	375	750	75	25
Ga (ppm)	18	90	180	18	17
Ge (ppm)	2	8	16	1.6	1.6
Hf (ppm)	8	15	30	3.0	5.8
In (ppm)	0.2	0.25	0.5	0.05	0.05
Li (ppm)	13.5	65	130	13	20
Mn (ppm)	140.5	7,000	14,000	1,400	600
Mo (ppm)	7	5	10	1.0	1.5
Nb (ppm)	13.5	55	110	11	12.5
Ni (ppm)	<20	640	1,280	128	50
Pb (ppm)	4,060	40	80	8.0	16
Rb (ppm)	174	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	46	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<5	13	25	2.5	5.5
Sr (ppm)	79	1,300	2,600	260	350
Ta (ppm)	0.55	5	10	1.0	1.1
Te (ppm)	<0.5	1.50	3	0.3	0.003
Th (ppm)	29.95	21	42	4.2	10.7
Tl (ppm)	2.5	1.8	3.6	0.36	0.75
U (ppm)	3.5	5.5	11	1.1	2.8
V (ppm)	48	1,150	2,300	230	110
W (ppm)	2.5	5	10	1	2
Zn (ppm)	1,455	400	800	80	71
Zr (ppm)	272	500	1,000	100	190
Sc (ppm)	8	150	300	30	13
La (ppm)	74	80	160	16	30
Ce (ppm)	167	165	330	33	64
Pr (ppm)	19.75	19.5	39	3.9	7.1
Nd (ppm)	72.5	80	160	16	26
Sm (ppm)	11.7	17.5	35	3.5	4.5
Eu (ppm)	1.3	5.5	11	1.1	0.88
Gd (ppm)	7.55	16.5	33	3.3	3.8
Tb (ppm)	1.1	3	6	0.6	0.64
Dy (ppm)	6.4	18.5	37	3.7	3.5
Ho (ppm)	1.22	3.9	7.8	0.78	0.8
Er (ppm)	3.45	11	22	2.2	2.3
Tm (ppm)	0.46	1.6	3.2	0.32	0.33
Yb (ppm)	3	11	22	2.2	2.2
Lu (ppm)	0.4	1.5	3	0.3	0.32
Y (ppm)	32.85	100	200	20	22
TotalREE	410.7				
TotalLREE	353.8				
TotalHREE	48.9				
%LREE	86				

Notes:
Bold values are critical minerals (Ba assumed to be associated with barite).
1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).
2 - estimated volume.
Green highlighted values are over 5x bulk continental crust.
Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.
LOI - lost on ignition.
LREE - Light REEs include La through Gd.
m3 - cubic meters.
na - not available.
ppb - parts per billion.
ppm - parts per million.
TotalREE - Total REEs include all the REEs + Sc.

Table - Thunder Summary of Laboratory Results.

Sample Name	24-LP3-SU1				
Sample Type	Waste Rock				
Area	Thunder				
Sample Unit	SU1	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Lat	37.39701				
Long	-108.12774				
Elevation (ft amsl)	10515				
Volume (m^3) Est.[2]	5,290				
SiO_2 (%)	83.35	--	--	60.6	66.6
Al_2O_3 (%)	3.19	--	--	15.9	15.4
Fe_2O_3 (%)	6.83	--	--	na	na
K_2O (%)	1.24	--	--	1.81	2.8
MgO (%)	0.165	--	--	4.66	2.48
MnO (%)	<0.01	--	--	0.1	0.1
CaO (%)	0.07	--	--	6.41	3.59
TiO_2 (%)	0.14	--	--	0.72	0.64
Na_2O (%)	0.06	--	--	3.07	3.27
P_2O_5 (%)	0.035	--	--	0.13	0.15
SrO (%)	0.02	--	--	na	na
BaO (%)	0.01	--	--	na	na
Cr_2O_3 (%)	<0.01	--	--	na	na
V_2O_5 (%)	0.01	--	--	na	na
LOI (%)	5.259	--	--	na	na
Au (ppm)	0.3005	0.02	0.03	0.003	0.0018
Ag (ppm)	5.06	0.40	0.8	0.08	0.05
Pd (ppb)	<1	5.0	10	1	0.5
Pt (ppb)	<10	2.5	5	0.5	0.5
Al (ppm)	16,100	420,500	841,000	84,100	80,400
F (%)	0.035	0.28	0.553	0.0553	na
Fe (ppm)	45,900	353,500	707,000	70,700	35,000
Fe (%)	4.59	35.35	70.7	7.07	3.5
Mg (ppm)	851	160,000	320,000	32,000	13,300
Ti (ppm)	803	27,000	54,000	5,400	3,900
Ti (%)	0.080	2.7	5.4	0.5	0.39
As (ppm)	344.5	5.0	10	1	1.5
B (ppm)	<20	50	100	10	15
Ba (ppm)	106.5	1,250	2,500	250	550
Be (ppm)	<5	7.5	15	1.5	3.0
Bi (ppm)	3	0.3	0.6	0.06	0.127
Cd (ppm)	0.3	0.49	0.98	0.098	0.098
Co (ppm)	<2	145	290	29	17
Cr (ppm)	10	925	1,850	185	85
Cs (ppm)	1.85	7.5	15	1.5	4.8
Cu (ppm)	95.5	375	750	75	25
Ga (ppm)	3.5	90	180	18	17
Ge (ppm)	1.5	8	16	1.6	1.6
Hf (ppm)	3	15	30	3.0	5.8
In (ppm)	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	<10	65	130	13	20
Mn (ppm)	53	7,000	14,000	1,400	600
Mo (ppm)	5	5	10	1.0	1.5
Nb (ppm)	<5	55	110	11	12.5
Ni (ppm)	<20	640	1,280	128	50
Pb (ppm)	126.5	40	80	8.0	16
Rb (ppm)	38	185	370	37	112
Re (ppm)	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	28	1	2	0.2	0.2
Se (ppm)	<1	250	500	50	50
Sn (ppm)	<5	13	25	2.5	5.5
Sr (ppm)	108.5	1,300	2,600	260	350
Ta (ppm)	<0.5	5	10	1.0	1.1
Te (ppm)	1.1	1.50	3	0.3	0.003
Th (ppm)	1.95	21	42	4.2	10.7
Tl (ppm)	86	1.8	3.6	0.36	0.75
U (ppm)	2.5	5.5	11	1.1	2.8
V (ppm)	19.5	1,150	2,300	230	110
W (ppm)	23.5	5	10	1	2
Zn (ppm)	90.5	400	800	80	71
Zr (ppm)	135.5	500	1,000	100	190
Sc (ppm)	<5	150	300	30	13
La (ppm)	9	80	160	16	30
Ce (ppm)	16	165	330	33	64
Pr (ppm)	1.9	19.5	39	3.9	7.1
Nd (ppm)	7	80	160	16	26
Sm (ppm)	1.15	17.5	35	3.5	4.5
Eu (ppm)	0.35	5.5	11	1.1	0.88
Gd (ppm)	1.1	16.5	33	3.3	3.8
Tb (ppm)	0.2	3	6	0.6	0.64
Dy (ppm)	1.05	18.5	37	3.7	3.5
Ho (ppm)	0.205	3.9	7.8	0.78	0.8
Er (ppm)	0.65	11	22	2.2	2.3
Tm (ppm)	0.095	1.6	3.2	0.32	0.33
Yb (ppm)	0.65	11	22	2.2	2.2
Lu (ppm)	0.1	1.5	3	0.3	0.32
Y (ppm)	5.5	100	200	20	22
TotalREE	45.0				
TotalLREE	36.5				
TotalHREE	8.5				
%LREE	81				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Summary of Laboratory Results Tip Top

