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Final

TERRESTRIAL
SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

Bonita Peak Mining District NPL Site

San Juan County, Colorado

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Table of Contents

List of Tables

List of Figures

Appendices

Attachments

LIST OF ACRONYMS

AUF	Area Use Factor
BERA	Baseline Ecological Risk Assessment
BLM	Bureau of Land Management
BPMD	Bonita Peak Mining District
BTAG	Biological Technical Assistance Group
COPEC	Contaminant of Potential Ecological Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
DL	Detection Limit
EcoSSL	Ecological Soil Screening Level
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESV	Ecological Screening Value
EU	Exposure Unit
HQ	Hazard Quotient
LANL	Los Alamos National Laboratory
NPL	National Priorities List
QAPP	Quality Assurance Project Plan
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
SLERA	Screening-Level Ecological Risk Assessment
TRV	Toxicity Reference Value
WP	Work Plan

EXECUTIVE SUMMARY

ES.1 Introduction

A terrestrial Screening-Level Ecological Risk Assessment (SLERA) was performed at the Bonita Peak Mining District (BPMD) National Priorities List (NPL) site located in San Juan County, CO. The goal of this effort was to (a) identify Contaminants of Potential Ecological Concern (COPECs), (b) assess the risk of those COPECs to four terrestrial ecological receptor groups potentially exposed to mine-impacted soils, and (c) rank the various mine-impacted exposure areas based on their total risk.

In 2015 and 2016, the United States Environmental Protection Agency (EPA) collected over 230 composite soil samples for analysis from 35 mine sites, 25 overbank riparian areas, and 12 public campsites. Much of the mine site and overbank sampling specifically targeted mine-impacted and non-vegetated soil sampling locations. As such, many of these samples represent "worse-case" exposure conditions.

All samples were analyzed for a broad suite of metals and provide the primary source of data used in the SLERA. This SLERA only relies on soil analytical data collected by EPA in 2015 and 2016, even though other agencies collected and chemically analyzed soil samples from many of the same locations at the BPMD NPL site over the past couple of decades. The reasons for this approach are that (a) the EPA data were all obtained under similar Work Plans (WPs) and Agency-approved Quality Assurance Project Plans (QAPPs) (b) the analytical results have all undergone data validation, and (c) the EPA data are of known quality. While not directly used herein, historical data were consulted when developing the 2015 and 2016 sampling methods.

It is recognized that 48 mine, mill, and tailings features and two broader study areas are included in the BPMD NPL site. However, EPA collected soils from 35 of the 48 sites during the 2015 and 2016 sampling campaign. The remaining 13 sites were either too remote for safe access or could not be sampled due to a lack of entry permission from property owners. Also, sampling at the 35 mine features focused specifically on waste rock piles and tailings areas, and not the more ecologically desirable surrounding terrestrial habitat. Therefore, mine site data represent the most disturbed areas associated with each mine feature. This SLERA evaluates each mine site as a distinct exposure area.

The overbank soil samples were collected at discrete terrestrial locations along the major waterways flowing through the BPMD. They represent mostly mine wastes carried downstream and deposited on the banks or in the floodplains of these waterways during periods of high flow (e.g., spring snowmelt). The samples were grouped into 25 Exposure Units (EUs) representing long stretches of shoreline. Because of their close proximity to the Animas River, Mineral Creek, Cement Creek, and their major tributaries, the overbank soil EUs overlap with the aquatic

EUs established in the final aquatic Baseline Ecological Risk Assessment (BERA) WP (TechLaw, 2016b). This SLERA evaluates each overbank soil EU as a distinct exposure area.

The 12 public campsites are scattered throughout the BPMD and range from small tent pads to large motorhome parking areas. These sites represent relatively flat areas that may contain mine-impacted soils associated with floodplains or nearby mines. Campsites may provide habitat for wildlife species tolerant to human activities. This SLERA evaluates each campsite as a distinct exposure area.

The 2015 and 2016 collected mine site and campsite soils samples were returned to the laboratory and passed through a 2 mm sieve in order to create more homogeneous samples. Only the sieved fraction (< 2 mm) was analyzed for total recoverable metals. The vast majority of overbank soil samples were analyzed for total recoverable metals unsieved. For sake of consistency, only unsieved overbank soil samples were considered herein. The analytical data were compiled into soil data sets for each of the three exposure area groups (i.e., mine sites, overbank soil EUs, and public campsites). With exceptions, many of the mine site and overbank soil EUs were represented by more than one composite soil sample (note: the 12 campsites were each represented by a single composite soil sample). When more than one sample was available for a given site, the maximum concentration of each analyte, or half of the maximum Detection Limit (DL) if an analyte was not detected above the method DL, was identified for use as the Exposure Point Concentration (EPC). EPCs were used to select soil COPECs, assess risk to individual terrestrial receptor groups, and calculate total risk at each exposure area for use in risk ranking.