Sample Name	24-GG1-SU1	24-GG1-SU2	24-GG1-SU3				
Sample Type	Waste Rock	Waste Rock	Waste Rock	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Area	Tip Top	Tip Top	Tip Top				
Sample Unit	SU1	SU2	SU3				
Lat	39.87127	39.87126	39.87104				
Long	-105.53299	-105.53313	-105.53332				
Elevation (ft amsl)	10,080	10,080	10,080				
Volume (m^3) Est.[2]	1,328	7,894	1,861				
SiO_2 (%)	68.06	69.59	68.37	--	--	60.6	66.6
Al_2O_3 (%)	12.54	12.17	12.37	--	--	15.9	15.4
Fe_2O_3 (%)	6.93	6.46	6.34	--	--	na	na
K_2O (%)	3.55	2.83	3.31	--	--	1.81	2.8
MgO (%)	0.53	0.64	0.58	--	--	4.66	2.48
MnO (%)	0.01	0.01	0.01	--	--	0.1	0.1
CaO (%)	0.465	0.395	0.665	--	--	6.41	3.59
TiO_2 (%)	0.29	0.25	0.305	--	--	0.72	0.64
Na_2O (%)	2.1	2.6	1.9	--	--	3.07	3.27
P_2O_5 (%)	0.115	0.085	0.125	--	--	0.13	0.15
SrO (%)	0.02	0.01	0.025	--	--	na	na
BaO (%)	0.09	0.055	0.07	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.01	0.01	<0.01	--	--	na	na
LOI (%)	5.73	5.00	6.19	--	--	na	na
Au (ppm)	3.30	1.54	1.44	0.02	0.03	0.003	0.0018
Ag (ppm)	1.89	1.20	1.41	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	63,850	61,750	62,900	420,500	841,000	84,100	80,400
F (%)	0.122	0.132	0.143	0.28	0.553	0.0553	na
Fe (ppm)	46,800	43,700	43,900	353,500	707,000	70,700	35,000
Fe (%)	4.68	4.37	4.39	35.35	70.7	7.07	3.5
Mg (ppm)	3,020	3,650	3,205	160,000	320,000	32,000	13,300
Ti (ppm)	1,685	1,520	1,855	27,000	54,000	5,400	3,900
Ti (%)	0.169	0.152	0.186	2.7	5.4	0.5	0.39
As (ppm)	<10	<10	<10	5.0	10	1	1.5
B (ppm)	<20	<20	<20	50	100	10	15
Ba (ppm)	750.5	463.5	679.5	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	9.95	4.25	5.15	0.3	0.6	0.06	0.127
Cd (ppm)	<0.2	<0.2	<0.2	0.49	0.98	0.098	0.098
Co (ppm)	3	3.5	3	145	290	29	17
Cr (ppm)	16	10	15	925	1,850	185	85
Cs (ppm)	0.7	0.75	0.95	7.5	15	1.5	4.8
Cu (ppm)	47.5	46.5	40	375	750	75	25
Ga (ppm)	22	21	21	90	180	18	17
Ge (ppm)	2	1	1.5	8	16	1.6	1.6
Hf (ppm)	8	9.5	7.5	15	30	3.0	5.8
In (ppm)	0.2	<0.2	<0.2	0.25	0.5	0.05	0.05
Li (ppm)	<10	<10	<10	65	130	13	20
Mn (ppm)	101	131.5	84	7,000	14,000	1,400	600
Mo (ppm)	11.5	4.5	14	5	10	1.0	1.5
Nb (ppm)	8.5	8	9.5	55	110	11	12.5
Ni (ppm)	<20	<20	<20	640	1,280	128	50
Pb (ppm)	308.5	135	204.5	40	80	8.0	16
Rb (ppm)	96.5	80.5	90.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	<1	<1	1	1	2	0.2	0.2
Se (ppm)	<1	<1	<1	250	500	50	50
Sn (ppm)	6.5	6.5	10.5	13	25	2.5	5.5
Sr (ppm)	158.5	76	184.5	1,300	2,600	260	350
Ta (ppm)	0.65	0.55	0.7	5	10	1.0	1.1
Te (ppm)	1.6	1.65	1.6	1.50	3	0.3	0.003
Th (ppm)	4.85	5.5	5.3	21	42	4.2	10.7
Tl (ppm)	<1	<1	<1	1.8	3.6	0.36	0.75
U (ppm)	2	2.5	2.5	5.5	11	1.1	2.8
V (ppm)	30.5	27	42	1,150	2,300	230	110
W (ppm)	83.5	177	63	5	10	1	2
Zn (ppm)	77	83.5	83	400	800	80	71
Zr (ppm)	301	342	272.5	500	1,000	100	190
Sc (ppm)	5	<5	5.5	150	300	30	13
La (ppm)	34.5	36.5	34.5	80	160	16	30
Ce (ppm)	76.5	74	71.5	165	330	33	64
Pr (ppm)	8.2	8.7	8.5	19.5	39	3.9	7.1
Nd (ppm)	32	34	32.5	80	160	16	26
Sm (ppm)	7.8	7.25	5.9	17.5	35	3.5	4.5
Eu (ppm)	1.65	1.35	1.35	5.5	11	1.1	0.88
Gd (ppm)	6.6	7.25	5.95	16.5	33	3.3	3.8
Tb (ppm)	1.35	1.25	0.9	3	6	0.6	0.64
Dy (ppm)	7	8.35	6.4	18.5	37	3.7	3.5
Ho (ppm)	1.52	1.76	1.42	3.9	7.8	0.78	0.8
Er (ppm)	4.6	5.4	4.45	11	22	2.2	2.3
Tm (ppm)	0.70	0.77	0.625	1.6	3.2	0.32	0.33
Yb (ppm)	4.7	5.3	4.3	11	22	2.2	2.2
Lu (ppm)	0.7	0.8	0.7	1.5	3	0.3	0.32
Y (ppm)	42.65	47.5	38.35	100	200	20	22
TotalREE	235.5	245.2	222.8				
TotalLREE	167.3	169.05	160.2				
TotalHREE	63.2	71.13	57.14				
%LREE	71	69	72				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

Table - Wellington Summary of Laboratory Results.

Sample Name	23-BK1-SU1	23-BK1-SU2	23-BK1-SU3	23-BK1-SU4	23-BK1-SU5	23-BK1-SU6	5x bulk continental crust[1]	10x bulk continental crust[1]	bulk continental crust[1]	upper continental crust[1]
Sample Type	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock	Waste Rock				
Area	Wellington	Wellington	Wellington	Wellington	Wellington	Wellington				
Sample Unit	SU1	SU2	SU3	SU4	SU5	SU6				
Lat	39.485118	39.485167	39.4852	39.485378	39.485674	39.485759				
Long	-106.010238	-106.009782	-106.009504	-106.009036	-106.008413	-106.007936				
Elevation (ft amsl)	10150	10148	10148	10148	10147	10147				
Volume (m^3) Est.[2]	9,949	16,203	14,188	36,222	14,393	6,959				
SiO_2 (%)	60.70	55.77	34.50	51.52	51.93	57.68	--	--	60.6	66.6
Al_2O_3 (%)	11.95	12.55	7.22	11.55	11.69	13.99	--	--	15.9	15.4
Fe_2O_3 (%)	10.09	9.14	26.87	12.00	11.38	9.40	--	--	na	na
K_2O (%)	2.67	3.11	1.87	2.52	2.94	3.39	--	--	1.81	2.8
MgO (%)	0.49	1.00	0.31	0.92	0.79	1.12	--	--	4.66	2.48
MnO (%)	0.14	0.25	0.05	0.39	0.25	0.25	--	--	0.1	0.1
CaO (%)	0.81	2.69	2.71	2.45	2.81	2.7	--	--	6.41	3.59
TiO_2 (%)	0.53	0.54	0.35	0.55	0.6	0.73	--	--	0.72	0.64
Na_2O (%)	0.11	0.30	0.12	0.3	0.16	0.37	--	--	3.07	3.27
P_2O_5 (%)	0.22	0.25	0.05	0.26	0.25	0.37	--	--	0.13	0.15
SrO (%)	0.015	0.02	<0.01	0.02	0.015	0.02	--	--	na	na
BaO (%)	0.05	0.08	0.03	0.065	0.14	0.125	--	--	na	na
Cr_2O_3 (%)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	--	na	na
V_2O_5 (%)	0.015	0.02	<0.01	0.02	0.03	0.03	--	--	na	na
LOI (%)	9.523	10.316	22.593	10.52	11.420	7.638	--	--	na	na
Au (ppm)	0.2205	0.33	0.967	0.434	0.183	0.1615	0.02	0.03	0.003	0.0018
Ag (ppm)	36.5	23.5	86.5	25.5	20.5	7	0.40	0.8	0.08	0.05
Pd (ppb)	<1	<1	<1	<1	<1	<1	5.0	10	1	0.5
Pt (ppb)	<10	<10	<10	<10	<10	<10	2.5	5	0.5	0.5
Al (ppm)	64,700	68,600	39,600	63,200	63,250	75,400	420,500	841,000	84,100	80,400
F (%)	0.065	0.077	0.040	0.066	0.073	0.083	0.28	0.553	0.0553	na
Fe (ppm)	72,350	65,200	184,500	85,750	81,150	66,800	353,500	707,000	70,700	35,000
Fe (%)	7.24	6.52	18.45	8.58	8.12	6.68	35.35	70.7	7.07	3.5
Mg (ppm)	2,900	6,000	1,750	5,550	4,750	6,600	160,000	320,000	32,000	13,300
Ti (ppm)	3,250	3,300	2,100	3,450	3,700	4,500	27,000	54,000	5,400	3,900
Ti (%)	0.33	0.33	0.21	0.35	0.37	0.45	2.7	5.4	0.5	0.39
As (ppm)	128.5	106	425	161	151	87	5.0	10	1	1.5
B (ppm)	39.5	37.5	58.5	45	43.5	35.5	50	100	10	15
Ba (ppm)	483.5	740.5	294	667	1,431	1,190	1,250	2,500	250	550
Be (ppm)	<5	<5	<5	<5	<5	<5	7.5	15	1.5	3.0
Bi (ppm)	27.75	27	78.5	8.85	9.7	3.35	0.3	0.6	0.06	0.127
Cd (ppm)	32	96.5	20.55	125.5	33.2	17.4	0.49	0.98	0.098	0.098
Co (ppm)	4.65	6.85	19.65	8.9	5	10.2	145	290	29	17
Cr (ppm)	28	38.5	17.5	32.5	32	26.5	925	1,850	185	85
Cs (ppm)	10.25	8.55	5.85	10.6	10.95	12.4	7.5	15	1.5	4.8
Cu (ppm)	316.5	356.5	114.5	372.5	182	67.5	375	750	75	25
Ga (ppm)	17.5	18	11	16.5	16.5	20	90	180	18	17
Ge (ppm)	2	2	2	2	2	2	8	16	1.6	1.6
Hf (ppm)	5	4.5	3	4.5	4.5	5.5	15	30	3.0	5.8
In (ppm)	20.85	21.1	17.4	15.7	7.5	4.7	0.25	0.5	0.05	0.05
Li (ppm)	36	33	29	28.5	25	26.5	65	130	13	20
Mn (ppm)	1,055	1,988	434.5	3,019	1,948	1,984	7,000	14,000	1,400	600
Mo (ppm)	3.5	4.5	2.5	3.5	4	2	5	10	1.0	1.5
Nb (ppm)	16.5	16.5	11	14	14.5	20.5	55	110	11	12.5
Ni (ppm)	10	12.5	11	17.5	11.5	16	640	1,280	128	50
Pb (ppm)	10,593	4,291	6,271	15,750	13,800	2,457	40	80	8.0	16
Rb (ppm)	124	127.5	87.65	109	132.5	141.5	185	370	37	112
Re (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.002	0.004	0.0004	0.0004
Sb (ppm)	10.95	7.1	11.45	19.55	12.1	4.7	1	2	0.2	0.2
Se (ppm)	1	1.5	2.5	1.5	1	<1	250	500	50	50
Sn (ppm)	7	5.5	11	32.5	7	5.5	13	25	2.5	5.5
Sr (ppm)	77	184	87	153.5	136	198	1,300	2,600	260	350
Ta (ppm)	1	1	0.6	0.8	0.85	1.05	5	10	1.0	1.1
Te (ppm)	0.37	0.31	2.27	0.19	0.37	0.15	1.50	3	0.3	0.003
Th (ppm)	11.85	12.6	5.95	12.25	10.85	14.95	21	42	4.2	10.7
Tl (ppm)	2.95	2.75	2.55	2.7	2.3	2	1.8	3.6	0.36	0.75
U (ppm)	3.55	4.56	2.04	4.34	3.59	4.16	5.5	11	1.1	2.8
V (ppm)	91	122	48	118.5	147	144.5	1,150	2,300	230	110
W (ppm)	12	13	8.5	12	10	19.5	5	10	1	2
Zn (ppm)	6,639	15,950	3,774	22,550	6,565	3,277	400	800	80	71
Zr (ppm)	167.5	152.5	106.3	155.5	151	197.5	500	1,000	100	190
Sc (ppm)	8.5	10	5.5	12	11.5	13.5	150	300	30	13
La (ppm)	47.9	46.6	28.3	43.75	46.15	64.35	80	160	16	30
Ce (ppm)	84.9	82.45	50	77.35	83	115.5	165	330	33	64
Pr (ppm)	9.67	9.64	5.77	9.15	9.64	13.48	19.5	39	3.9	7.1
Nd (ppm)	34.65	35.2	20.75	33.45	35.15	49.7	80	160	16	26
Sm (ppm)	5.45	5.65	3.35	5.55	5.6	7.85	17.5	35	3.5	4.5
Eu (ppm)	0.97	1.2	0.58	1.14	1.09	1.69	5.5	11	1.1	0.88
Gd (ppm)	3.74	4.01	2.24	4.26	3.84	5.68	16.5	33	3.3	3.8
Tb (ppm)	0.51	0.56	0.32	0.61	0.54	0.75	3	6	0.6	0.64
Dy (ppm)	2.84	3.06	1.80	3.53	2.97	3.97	18.5	37	3.7	3.5
Ho (ppm)	0.57	0.61	0.34	0.71	0.58	0.77	3.9	7.8	0.78	0.8
Er (ppm)	1.61	1.71	0.96	2.10	1.7	2.17	11	22	2.2	2.3
Tm (ppm)	0.24	0.25	0.14	0.29	0.26	0.31	1.6	3.2	0.32	0.33
Yb (ppm)	1.6	1.7	1	2.05	1.7	2	11	22	2.2	2.2
Lu (ppm)	0.26	0.26	0.16	0.31	0.26	0.3	1.5	3	0.3	0.32
Y (ppm)	15.4	16.15	9.5	19.5	15.65	20.7	100	200	20	22
TotalREE	218.8	219.0	130.7	215.7	219.6	302.7				
TotalLREE	187.3	184.7	111.0	174.7	184.5	258.3				
TotalHREE	23.0	24.3	14.2	29.1	23.6	31.0				
%LREE	86	84	85	81	84	85				

Notes:

Bold values are critical minerals (Ba assumed to be associated with barite).