The four terrestrial receptor groups considered in this SLERA are terrestrial plants, soil invertebrates, birds, and mammals. The first two receptor groups represent community-level organisms which are assumed to be exposed to the mine feature-impacted soils via direct contact. The other two receptor groups represent generic birds and mammals that may forage in the BPMD terrestrial habitats, including the exposure areas of interest to this SLERA. No food chain modeling was performed to quantify dietary exposure to birds and mammals. Instead, the evaluation used published soil Ecological Screening Values (ESVs) developed specifically to protect sensitive terrestrial wildlife receptors exposed to contaminated soils and to prey items in direct or indirect contact with those soils. This approach was not only consistent with the goals of this SLERA but also greatly streamlined the wildlife risk evaluation. Note that wildlife food chain modeling is considered a risk refinement procedure and, if deemed necessary, will be used in the future terrestrial BERA for the BPMD NPL site.

ES.2 Selection of Soil COPECs

The first step in the SLERA process consisted of identifying the soil COPECs to be carried forward for further evaluation. COPECs were identified for each of the three exposure area and receptor groups. This was achieved by first identifying the highest concentration of each analyte measured in the composite soil samples collected at the various exposure areas (i.e., mine sites, overbank soil EUs, and campsites). These analyte- and exposure area-specific concentrations, which represent the maximum EPCs, were divided by the lowest of the corresponding published no-effect soil ESVs for terrestrial plants, soil invertebrates, birds, or mammals in order to calculate a Hazard Quotient (HQ), where HQ = max EPC/most-conservative no-effect ESV. Analytes with an HQ above 1.0 were retained as soil COPECs warranting further evaluation. An analyte lacking a no-effect soil ESV was also retained as a COPEC for discussion in the uncertainty analysis.

Exhibit ES.1 summarizes the COPECs at the three exposure area groups. All analyzed metals, except for nickel, were retained for further evaluation at the mine sites. All analyzed metals were retained for further evaluation at the overbank soil EUs. Finally, all analyzed metals, except for beryllium and nickel, were retained for further evaluation at the public campsites. Hence, with the few exceptions noted above, all analyzed metals were retained as COPECs for further evaluation in this terrestrial SLERA.

Exhibit ES.1: Soil COPECs for the three exposure areas at the BPMD NPL site						
	Mine Wastes		Overbank Soils		Public Campsites	
Analyte	Soil COPEC?	Reason Code	Soil COPEC?	Reason Code	Soil COPEC?	Reason Code
aluminum	Y	c	Y	c	Y	c
antimony	Y	a	Y	a	Y	a
arsenic	Y	a	Y	a	Y	a
barium	Y	a	Y	a	Y	a
beryllium	Y	a	Y	a	N	b
cadmium	Y	a	Y	a	Y	a
chromium	Y	a	Y	a	Y	a
cobalt	Y	a	Y	a	Y	a
copper	Y	a	Y	a	Y	a
iron	Y	c	Y	c	Y	c
lead	Y	a	Y	a	Y	a
manganese	Y	a	Y	a	Y	a
mercury	Y	a	Y	a	Y	a
molybdenum	Y	a	Y	a	Y	a
nickel	N	b	Y	a	N	b
selenium	Y	a	Y	a	Y	a
silver	Y	a	Y	a	Y	a
thallium	Y	a	Y	a	Y	a
vanadium	Y	a	Y	a	Y	a
zinc	Y	a	Y	a	Y	a

BPMD = Bonita Peak Mining District; COPEC = contaminant of potential ecological concern; ESV = ecological screening value; HQ = hazard quotient; NPL = National Priorities List

Reason code:

a = HQ > 1

b = HQ < 1

c = analyte is detected but has no ESV

ES.3 Risk Characterization

ES.3.1 Introduction

The next step in the process was to quantify the potential for ecological risk associated with the soil COPECs to the four terrestrial receptor groups at each of the 72 exposure areas associated with the BPMD NPL site. This approach consisted of comparing Reasonable Maximum Exposures (RMEs; represented by the maximum concentration in each exposure area) against each of the no-effect soil ESVs for terrestrial plants, soil invertebrates, birds, and mammals in order to calculate COPEC-specific HQs for all four receptor groups. The future terrestrial BERA for the BPMD NPL site will implement more realistic exposure and toxicity assumptions. The current approach satisfies the major goals of this SLERA, which are to identify COPECs, assess the risk to four terrestrial receptor groups, and rank the mine-impacted exposure areas based on their total risk.

An HQ table was prepared for each exposure area to summarize the potential for ecological risk to the four receptor groups exposed to the COPECs identified in the soil samples collected from each mine site, overbank soil EU, and public campsite. These HQ tables, which are all included in this SLERA report for review and consideration, can be interpreted in two separate and distinct ways, as follows:

- A typical approach discusses each of the 72 exposure areas at the BPMD NPL site individually in terms of their potential for ecological risk by COPEC to each receptor group.

- A "risk ranking" approach discusses each exposure area in terms of its relative risk within the mine sites, overbank soil EUs, and campsites *but without focusing specifically on individual COPECs, receptor groups or HQs*.

The decision was made not to discuss the potential for ecological risk using the typical approach outlined above because (1) it would generate much text with little relevance to the site-specific conditions in the exposure areas, (2) the EPCs (= max concentrations) are highly conservative values and are not further refined in this SLERA, and (3) it is not necessary to achieve the goals of this SLERA.

Instead, the risk characterization follows a risk ranking method. This alternative approach has several advantages: (1) the supporting text is more succinct because the focus is on assessing the total risk at each exposure area instead of the individual components which make up that total risk, (2) the focus shifts from discussing individual HQs or receptor groups to showing how an exposure area ranks compared to its peers, (3) the discussion emphasizes a handful of risk ranking summary tables (one each for the mine site, overbank soil EU, and public campsite exposure areas), and (4) the total risk concept is used to logically divide all the exposure areas into three generic risk categories, called higher-risk exposure areas, moderate-risk exposure areas, and lower-risk exposure areas.

The risk-ranking approach provides a product that risk managers can use to objectively evaluate all the exposure areas assessed in this SLERA, determine the risk categories in which they fall, determine which of those exposure areas may need further investigation, and which might require remedial attention.

The risk ranking approach for the exposure areas included in this terrestrial SLERA consists of five sequential steps, as follows:

- *Step 1*: Calculate the COPEC-specific plant, invertebrate, bird, and mammal HQs.

This information determines the potential for ecological risks for each COPEC to each of the four terrestrial receptor groups at each exposure area under maximum exposure conditions.

- *Step 2*: Sum the HQs for each COPEC across the four terrestrial receptor groups, as follows:

$$\Sigma\text{COPEC HQs} = \text{plant HQ} + \text{invertebrate HQ} + \text{bird HQ} + \text{mammal HQ}$$

- *Step 3*: Add all the ΣCOPEC HQs to calculate a "total risk" for each exposure area, as follows:

$$\text{Total risk} = \text{sum}\ (\Sigma\text{COPEC}_1\ \text{HQs} + \Sigma\text{COPEC}_2\ \text{HQs} + \Sigma\text{COPEC}_3\ \text{HQs} + \ldots)$$

Note that summing the HQs as described above does ***NOT*** imply in any way that this SLERA considers risk to be additive across the four receptor groups and 20 COPECs. Instead, this simple mathematical approach is used only as a tool to represent each exposure area by a single value called total risk. This value can then be directly compared against the total risks calculated for all the other exposure areas within a group.

- *Step 4*: Calculate the percent of the total risk associated with each ΣCOPEC HQs, as follows:

$$\%\ \text{of total risk} = (\Sigma\text{COPEC}_x\ \text{HQs/total risk}) * 100$$

The % of total risk shows which of the COPECs are responsible for the most risk at a particular exposure area.

- *Step 5*: Assign the exposure areas to one of three risk categories

The total risks calculated in Step 3 above are then used to organize the exposure areas into three broad risk categories called higher-risk exposure areas, moderate-risk exposure areas, and lower-risk exposure areas.

These three risk categories were determined based on the following observations: most exposure areas with a total risk below 200 have 5 or less individual HQs for plants, invertebrates, birds, and mammals above 10. On the other hand, most exposure areas with a total risk above 500 have 10 or more individual HQs above 10.

The three broad risk categories are defined as follows:

- Lower-risk exposure areas: total risk less than 200
- Moderate-risk exposure areas: total risk between 200 and 500
- Higher risk exposure areas: total risk above 500

These categories represent a possible range of ecological risk associated with the presence of the soil COPECs. It is not possible to know, without much additional research, what actual ecological effects may be associated with the presence of the soil COPECs at the lower-risk exposure areas. However, it is deemed quite likely that whatever ecological risks are present at the lower-risk exposure areas would increase substantially in the moderate-risk and higher-risk exposure areas. Hence, the risk-ranking results should not be viewed as absolutes because they only show the potential for ecological risk in relative terms. That is the reason that the words “lower-risk” and “higher risk” are used throughout this report instead of “low-risk” and “high-risk”.

ES.3.2 Risk ranking of the 35 mine site exposure areas

Exhibit ES.2 summarizes the risk ranking of the 35 mine site exposure areas.

- Thirty of the 35 mine sites represent higher-risk exposure areas (total risk > 500) and five represent moderate-risk exposure areas (total risk ranging between 200 and 500). None of the mine sites fall into the lower-risk exposure area category (total risk < 200).

- With a few exceptions, lead is the main risk driver, with zinc as a strong secondary risk driver. The range of maximum lead and zinc concentrations in the higher-risk and moderate-risk categories are as follows:

    - *Higher-risk exposure areas:* lead = 2,210 mg/kg to 35,700 mg/kg; zinc = 321 mg/kg to 66,800 mg/kg
    - *Moderate-risk exposure areas:* lead = 502 mg/kg to 2,800 mg/kg; zinc = 248 mg/kg to 1,040 mg/kg

- Arsenic is identified as the primary risk driver at Koehler Tunnel (max EPC = 13,700 mg/kg) and Longfellow Mine (max EPC = 3,160 mg/kg).

- With a few exceptions, the top three risk drivers across the two risk categories systematically account for over 70% of the total potential for ecological risk at the mine site exposure areas.