1 - bulk continental crust from Taylor and McLennan (2003) except for Pt, F, major compounds (Rudnick and Gao, 2003) and Te (McDonough, 2003). Te values for the average upper crust are from Li and Schoonmaker (2003). Major compounds bulk continental crust from Rudnick and Gao (2003).

2 - estimated volume.

Green highlighted values are over 5x bulk continental crust.

Yellow highlighted values are over 10x bulk continental crust.

HREE - Heavy REEs include Tb through Lu + Y.

LOI - lost on ignition.

LREE - Light REEs include La through Gd.

m3 - cubic meters.

na - not available.

ppb - parts per billion.

ppm - parts per million.

TotalREE - Total REEs include all the REEs + Sc.

APPENDIX E

Appendix – Additional Geological Background

The following summary provides additional details associated with the historic mine waste piles sampled during this investigation. Materials referenced here are included in the main report reference section.

Perigo Mining District

The Tip Top (Golden Flint) Mine is located within the Perigo Mining District (Burnell, 2015) which is within the larger Northern Gilpin mining district (Lovering and Goddard, 1950; Koschmann and Bergendahl, 1968; Burnell, 2015). The Perigo Mine is located about 0.3 miles directly north of the Tip Top in Gamble Gulch. Gold was first discovered in Gamble Gulch in 1859 and the lode deposits shortly after (1860) (Koschmann and Bergendahl, 1968). Between 1901 and 1909, the Perigo Mine produced about 42.5 tons of gold and silver ore. Ore and sulfide minerals included pyrite, gold, and some galena (Lovering and Goddard, 1950). The Golden Flint vein is within a Precambrian microcline-quartz-plagioclase-biotite gneiss (Sims, 1964) and irregular Laramide-age stocks and dikes of quartz monzonite porphyry and dikes of bostonite porphyry occur in the area (Lovering and Goddard, 1950; Koschmann and Bergendahl, 1968; Sims, 1964). As reported by Bastin and Hill (1917; page 200), "*The Golden Flint vein is about three-fourths of a mile south-southwest of Perigo. It strikes N. 85d W., and appears to dip about 80d N. It is developed by a shaft 400 feet deep, now water filled. The ore is entirely pyrite in a quartz gangue.*" Generally, as summarized by Koschmann and Bergendahl (1968; page 101):

> "*The ore deposits are pyritic gold veins in fractures, most of which trend northeast; a few strike west or northwest. The primary ores are in general low grade and contain less than half an ounce of gold and 1 ounce or less of silver to the ton, but some veins have higher grade ore in the supergene enriched upper parts. Many of the deposits are discontinuous lodes along shear zones that carry pyrite disseminated through several feet of sheared rock; however, fissure fillings are more abundant. Besides pyrite the ore contains variable amounts of chalcopyrite and locally, some galena and sphalerite. Quartz is the common gangue mineral in the veins (Lovering and Goddard, 1950, p. 193-194).*"

Bastin and Hill (1917; page 159) report the presence of a mill at the Golden Flint and that the original mill was abandoned in 1912 and a new mill was operational by 1913 (Bastin and Hill, 1917; page 159). This new mill operated at a capacity of 100 tons daily and was treating sulfide ores by amalgamation, concentration, and cyanidation (State of Colorado Bureau of Mines, 1914). Metals mined at the property included gold, silver, and copper (State of Colorado Bureau of Mines, 1916).

Peru-Argentine Mining District

The Peru-Argentine district deposits occur in veins within Early Proterozoic gneiss (Widman and Miersemann, 2001) and may be related to other deposits in the neighboring Montezuma mining district (to the west, see discussion in the Montezuma mining district section). In the Georgetown quadrangle, intrusives in the Precambrian rocks include porphyry bodies that are predominantly associated with a magmatic pulse that occurred between 43 and 35 Ma (Bookstrom and others, 1987, cited in Widmann and Miersemann, 2001).

Wood and others (2007) give a detailed description of the Sidney Tunnel and associated waste piles. The Sidney Tunnel was constructed beginning in 1902 to target veins beneath other workings around Pendleton Mountain. This mine primarily produced silver ore from veins in Early Proterozoic biotite gneiss and operated for about 10 years and intermittently until at least 1943 (USFS, 2004; Widmann and Miersemann, 2002; Wood and others, 2007). Reportedly, the tunnel is ~3,000 feet long and includes various crosscuts, drifts, shafts, and winzes (another 2,000 feet) (Wood and others, 2007). According to the Mine Reporter (25 July, 1907: page 87), miners encountered "*galena ore, assaying as high as 72% lead and 204 oz silver*" 2,310 feet from the mine portal and at a depth of 1,000 feet. Reportedly the tunnel intersected 12 veins and shipments from the mine (circa 1920) averaged over 100 oz/ton silver and contained a "*little*" lead (Wood and others, 2007). In 1921, about 257 tons of high-grade silver ore from one of the veins averaged 114 oz/ton silver and contained small amounts of gold and copper. Production from several lodes in the area averaged 0.05 oz/ton gold, 210 oz/ton silver, 15.3% lead, and 21% zinc (Wood and others, 2007). The Dibben Mill site is located to the south of the Sidney waste pile. According to the USFS, the Dibbens Mill was built in 1868, operated intermittently until 1872, and reportedly was a concentrator mill and retorting operation (USFS, 2004). This mill operated again in 1918 and included stamps to work gold ores (USFS, 2004).

The Santiago Mine produced gold, silver, lead, copper, and zinc between 1901 and 1927 (Lovering, 1935) including approximately: 12,653 oz gold; 326,179 oz silver; 2.4 million lbs lead; 1.15 million lbs copper (totals are for the Santiago-Commonwealth, and Centennial mines) (Lovering and Goddard, 1950). Ore was mined from 2 to 8 foot veins, composed of silicified and pyritized granite breccia, in the Middle Proterozoic Silver Plume Granite and Early Proterozoic biotite gneiss (Kellogg and others, 2008). Ore minerals include galena, chalcopyrite, pyrite, and sphalerite with quartz and ankerite gangue. As summarized by Lovering and Goddard (1950; p. 137), pyrite and sphalerite increase with depth and the gold content in the lower levels is related to "*rosin-jack*" (yellow variety) sphalerite.