Exhibit ES.2: Risk ranking for the 35 mine site exposure areas at the BPMD NPL site						
Risk Ranking	NPL Mine Site Name	Total Risk	Top 3 risk drivers			Fraction of total risk (%)[a]
			risk driver 1	risk driver 2	risk driver 3	
HIGHER-RISK EXPOSURE AREAS						
1	Bandora Mine	8491	zinc	lead	antimony	80
2	Mountain Queen Mine	6884	lead	antimony	zinc	88
3	Clipper Mine	4802	lead	zinc	antimony	93
4	Ben Butler Mine	4723	lead	zinc	antimony	91
5	Koehler Tunnel	4445	arsenic	lead	mercury	93
6	Red Cloud Mine	4188	lead	antimony	zinc	85
7	Sunnyside Mine	3984	lead	zinc	cadmium	86
8	Grand Mogul Mine	3969	lead	zinc	antimony	87
9	Mogul Mine	3626	lead	zinc	antimony	86
10	Pride of the West Mine	3190	lead	zinc	cadmium	85
11	Junction Mine	2756	lead	mercury	arsenic	86
12	Silver Wing Mine	2590	antimony	lead	copper	84
13	Forest Queen Mine	2558	lead	manganese	zinc	84
14	Paradise Mine	2186	lead	selenium	antimony	94
15	London Mine	2125	lead	antimony	zinc	81
16	Vermillion Mine	2065	lead	zinc	mercury	85
17	Longfellow Mine	1650	arsenic	lead	antimony	85
18	Anglo Saxon Mine	1575	lead	antimony	zinc	85
19	Boston Mine	1540	lead	antimony	zinc	70
20	Tom Moore Mine	1503	lead	zinc	molybdenum	82
21	Howardsville Colo Goldfields Tailings	1501	lead	zinc	arsenic	73
22	Frisco/Bagley Tunnel	1367	lead	zinc	mercury	81
23	Henrietta Mine	1199	lead	zinc	antimony	88
24	Ben Franklin Mine	1158	lead	zinc	antimony	85
25	Columbus Mine	1035	lead	zinc	mercury	84
26	Sunbank Group Mine	981	antimony	lead	thallium	77
27	Dewitt Mine	978	lead	antimony	arsenic	84
28	Kittimack Tailings	959	lead	zinc	copper	81
29	Yukon Tunnel (Gold Hub)	859	lead	copper	selenium	75
30	Brooklyn Mine	580	lead	antimony	zinc	76
MODERATE-RISK EXPOSURE AREAS						
31	Gold King Mine	464	lead	selenium	zinc	80
32	Joe and Johns Mine	459	lead	arsenic	zinc	58
33	Red and Bonita Mine	324	lead	mercury	zinc	84
34	Natalie/Occidental Mine	248	lead	selenium	mercury	57
35	Lark Mine	208	lead	antimony	arsenic	55
LOWER-RISK EXPOSURE AREAS						
none of the mine sites fell in this category						

[a] fraction of total risk = sum of risk of top 3 risk drivers/total risk

note: none of the mine sites fall into the lower-risk category

ES.3.3 Risk ranking of the 25 overbank soil EUs

Exhibit ES.3 summarizes the risk ranking of the 25 overbank soil EUs.

- Twelve of the 25 overbank soil EUs represent higher-risk exposure areas (total risk > 500), six represent moderate-risk exposure areas (total risk ranging between 200 and 500), and seven represent lower-risk exposure areas (total risk < 200).

- With exceptions, lead and zinc are the two main risk drivers. The range of maximum concentrations for these two metals in the three risk categories are as follows:

    - *Higher-risk exposure areas:* lead = 1,250 mg/kg to 10,500 mg/kg; zinc = 446 mg/kg to 30,200 mg/kg
    - *Moderate-risk exposure areas:* lead = 349 mg/kg to 1,760 mg/kg; zinc = 577 mg/kg to 4,120 mg/kg
    - *Lower-risk exposure areas:* lead = 162 mg/kg to 508 mg/kg; zinc = 176 mg/kg to 813 mg/kg

- The top three risk drivers across the three risk categories systematically account for over half of the total risk at the overbank soil EUs.

ES.3.4 Risk ranking of the 12 public campsite exposure areas

Exhibit ES.4 summarizes the risk ranking of the 12 public campsite exposure areas.

- Three of the 12 public campsites represent higher-risk exposure areas (total risk > 500), two represent moderate-risk exposure areas (total risk ranging between 200 and 500), and seven represent lower-risk exposure areas (total risk < 200).

- With exceptions, lead and zinc are the two main risk drivers at the public campsites. The range of concentrations for these two metals in the three risk categories are as follows:

    - *Higher-risk exposure areas:* lead = 2,880 mg/kg to 44,200 mg/kg; zinc = 740 mg/kg to 17,300 mg/kg
    - *Moderate-risk exposure areas:* lead = 761 mg/kg to 1,330 mg/kg; zinc = 540 mg/kg to 1,520 mg/kg
    - *Lower-risk exposure areas:* lead = 73.6 mg/kg to 530 mg/kg; zinc = 74.3 mg/kg to 874 mg/kg

- The top three risk drivers across the three risk categories systematically account for over half of the total risk at the public campsite exposure areas.

Exhibit ES.3: Risk ranking for the 25 overbank soil exposure areas at the BPMD NPL site						
Risk Ranking	EU	Total Risk	Top 3 risk drivers			Fraction of
			risk driver 1	risk driver 2	risk driver 3	total risk (%)[a]
HIGHER-RISK EXPOSURE AREAS						
1	EU-15	4175	zinc	cadmium	lead	74
2	EU-10	2024	lead	manganese	zinc	83
3	EU-24	1259	zinc	manganese	lead	62
4	EU-13	1222	lead	mercury	zinc	73
5	EU-16	898	lead	manganese	mercury	70
6	EU-12	757	lead	zinc	manganese	66
7	EU-04	755	lead	arsenic	zinc	70
8	EU-3.5	670	lead	mercury	chromium	81
9	EU-22	664	zinc	lead	antimony	80
10	EU-19	650	lead	manganese	thallium	56
11	EU-09	561	lead	zinc	manganese	78
12	EU-14	557	lead	zinc	manganese	59
MODERATE-RISK EXPOSURE AREAS						
13	EU-05	486	zinc	cadmium	manganese	68
14	EU-20	379	lead	zinc	mercury	65
15	EU-08	330	lead	zinc	manganese	77
16	EU-01	320	lead	zinc	antimony	49
17	EU-03	314	lead	manganese	chromium	68
18	EU-21	257	lead	zinc	antimony	59
LOWER-RISK EXPOSURE AREAS						
19	EU-06	185	manganese	selenium	zinc	51
20	EU-17	182	manganese	zinc	lead	60
21	EU-07	174	lead	zinc	chromium	63
22	EU-18	147	lead	chromium	zinc	57
23	EU-23	139	lead	chromium	antimony	63
24	EU-02	109	lead	zinc	selenium	56
25	EU-11	100	chromium	lead	zinc	52

Exhibit ES.4: Risk ranking for the 12 campsite exposure areas at the BPMD NPL site						
Risk Ranking	Public Camp Site	Total Risk	Top 3 risk drivers			Fraction of
			risk driver 1	risk driver 2	risk driver 3	total risk (%)[b]
HIGHER-RISK EXPOSURE AREAS						
1	CMP4	7607	lead	zinc	mercury	87.2
2	CMP7	2007	lead	zinc	antimony	90.2
3	CMP2	557	lead	copper	zinc	77.5
MODERATE-RISK EXPOSURE AREAS						
4	CMP15a	472	lead	copper	cadmium	54.2
5	CMP9	335	lead	antimony	zinc	65.6
LOWER-RISK EXPOSURE AREAS						
6	CMP15	168	lead	zinc	chromium	76.7
7	CMP11	149	lead	mercury	zinc	58.8
8	CMP12	131	lead	zinc	mercury	53.4
9	CMP5	114	lead	mercury	chromium	54.2
10	CMP14	90	lead	zinc	chromium	61.3
11	CMP13	74	chromium	lead	zinc	57.1
12	CMP10	69	selenium	chromium	lead	51.4

[a] fraction of total risk = sum of risk of top 3 risk drivers/total risk

ES.3.5 Risk ranking discussion

The risk ranking procedure for the 72 exposure areas included in this terrestrial SLERA identifies several broad patterns, as follows:

- The mine sites have the highest proportion of exposure areas ranked in the "higher-risk" category (30 out of 35, or 86%), followed by the overbank soil EUs (12 out of 25, or 48%), and the campsite exposure areas (3 out of 12, or 25%). This finding is consistent with the observation that the mine waste piles represent a major source of contamination to the terrestrial and aquatic ecosystems at the BPMD NPL site. Hence, as an aggregate, they represent some of the highest levels of potential terrestrial ecological risk.

- Conversely, the public campsites have the highest proportion of exposure areas ranked in the "lower-risk" category (7 out of 12, or 58%), followed by the overbank soil EUs (7 out of 25, or 28%), and the mine site exposure areas (0 out of 35, or 0%). This evidence indicates that, as an aggregate, more of the public campsites have a lower potential for terrestrial ecological risk compared to the two other groups.

- A relatively small number of soil COPECs are responsible for most of the terrestrial ecological risk identified in the three exposure area groups. Lead and zinc are the primary risk drivers for most of the exposure areas but antimony, arsenic, cadmium, manganese, and mercury are also risk drivers in a few other areas. With some exceptions, the remaining COPECs, which consist of barium, beryllium, chromium, cobalt, copper, molybdenum, selenium, silver, thallium, and vanadium, showed marginal ecological risk.

- The cumulative risk associated with antimony is driven entirely by the mammal ESV (note: a bird ESV is not available for this metal). The mammal ESV, which equals 0.27 mg/kg, is 41 times and 289 times lower than the plant and invertebrate ESVs, respectively. Hence, mammals "drive" the ecological risk associated with this metal.

- Birds are systematically the most at risk (i.e., highest HQs) of the four terrestrial receptor groups evaluated in this SLERA. This observation reflects two inter-related elements: (a) lead and zinc are the two principal risk drivers because of their high soil concentrations, and (b) the bird ESVs for these two COPECs are the lowest of the four receptor groups, indicating the high sensitivity of birds to these metals. While highly-contaminated mine wastes and tailings areas do not provide ideal terrestrial habitat, some bird species may be attracted to these areas when looking for grit to ingest. The overbank soil EUs and the public campsites are in relatively natural areas and provide some habitat for birds. While concentrations of metals are lower in these areas than at the mine sites, they are still high enough to be of concern.

ES.3.6 Uncertainty analysis

Uncertainty analysis is an integral part of the SLERA process. Many choices and assumptions were made which can affect the outcome of the risk characterization. The key uncertainties include the following:

- The majority of the 2015-2016 sampling effort focused specifically on areas that maximized the chances of finding high levels of mining-related metals in soil. As a result, the samples used for calculating the EPCs likely represent high-level exposure conditions experienced by terrestrial receptor groups living and/or foraging throughout the BPMD NPL site. The samples are not expected to represent the metal concentrations that may be present in more suitable terrestrial habitats.