Montezuma Mining District

The Peruvian Mine, which targeted the Peruvian vein, was discovered in 1874 and mined until 1893 (Lovering, 1935). Some mining in this area was also conducted between 1914 and 1915, when the Shoe Basin tunnel was driven, but no mining was reported after this time (Lovering, 1935). Silver, lead, copper, zinc, and a negligible amount of gold were produced from the Peruvian and the nearby Shoe Basin vein. Ore deposits in this area occur in veins, associated with the Eocene Montezuma stock and associated intrusive rocks (see description in the Peru-Argentine mining district section), within Early Proterozoic biotite gneiss (Kellogg and others, 2008). Neuerburg and others (1974; page 1) indicate that the "*ore consists of silver-lead-zinc veins clustered on the propylitic fringe of a geometrically complex system of altered rocks, which is centered on the intersection of the Oligocene Montezuma stock with the Montezuma shear zone of Precambrian ancestry*." Cunnigham and others (1994) report that the Montezuma stock (pluton) is Eocene in age (35.0 +/- 3.2 Ma) while Rosera and others (2021) report that ages of the Montezuma pluton and one hydrothermally altered volcanic plug in the area overlap within uncertainty at ~38.7 Ma (Eocene) and that mineralization in the Montezuma district is at least this age or younger.

A monzonite porphyry dike is exposed at the surface at the Peruvian mine and is likely the dike exposed in the mine (Lovering, 1935). Reportedly, ore closer to the surface contained "*gray copper*" (tetrahedrite and/or tennantite?), galena, sphalerite, pyrite, and between 10 to 50 oz/ton silver. Deeper ore was higher in zinc content and galena was the most abundant sulfide (Lovering, 1939). Lovering (1939; page 96) states the following,

> *"The ore on the dump of the Shoe Basin tunnel was of two kinds – a thoroughly silicified gneiss containing disseminated sulphides, and a fissure filling consisting of quartz, barite, dolomite, and sulphides. Galena was abundant and occurred medium-sized grains disseminated through the vein quartz, barite, and silicified gneiss……Pyrite and brown sphalerite were common; some gray copper was present and was associated with dolomite, but both were rare. The ore on the dump of the Peruvian shaft was chiefly galena and sphalerite in a quartz-barite gangue, but gray copper was moderately abundant."*

Breckenridge Mining District

The Wellington Mine is in the Breckenridge mining district (Burnell, 2015). Lead-silver mining in the French Gulch area began between the late 1880s to the early 1890s. Output declined until 1910 when the Wellington-Oro (Wellington) mine became more active and supplied most of the lead and zinc ore from the area until 1929 (Lovering and Goddard, 1950). The Wellington primarily produced lead and zinc as well as some gold and silver from veins between about

1887 and 1972 (TechLaw, 2021). It was the most productive mine in the Breckenridge Mining District with the total known output (up to 1950) estimated at 737,014 tons which yielded (Lovering and Goddard, 1950): ~6,502 oz of gold; over 749,000 oz of silver; over 40.7 million pounds (lbs) of lead; and over 164.5 million tons of zinc.

Concentrate and shipped ore from the Wellington circa 1909 contained (Lovering and Goddard, 1950) (concentrate and shipped ore, respectively): 0.02, 0.02 ounces per ton (oz/ton) gold; 10, 10 oz/ton silver; 50, 45% lead; 5, 6% zinc; 14, 10% iron and; 5, 7% silica.

The Wellington includes over 12 miles of underground workings and several entrances including the Extenuate adit (Extenuate) (TechLaw, 2021). Waste piles associated with the Extenuate (also known historically as X.10.U.8) were sampled during this investigation. The Extenuate is located east of the main Wellington and Oro historic portals to the mine. The Extenuate underground level is located below the Wellington tunnel level and above the Oro level workings of the mine. The deposit is associated with Laramide porphyritic monzonite and quartz monzonites that intrude older Cretaceous sedimentary rocks in the area (Lovering and Goddard, 1950). The waste piles in this area are likely associated with the historic mining of several areas within this level including the Fault (also known as the Extenuate fault zone), Siam, Spur, and East veins (Ransome, 1911) collectively known as the Oro-Wellington group veins (Lovering and Goddard, 1950).

As indicated by Ransome (1911), veins in the mine are generally well-defined and range between 4 and 10 feet wide with a maximum width of ~15 feet. These veins consist predominantly of varying amounts of pyrite (FeS_2), sphalerite (ZnS), and galena (PbS) with some native gold and silver whose form is unknown (Lovering and Goddard, 1950). Common gangue minerals include ankerite, calcite , quartz, and sericite (Lovering and Goddard, 1950). During historical mining, waste material from the Wellington reportedly consisted of "*small fragments of metallized porphyry or of pyrite containing too small a proportion of galena and sphalerite to be classed as ore*" at the time (Ransome, 1911, p. 133). Other gangue minerals included siderite and barite (younger in age than the sulfides) but reportedly were not abundant and occur as veinlets or vug linings (Ransome, 1911).

<u>Alma Mining District</u>

The Orphan Boy sporadically operated between about 1862 and 1950 (Pilcher, 1968). The Orphan Boy vein and weakly developed manto deposits are hosted in the Cambrian Sawatch Quartzite where the ore is composed of massive pyrite with variable amounts (up to 30% of veins) of galena, sphalerite and chalcopyrite with calcite gangue (Scarbrough, 2001). Mineralized fissure and replacement veins occur along minor northeast trending faults and, in the Orphan Boy, most of the replacements occur along these minor faults beneath a porphyry sill (Pilcher, 1968). The Orphan Boy intersects several mineralized veins. Igneous sills and dikes occur in most of the rocks in the area including the Sawatch Quartzite. These sills, dikes, and irregular bodies (mostly sills in the Sawatch Quartzite) occur in most rocks, are either Laramide-age or younger (e.g., Paleocene, Eocene, or Oligocene), and include quartz monzonite porphyry, monzodiorite porphyry, diorite, or a white porphyry (Pilcher, 1968; Widmann and others, 2004). Generally, the ores associated with these deposits (Scarbrough, 2001; pg. 26),

> *"are mostly oxidized, but hypogene by-product minerals include sphalerite, galena, and chalcopyrite; gangue minerals include ferroan dolomite, pyrite, and quartz (Vanderwilt, 1947)…….Grades in quartzite-hosted deposits exhibit wide variation, even within contiguous deposits. Individual ore shoots within the Orphan Boy Mine averaged 0.05-0.30 opt (ounces per ton) gold and 0.30-10.0 opt silver; base metals varied from 5.0-10.0 percent lead, 3.0-35.0 percent zinc (Shawe, 1990)."*

Gold is generally not visible and, at the nearby Buckskin Joe mines to the north, is associated with pyrite while a portion of the gold at the Orphan Boy is associated with galena (Pilcher, 1968). Pilcher (1968) reports that the ore is primarily pyrite and sphalerite in a dolomite with the vein filling varying from solid dolomite to nearly solid pyrite. Other minerals include minor amounts of chalcopyrite with smaller amounts of galena, quartz, and barite (Pilcher, 1968). Trace amounts of matildite, aikinite, one or more gold or gold-silver tellurides, and potentially native gold also occur at the Orphan Boy (Pilcher, 1968).

As summarized by Scarbrough (2001; page 40), by 1912 more than 11,000 tons of ore were produced which typically averaged 0.25-0.50 oz/ton gold, 10-25 oz/ton silver, 3-4% copper, and 20% zinc. A 1.5-feet-wide vein averaged 0.30 oz/ton gold, 10 oz/ton silver, 10% lead, and 35% zinc. A ~3.3 feet-thick tabular manto body had average values of 0.05 oz/ton gold, 6.0 oz/ton silver, and 3% zinc while a similar 1-7.5-feet-thick manto averaged 0.15 oz/ton gold, 6.0 oz/ton silver, 5% lead, and 17% zinc (Scarbrough, 2001).