- The current risk analysis assumed that 100% of the soil COPECs measured by the chemical analyses represented the bioavailable fraction accessible for uptake by the ecological receptors. This assumption is expected to be unrealistically conservative. The difference between the reported metal concentrations in soil and the actual bioavailable fraction is not known but may be quite large. Therefore, assuming 100% bioavailability may result in an overestimation of risk.

- This SLERA does not consider background levels in the risk calculations. Analysis of background concentrations fell outside its scope and was not needed to identify COPECs and assess risk at high-exposure areas impacted by mining activities. Background-area soils may have naturally high metal levels given the mineralized nature of the geology at the BPMD. The issue of how soil background concentrations may affect the risk conclusions will be fully investigated in the future terrestrial BERA.

- The mining-related waste piles consist of chunks of overburden rocks and/or sterile, ground-up ore-bearing tailings; some of these materials may also be compacted into a hard crusty layer. These waste materials may not provide the required physical properties needed to support terrestrial plant and invertebrate communities. The SLERA only assesses ecological risk from exposure to COPECs by comparing metal concentrations to soil ESVs and assuming that this approach accounts for all possible responses, even those not associated with metal toxicity. The SLERA does not consider the potential impacts of the "physical" properties of the mine wastes (i.e., compaction, lack of nutrients, lack of an organic matrix, and/or lack of a viable soil microbial community) on the local plants and invertebrates. This missing information represents a data gap that results in additional uncertainty.

- The generic food chain models used to derive the soil no-effect ESVs protective of birds and mammals use an Area Use Factor (AUF) of 1.0. This AUF assumes that the receptor species receive 100% of their daily dose exclusively from the location of maximum concentration at each terrestrial exposure area. This assumption may be overprotective for large home-range receptors. HQs are quite sensitive to the magnitude of the AUF. For example, decreasing the AUF by a factor of two (say, from 1.0 to 0.5) also decreases an HQ by a factor of two. Hence, an AUF of 1.0 is highly conservative and yields HQs that may overestimate risks, particularly to more mobile bird and mammal species with home ranges larger than the individual exposure areas assessed in this SLERA.

- Three of the four receptor groups have one or more missing soil ESVs, as follows (note: aluminum and iron lack soil ESVs altogether and are discussed separately in the risk characterization):

  - plants: chromium
  - invertebrates: cobalt, molybdenum, silver, thallium and vanadium
  - birds: antimony and beryllium

  As discussed in this SLERA, most of these metals are considered minor soil COPECs to other receptors for which respective ESVs are available. Hence, the uncertainty associated with these missing ESVs appears small.

- The published soil ESVs for plants and invertebrates may have limited use at mining sites. The reason is that soil ESVs for community-level receptor groups are typically derived by mixing highly-soluble metal salts into test soils and then immediately exposing seeds/seedlings and worms to these freshly-amended soils. The metals in these test soils are highly bioavailable, which results in conservative (i.e., low) ESVs (Davies *et al.*, 2003). In contrast, much of the metals in mine wastes are part of the soil matrix and are typically much less bioavailable compared to the highly-soluble metal salts used in deriving the soil ESVs (Spurgeon and Hopkin, 1994). The terrestrial community-level risks calculated using the published soil ESVs should therefore be viewed as highly conservative when applied at mining sites.

- The SLERA did not quantify the potential for ecological risk for any particular wildlife receptor species. Instead, risk was evaluated by comparing maximum soil concentrations to soil no-effect ESVs protective of the most sensitive of the available bird or mammal feeding guilds (i.e., herbivores, omnivores, carnivores). On the other hand, this approach did not necessarily apply to the specific wildlife receptors that may be present in the San Juan Mountains. The highly-conservative exposure characterization (i.e., use of maximum soil concentrations as the EPCs), and the fact that the lowest of the COPEC-specific no-effect soil ESVs for birds and mammals were retained to calculate the HQs, ensured that the wildlife risks are likely to be biased high.

The available evidence indicates that several of the major assumptions used in this SLERA resulted in conservative ecological risk estimates for both terrestrial community-level receptor groups and the bird and mammal wildlife species. This inherent conservatism is acceptable in a SLERA to ensure that COPECs and receptors are not inadvertently eliminated from further consideration. It is expected that the future terrestrial BERA will characterize risk using less-conservative exposure and effects assumptions.

1.0 GENERAL INTRODUCTION

This report presents the United States Environmental Protection Agency's (EPA) terrestrial Screening-Level Ecological Risk Assessment (SLERA) of select mining-impacted locations associated with the Bonita Peak Mining District (BPMD) National Priorities List (NPL) Superfund site located in San Juan County, Colorado. The BPMD Superfund site consists of select mine features located in the headwaters of the Animas River watershed near Silverton, Colorado. Many years of mining operations and associated waste disposal practices have contaminated the local environment with metals. Metals concentrations may be high enough to adversely impact ecological receptors that occur or have potential to occur in BPMD terrestrial habitats. This SLERA is the first step in evaluating ecological risks to terrestrial receptors from exposure to BPMD contamination sources.

The following guidance was used to help prepare this report:

- U.S EPA. 1997. Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments. Interim Final. EPA 540-R-97-006.

EPA is applying the 8-step Ecological Risk Assessment (ERA) process to evaluate risks of BPMD Superfund site mining-related contamination to terrestrial receptors. This process provides a logical and efficient way to document if actual or potential ecological risks exist at a site, identify which contaminants pose an ecological risk, and generate information to help evaluate and select cleanup options. The SLERA covers the first two steps of this process by providing a simplified assessment using limited site data, high-level exposure estimates, and screening-level toxicity values to identify exposure pathways and Contaminants of Potential Ecological Concern (COPECs) that warrant further refinement.

Additional ecological risk evaluations may be needed if exposure pathways and risks are identified. These evaluations start with the problem-formulation phase in Step 3. During this stage, COPECs, contaminant effect characterizations, exposure pathways, assessment endpoints, and a Conceptual Site Model (CSM) are refined. These refinements lead to Step 4 of the ERA process, which consists of selecting risk questions and measurement endpoints, and identifying associated data collection activities. Both the Step 3 and Step 4 activities are documented using a Baseline Ecological Risk Assessment (BERA) Work Plan (WP). A Sampling and Analysis Plan (SAP) builds upon the BERA WP by providing detailed site investigation and analysis methods and associated data quality objectives.

Step 5 provides an opportunity to verify that the BERA WP and SAP are appropriate and implementable at the site. During this step, initial field-based sampling results may support reassessment and refinement of the Steps 3 and 4 site investigation methods. Step 6 consists of implementing all field sampling and exposure characterization studies. Step 7 is the risk characterization, which integrates exposure and effects data to derive risk estimates and identify uncertainties associated with risk estimates. This step is documented in the final BERA.

Risk management activities are performed by the risk managers and not the risk assessors. The former evaluate information obtained in Steps 1 through 7 to select site-specific cleanup options. Management decisions are finalized in the site-specific Record of Decision, which represents the final element of the 8-step ERA process.

This SLERA was performed to 1) identify the mining-derived COPECs for terrestrial community-level and wildlife receptors, 2) assess the potential for ecological risk of those COPECs under conservative exposure and toxicity assumptions, and 3) rank the various exposure areas at the BPMD NPL site in terms of their potential for ecological risk. Results obtained from these analyses are expected to inform future development of the BPMD BERA WP and SAP. Ranking the various BPMD terrestrial exposure areas into broad ecological risk categories could also be useful to risk managers when identifying exposure areas that may require remedial attention.

Assessment approaches and a draft version of this SLERA have been presented to, reviewed by, and commented on by the BPMD Biological Technical Assistance Group (BTAG) members. EPA fielded BTAG recommendations and comments; results of which are reflected in this SLERA. Formal BTAG comments and EPA responses are provided in **Attachment 1** of this SLERA.

1.1 Site description and history

The BPMD Superfund site consists of 46 historic mine features and two study areas, all of which are located in the upper reaches of the Animas River watershed near Silverton in San Juan County, Colorado. These mine features are generally located in and just outside of the extensively-mineralized Silverton Caldera basin. This area of San Juan County primarily consists of San Juan National Forest, lands managed by the Bureau of Land Management (BLM), and privately-owned land. The Silverton Caldera basin forms a complex mosaic of BLM property and thousands of private mining claims (Lyon *et al.*, 2003). National forests are also present, managed by the U.S. Forest Service, and mostly occur just outside of the Silverton Caldera basin. Large deposits of metals are the major geologic resource found in the basin (Storosh, 2013). As a result, the area has been subject to both large- and small-scale mining operations in boom and bust fashion from 1871 to 1991.

The discovery of gold and silver brought miners to the Silverton area and the upper Animas River region in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. The richer ore deposits were discovered and mined to the extent possible between 1870 and 1890. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, twelve concentration mills in the valley sent their output to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down around 1905, and mines were consolidated into fewer and larger operations with facilities for milling large volumes of ore. Mining and milling continued throughout the basin after 1907 whenever prices were favorable.

Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of a historic mining town developed in the 1880s in response to increased mining activity in the surrounding area. The town was the central location and railroad terminus for the milling and shipping of mine ores from the surrounding three-square-mile valley. The town declined in the 1920s and no remnants of it remain today. Only one year-round productive mine (Sunnyside Mine) remained in the county by the 1970's. This mine ceased production in 1991, and has since undergone extensive reclamation efforts. Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. These include, but are not limited to the Upper Gold King 7 Level Mine, American Tunnel, Grand Mogul Mine, Mogul Mine, Red & Bonita Mine, Evelyne Mine, Henrietta Mine, Joe and John Mine, and Lark Mine.

Howardsville, located between Silverton and Eureka at the mouth of Cunningham Creek, was established in 1874 by the Bullion City Company. This settlement became the base for many mines up Cunningham Gulch, including the Old Hundred Mine, Buffalo Boy Mine, Green Mountain Mine, Pride of the West Mine, Shenandoah-Dives Mine, Gary Owen Mine, and Emma Mine (Herron *et al*., 2000). The Pride of the West mill was built in 1940 as a 50-ton capacity mill and was further expanded in 1967 by the Dixilyn Corporation to a 400-ton capacity mill (Church *et al*., 2007).