A historic ore stockpile from milling operations at the Duquesne smelter site, located downstream to the west, was sampled on the north side of Sacramento Creek, Park County (Widmann and others, 2007; see author's notes, page 10, description of mine waste). Reportedly, this smelter received ore from nearby mines and operated for a short time between 1879 and 1881 (Park County, 2014). It is unknown exactly what mines supplied ore to this operation without more investigation.

<u>Leadville Mining District</u>

The geology and ore deposits in the area are complex and are summarized here. The Leadville mining district was discovered in 1860 and has been mined continuously, except 1957 to 1971) (Thompson and Arehart, 1990) until the late 1990s. Historically, the district produced about

8,400 tons of silver, 101 tons of gold, 53,000 tons of copper, 1.2 million tons of lead, 1.235 million tons of zinc, and up to 2.6 million tons of iron-manganese ore. Bismuth was also produced as a byproduct of smelting in the district. Galena, or lead sulfide solution minerals, from the Leadville district contain up to 6,200 parts per million (ppm) antimony, up to 2,000 ppm tellurium, up to 1,200 ppm arsenic, and 5.5-11 weight percent bismuth (Chapman and Stevens, 1933; Foord and Shaw, 1989). Bismuthinite, associated with argentite in inclusions with galena is common at Leadville in both primary and secondary ores (Eckel, 1961; Streufert and Cappa, 1994).

Ore deposits in the district are primarily hosted in the Cambrian through Mississippian marine deposits with most of the manto occurring in the Leadville, Dyer, and Manitou dolomites. Sedimentary rocks in the area were intruded between the Late Cretaceous and middle Tertiary represented by six different igneous rock types that range from Late Cretaceous-early Tertiary granodiorite to ore-related middle Tertiary monzogranite (Thompson and Arehart, 1990). The major ore deposits in the district are zoned around the Breece Hill stock and reportedly, this stock was the thermal center of the Leadville mining district (Emmons and others, 1927; Thompson and Arehart, 1990; Wallace, 1993).

The Penn mine was historically known as the Breece Iron mine (Emmons and others, 1927; Cappa and Bartos, 2007). The mines of the Penn Group targeted contact metamorphic-(carbonate) related magnetite-serpentinite-(carbonate) deposits around the Breece Hill stock as well as other deposit types (Emmons and others, 1927; Thompson and Arehart, 1990; Wallace, 1993). The Johnson Gulch Porphyry (43.1 Ma), a quartz monzonite porphyry, forms this stock as well as other sill-laccolith complexes and dikes (Thompson and Arehart, 1990). The magnetite-serpentinite deposits, mined for smelter flux between 1880 and 1930, locally also contain silver and gold, are smaller than other deposit types in the district, and occur locally within 200 meters of the Breece Hill stock (Emmons and others, 1927; Thompson and Arehart, 1990; Wallace, 1993). At the Penn mine, these deposits occur as irregular replacement deposits in limestone where magnetite occurs with a non-fibrous serpentine in the surface workings and upper levels of the mine (aka the old Breece Iron mine) (Emmons and others, 1927). The limestone is likely the Leadville Limestone (a dolomitic limestone in this area also historically known in the district as the Blue Limestone) however, it is difficult to determine what the original rock types were at the Penn Mine because they are too altered (Emmons and others, 1927). The iron deposits are composed primarily of magnetite and specularite (80%) but, in places, contain hematite and pyrite with minor chalcopyrite and little zinc blende and galena (Emmons and others, 1927). Emmons and others (1927; as summarized by Thompson and Arehart, 1990) indicate that the contact metamorphic bodies contained 2 to 5.8 g/metric ton gold and 68.5 to 137 g/metric ton silver. According to Emmons and others (1927), serpentine and siderite are the most abundant gangue minerals and other minor gangue minerals that occur in places include wollastonite, epidote, sericite, and a little quartz. Near the contacts, the magnetite is accompanied by pyrite and sericite and, where oxidized, vivianite.

Numerous quartz-pyrite-gold veins and veinlets cut the Breece Hill stock (Wallace, 1993). A vein mined at the Penn Group of mines occurred in a zone of broken and decomposed porphyry with a narrow seam with gold, and pyrite with chalcocite at depth (reportedly, copper was mined from the lower levels of the Penn Mine) (Emmons and others, 1927). At the Penn mine, the magnetite-specularite disappears farther from the stock and (Loughlin, 1926; page 10):

> *"is bordered and underlain by mixed sulphide and siliceous ores or their oxidized equivalents, and other bodies of it may be similarly bordered, especially where they are cut by vines of quartz and pyrite with our without appreciable quantities of other sulphides. These veins may expand into replacement sulphides bodies beyond the limits of the magnetite……As the magnetite-specularite masses were formed at an early stage, they served in some places as impervious caps, beneath which sulphides ore was deposited at a later stage."*

As indicated by Behre (1953), some mines at Breece Hill contained gold ore that commonly abruptly changed in deeper workings to sulfide deposits that contained lower precious metal concentrations. Several other minerals have been reported from the mines on Breece Hill including argentite, bismutite, bismuthite, and lillianite. Also, as reported by Henderson (1926), most of the galena from the Leadville district contains antimony. Bismuth is rare in the Leadville mining district but occurs as intergrowths in galena with argentite and in the oxidized ore at Breece Hill (Henderson, 1926). Other minerals associated with bismuth deposition include tellurides (hessite, altaite, tennantite and chalcopyrite), galeno-bismutite, argentite, and native silver (Behre, 1953). Bismuth ores were produced from mines on Breece Hill including the Ballard, Big Six, and Penn groups mines (bismuth minerals were also found at the Little Prince) (Henderson, 1926). This ore, reportedly (Henderson, 1926; page 155) "*a mixture of bismuth carbonate and oxide, or a bismuth ocher with the carbonate predominating*", ranges from 2 to 40% bismuth and 1.5 oz/t gold (Henderson, 1926). The Balllard Mine and others produced over ~15,000 lbs of bismuth between 1904 and 1906 (Henderson, 1926).

<u>Eureka/San Juan Mining District area</u>

Highland Mary mill tailings

The tailings are processed material from the historic Highland Mary mine located about 1,200 feet from the mill and 650 feet higher (King and Allsman, 1950). The mine produced ore from fracture zone veins within the Shenandoah-Dives vein system (Varnes, 1963). The veins in this area are within the Oligocene Silverton Volcanics (lava flows and related volcaniclastic rocks of predominantly intermediate composition but ranging from andesite to rhyolite [Luedke and

Burbank, 2000]) and extend into the Precambrian schist and gneiss (Ransome, 1901; King and Allsman, 1950; Varnes, 1963). The Highland Mary produced ore from the Shenandoah-Dives vein system and the ore was (Varnes, 1963: p. A45) "*principally galena, chalcopyrite, and pyrite, with some sphalerite, tetrahedrite, and a little free gold in a quartz and calcite gangue.*" The mill processed about 100 tons of ore per day that in 1947 contained 1.32% lead, 0.16% copper, 0.10 oz of gold, and 4.81 oz of silver per ton. Three decades prior, the ore contained greater than 100 oz of silver and 0.75 oz of gold per ton (King and Allsman, 1950). Ore minerals reported by King and Allsman (1950) indicate the same as above but include tennantite and these authors indicate that the precious metals are (p. 104) "*usually associated with the gray copper minerals but also with the galena*."

The mill used a concentrator and flotation methods, generally operated between 1902 and 1944, and processed between 100 and 150 tons/day (Jones, 2007). Historic analysis of typical mill tailings was reportedly 0.01 ounce per ton gold, 0.50 ounce per ton silver, 0.15% lead, 0.11% zinc, and 0.03% copper. Typical jig and bulk flotation concentrates were: 33.85 and 1.92 oz/ton gold; 111.8 and 91.7 oz/ton silver; 59.8 and 32.2% lead; 0.5 and 1.10% zinc and; 0.15 and 2.50% copper, respectively (King and Allsman, 1950). The Highland Mary and Trilby Tunnel mines produced approximately 168,000 tons of ore between 1901 and 1957 which included 16,000 oz of gold, 2,513,000 oz of silver, 1,263,000 lbs of copper, 9,120,000 lbs of lead, and 1,000 thousand lbs of zinc (zinc concentrates) (Varnes, 1963). The Highland Mary produced ore from the Shenandoah-Dives vein system and the ore was (Varnes, 1963: p. A45) "*principally galena, chalcopyrite, and pyrite, with some sphalerite, tetrahedrite, and a little free gold in a quartz and calcite gangue.*"

Mayflower Mill tailings

The Mayflower Mill (aka Shenandoah-Dives Mill) was built in 1929, started production in 1930, and processed ore from mines in the region (Jones, 2007). The mill operated until 1991 and processed between 300 and 1,200 tons/day using flotation, concentrator, and amalgamation milling methods during its lifetime (Jones, 2007; EPA, 2022). Pile 4 (a.k.a. TP-4) was constructed in 1976 and reclaimed between 1989 and 2006 (SGC, 2020). The Sunnyside Gold Corporation (SGC) reportedly processed ore from the Sunnyside Mine for 5 years and the tailings from this processing were placed in the upper level of Pile 4 (Knight Piesold, 2018). SGC also relocated ~80,000 tons of mostly historic mine waste and tails to TP-4 and performed remedial activities (e.g., regrading, reseeding, etc.) at this mine waste pile (Knight Piesold, 2018). The EPA estimates that TP-4 has an area of 38.3 acres, with an estimated maximum tailing depth of 97 feet, and an estimated tailings volume of 3 million cubic yards (EPA, 2023, personal communication).

The Sunnyside group is located ~7 miles northeast of Silverton and includes the Gold King, American Tunnel, and Mogul mines. It is comprised of eight separate ore shoots and has accounted for ~60% of the gold, silver, copper, lead, and zinc production from San Juan County. Metals here are contained in galena, sphalerite, chalcopyrite, and tetrahedrite. Gangue minerals include manganese bearing rhodonite and rhodochrosite (Blood, 1968). Due to the complex history of Pile 4, no attempt is made herein to determine the exact source of the tails in this pile.

Brookyln Mine

The Brooklyn Mine workings are on the north side of Browns Gulch and follow a northeast trending quartz-pyrite vein containing native gold, sphalerite, galena, and chalcopyrite (Burbank and others, 1972; Neubert and others, 1992; Rosemeyer, 2002). Rosemeyer (2002) reports other minor or trace minerals including: cosalite, petzite, rhodochrosite, tennantite, tetradymite, tetrahedrite, and several other minerals. The vein occurs in hydrothermally altered Burns Member of the Oligocene Silverton Volcanics which includes interbedded lava flows (e.g., tuffs) and related volcaniclastic rocks (flow breccias) (Luedke and Burbank, 2000). The Burns Member consists predominantly of altered porphyritic andesite, trachyandesite, and dacite in the area (Luedke and Burbank, 2000). Along portions of the vein, narrow fissures contain native gold associated with minor manganiferous carbonate and pyrite (Burbank and others, 1972). The main Brooklyn vein cuts several older NW striking faults and narrow veins that contain lower gold and silver concentrations and consist of quartz, pyrite, sphalerite, and galena (Rosemeyer, 2002). Reportedly, mineralization from the later Brooklyn vein permeates these older veins in areas (Rosemeyer, 2002).

As reported by Rosemeyer (2002; page 164):

> *"Mineralization along the Brooklyn vein is not continuous but is concentrated in ore shoots along the structure. To date, three main gold/pyrite orebodies have been mined that are associated with intersecting cross veins. It is estimated that about 77 percent of the reported production for the mine came from the gold/pyrite ore mined from 1901 through 1942………A bulk sample of the gold/pyrite ore tested….in the 1930s at Silverton assayed 0.98 ounces of gold, 4.2 ounces of silver, 4 percent lead, 3 percent copper, 3 percent zinc, and 21 percent iron (mainly pyrite)."*

Production from the Brooklyn Mine was sporadic and small with an estimated production of 8,600 oz gold; 51,000 oz silver; 5,000 lb copper; 36,000 lb lead; and 8,500 lb zinc (Neubert and others, 1992). The EPA estimates that the volume of all the mine waste piles in the Brooklyn Mine area is 15,000 cubic yards (EPA, 2019, see Appendix A, Park 2).

North Star Mine

Production at the historic North Star mine started around 1876, with an increase in development around 1881 (Ransome, 1901) and was mainly from the Shenandoah-Dives vein system (King and Allsman, 1950; Varnes, 1963). Veins in this area are along the southern rim of the Silverton caldera within the Oligocene monzogranite to granodiorite Sultan Mountain Stock (a composite intrusive body along the rim of the caldera) (Luedke and Burbank, 2000). The North Star mine is located on the northeast flank of the Sultan Mountain Stock where mineralized veins are concentric and generally parallel the ring faults associated with the Silverton caldera (Musgrave and Thompson, 1991).

Musgrave and Thompson (1991) report that major vein minerals in the north end of the Sultan Mountain Stock area include quartz, sulfides, carbonates, and barite (in some locations) (Musgrave and Thompson, 1991). They included 25 additional minerals from the nearby Pittsburg level (to the south) including, by estimated abundance of total vein volume: quartz (30-95%), pyrite (10-15%), chalcopyrite (5%), rhodochrosite-siderite (2%), tetrahedrite (2%), galena (1-2%), and sphalerite (1-2%). Other minerals less than 0.5% include gold, hematite, calcite, wolframite, covellite, digenite, anglesite, pearceite, and jamesonite (Musgrave and Thompson, 1991). Sulfide content of the vein material at the North Star Level 7 (~40%) may be greater than the Pittsburg level (~20%) based on their preliminary inspection (Musgrave and Thompson, 1991). Principal ore minerals associated with this vein system reported by other authors include (King and Allsman, 1950: p. 66), *"….galena, sphalerite, chalcopyrite, together with gold and silver. The gold is sometimes found in the free state, whereas the silver may be contained in the sulfides or accompany them as complex silver minerals*." Ransome (1901) reports that the veins at the North Star contained abundant quartz, with some barite, and sulfide mineralization that included galena, tetrahedrite, pyrite (reportedly containing some gold), sphalerite, chalcopyrite, as well as some free gold.

La Plata Mining District

Columbus Mine

As reported by Neubert and others (1992), the Columbus vein is within silicified and metamorphosed Permian Cutler Formation and Laramide-age diorite. The vein is traceable for about 4,500 feet, from the northeast side of Columbus Basin to Ashland Gulch on the southwest side of Lewis Mountain, strikes about N. 60o E, and dips about 65o northwest (Neubert and others, 1992). Per Eckel (1949), all the workings of the Columbus mine are in a tongue of hornblende diorite extending northwestward from the Lewis Mountain stock. Northeast and southwest of the mine the vein cuts thoroughly silicified beds of the Cutler Formation and several associated sills.

The vein is within a pyrite-rich shear zone up to at least 55-feet wide with a siliceous high-grade core up to 10-feet wide (Neubert and others, 1992). Ore material contains quartz, pyrite, calcite, and possible gold tellurides (Neubert and others, 1992; Eckel, 1949). Recorded production from the Columbus Mine is estimated to include: 115 oz gold, 230 oz silver, 26 lbs copper, and 70 lbs lead (Neubert and others, 1992). Additional geochemical sampling results for many mine waste piles in the La Plata mining district are available in Neubert and others (1992).

Doyle Group area

The Doyle Group deposits include gold-bearing replacement and pyrite vein deposits (Eckel, 1949). Reportedly, the first claims in the area around Jackson Ridge were made in 1888 with production commencing around 1896 with sporadic production until 1936 when an avalanche destroyed most of the mine facilities (CGS internal Sunshine Mining Files). Most of the historic mining targeted the pyrite replacement deposits in the Pony Express Limestone Member (Pony Express) of the Jurassic Wanakah Formation. Numerous Laramide-age dikes and sills (mostly diorite-monzonite porphyry) intrude the Cretaceous sedimentary rocks in this area and other sedimentary formations are completely silicified. Per Eckel (1949), the Pony Express has been almost completely replaced by fine to coarse granular pyrite containing gold and a little chalcopyrite. Veins in the area contain pyrite but with more quartz compared to the limestone replacement deposit. The Pony Express is exposed in mine openings and ranges from 4 inches to 5 feet thick (Eckel, 1949). In one area (the North Star-Sundown Mine) it averages 2 feet thick. Numerous faults and fissures intersect the rocks in the area along the south side of Jackson Ridge (Eckel, 1949; Neubert and others, 1992).

Along the south side of Jackson Ridge, the Pony Express is almost completely replaced by massive gold-bearing pyrite in several places and locally, it contains abundant quartz (Eckel, 1949). Near the surface, the pyrite is altered to limonite in places (Eckel, 1949). Per Neubert and others (1992), although records from this area are incomplete, production from the area is estimated to be: 3,500 oz gold, 181 oz silver, and 97 lbs of copper. Most of the production was from the North Star-Sundown mine where the mineralized bed ranges from ~0.8 to 4 feet thick and is replaced by pyrite, quartz, and clay in places (Neubert and others, 1992). Although pyrite was the only sulfide identified by Neubert and others (1992), they also report free gold, malachite staining, and the potential for gold telluride minerals based on their laboratory analysis of samples collected from within the North Star-Sundown mine. They also report that silver and most of the base metals were absent and that cobalt concentrations were elevated (> 100 ppm) in many of the samples which were often higher than copper, lead, and zinc concentrations. Lower gold concentrations (generally less than 1,000 parts per billion [ppb]) were detected in samples collected from the silicified sedimentary rocks in this area which contains varying quantities of disseminated pyrite and/or limonite (Neubert and others, 1992).

According to Eckel (1949), two tons of ore shipped from the Thunder Mine in 1937 and contained 0.69 oz gold and 6 oz of silver. The lower adit of the Thunder Mine followed a vein intersecting a 2- to 5-foot-wide fracture zone in the Entrada Sandstone containing limonite gouge and pyritized breccia (Eckel, 1949; Neubert and others, 1992). An upper adit is within the Junction Creek Sandstone that contains more pyrite, brecciated sandstone, gouge, quartz, and galena (Eckel, 1949). Historic analyses of samples from this area contained a maximum of 140 ppb gold and 1,500 ppm zinc with anomalous concentrations of mercury (12 ppm) and arsenic (3,190 ppm) in an ore-bin sample (Neubert and others, 1992).

Northgate Mining District

The first claims near the Gero Tunnel and Penber fluorspar mines were staked in the area around 1918 and fluorspar was produced between 1922 and 1927. After this, the mines were idle until about 1941. Additional mining was conducted between 1941 and 1945 when mining ceased again (Shawe and others, 1976). Larger scale mining in this area started in 1951 and continued into the 1970s. Fluorspar mining in Colorado ended in the 1970s (Arbogast and others, 2011). About 32% of the total fluorspar production in Colorado (to date in 1975) was mined from the Northgate mining district (Brady, 1975).

The largest deposits of fluorspar in the Northgate mining district occur along faults on Pinkham Mountain and are associated with vein zones including the north trending Fluorspar-Gero-Penber fault zone (Steven, 1960). In this area, fluorspar is deposited along faults mostly within Precambrian granitic rocks (e.g., quartz monzonite) and the late-Eocene to Oligocene White River Formation. Less fluorspar occurs in the Precambrian hornblende and hornblende-biotite gneiss where there was less space along fractures (Steven, 1960). Fluorspar deposits occur within the fractures while the White River Formation was (Steven, 1960; p. 325) "*widely impregnated or replaced by fluorspar.*" The White River Formation consists mostly of arkose, tuffaceous siltstones, and clays.

Steven (1960) reports that the known vertical range was 600 feet in the main vein zones and 1,050 feet in the entire district although none of the mines had reached the bottom of the deposits at that time. The fluorspar in this area occurs as veins and breccia filling where the former contains (Steven, 1960: p. 393) "*greenish, yellowish, or colorless fluorite which occurs in botryoidal layers with finely granular to columnar structure. In the Northgate district, the fluorspar consists largely of fluorite intermixed with finely granular quartz, chalcedony, wallrock fragments, and other minor impurities.*" General grades of fluorite in the Fluorspar-Gero-Penber vein zone include high grade stringers containing more than 80% fluorite, 60% fluorite along 3- to 6-foot vein zones, and averages of 40-50% fluorite in veins 8- to 10-feet thick (Steven, 1960). Clay (montmorillonite) commonly occurs with the fluorite and fault gouge and calcite is common in the mineralized White River Formation arkose (Shawe and others, 1976).

Sulfide minerals are rare in vein zones (Steven, 1960) and the quartz monzonite in the Fluorspar-Gero-Pember zone contains siliceous and pyritic alteration zones (Brady, 1975). Minor quantities of quartz, pyrite, barite, and manganese oxides occur in some of the deposits in the Northgate district (Brady, 1975; Shawe and others, 1976). Molybdenum was detected in anomalous amounts in Precambrian quartz monzonite wallrock next to the fluorspar veins (up to 800 ppm in wallrock and decreasing away from the vein) where (USGS, 1970; p. A5) "*dark-gray veinlets are pervasive through the rock, even along mineral cleavage planes, and are composed of a fine mixture or intergrowth of fluorite, chalcedonic quartz, pyrite, and in one place, molybdenite."* Pure fluorite from vein systems in the area contain trace barium, manganese, strontium, and yttrium while trace amounts of zinc, copper, and silver occur in manganese oxide zones (Shawe and others, 1976).

Other deposits in the area include low-grade copper deposits which are generally associated with lenses in pegmatite bodies associated with the Precambrian gneiss that contain < 10% chalcopyrite and molybdenite. In places, secondary chrysocolla and malachite are found in historic mine dump samples (Steven, 1960).