The town of Eureka is located about eight miles northeast of Silverton at the confluence of Upper Animas and Eureka Gulch. Some of the mines located up Eureka Gulch include the Sunnyside Mine, the Clipper Mine, the Ben Franklin Mine, the Bavarian Mine, the Midway Mine, the Moonbeam Mine, and the Ransom Mine (Herron *et al*., 2000). The Sunnyside Flotation Mill in Eureka was built in 1917 with a 600 tons per day capacity. Two settling ponds were built in the Animas River Valley but the tailings dams were partially breached and tailings were washed down the Animas River after the mill was abandoned in 1949 (Church *et al*., 2007).

Animas Forks, named for the three forks of the Animas River, is located twelve miles northeast of Silverton and was first established in 1874. Numerous mines were located upstream of Animas forks. The town started declining in 1910 when the Gold Prince Mill ceased operation and became a ghost town in the 1920's.

Prospectors were finding mineralized veins along both the middle and main forks of Mineral creek as early as 1874. However, the drainage did not attract much attention because these formations were scattered and offered low-grade ores. The Silver Crown Mine on Mill Creek was the most promising mine in the late 1870's and saw some development. Sweetville, a settlement at the base of Red Mountain Pass, was started in 1882 to allow access to the rich veins found on the north side of Red Mountain, and to help explore the Mineral Creek basin. The rival camp of Chattanooga was located next to Sweetville. The two camps merged under the name of Chattanooga in 1883.

The Mineral Creek district became prominent in San Juan County in the early 1890's when the North Star and Victoria mines and mills located close to Silverton became the most significant producers. The Bandora Mine had rich ores, but production did not start until 1893 when the silver crash shuttered the facility for the next few years. The most prominent mines on Mineral Creek were Northstar Mine, Hercules Mine, Victoria Mine, Bandora Mine, Brooklyn Mine, and Bonner Mine. The Mineral Creek district did not experience the intense mining development that the Upper Animas and Cement Creek had received.

Mining stopped in the BPMD in 1991. Since then, many small-and large-scale reclamation and cleanup activities have been implemented, including removing mine wastes from sensitive ecological areas, rerouting surface water runoff around tailings piles, and plugging numerous portals and adits. In August 2015, EPA contactors triggered a release of about 3 million gallons of metals-laden water from the Gold King Mine adit in Cement Creek near Gladstone (EPA, 2015a). The accidental release occurred when an excavator was assessing the on-going releases of water from the mine. Since the Gold King Mine spill, EPA has monitored downstream water chemistry and quality, installed an interim water treatment plant in Gladstone, and worked with various stakeholders to develop monitoring and preparedness plans (EPA, 2016).

The area in and around the BPMD has become a popular recreation destination in the last 20 years. The rich cultural and natural history and abundance and accessibility of public land attracts many visitors to the BPMD throughout the year. Summer and fall recreation activities include all-terrain vehicle use, camping, wildlife viewing, hiking, biking, fishing, and hunting. The relic mining site structures provide unique viewing areas for visitors interested in the region's rich mining heritage (River Protection Workgroup, 2013). Several public camping areas and numerous backcountry campsites are located throughout the BPMD.

EPA, the BLM, the United States Fish and Wildlife Service, the United States Geological Survey, United States Forest Service and the United States Department of Interior performed multiple sampling campaigns in the BPMD from the mid-1990's until 2016 to gather data on the nature and extent of contamination from mining activities. These efforts collected surface water, sediment, pore water, soils and mine waste, benthic macroinvertebrates, stream flows, bioassays, and real-time water quality parameters. The soil samples obtained by EPA during the 2015 and 2016 sampling effort provides the analytical data used in the terrestrial SLERA.

1.2 SLERA organization

This SLERA is organized as follows:

- Section 2: Sampling, data base development and data processing
- Section 3: CSM
- Section 4: Endpoint selection
- Section 5: Effects analysis and selecting soil COPECs
- Section 6: Exposure analysis
- Section 7: Risk characterization
- Section 8: References

2.0 SAMPLING, DATABASE DEVELOPMENT AND DATA PROCESSING

2.1 Summary of the soil sampling effort in support of the terrestrial SLERA

EPA collected soil samples in support of this terrestrial SLERA during the summers of 2015 and 2016 from pre-selected locations at mining sites, floodplain areas ("overbank soils"), and public campsites. Privately-owned campsites were not sampled. The waste rock and tailings piles were all located within named mine workings, the overbank soils represent material deposited in the floodplains of rivers, creeks, and gulches during periods of high water, and the public campsites represent areas that may have been affected by nearby mining activity, or if located in floodplains, by transport and deposition of mine waste from upstream sources.

A major goal of the 2015-2016 sampling program was to obtain current information about the nature and extent of mining-related contamination in select terrestrial areas of the BPMD. The soil samples were collected, handled, and analyzed using the approaches and techniques described in two Quality Assurance Project Plans (QAPPs; TechLaw, 2015 and 2016a).

All samples were analyzed for total recoverable metals, including mercury. In addition, the samples obtained from the mine waste sites were analyzed for acid-base accounting and paste pH. A subset of mine sites soil samples were also analyzed using the synthetic precipitation leaching procedure. Regardless of origin, all samples were collected using disposable equipment to limit the need for decontamination in the field.

As discussed in the two QAPPs, all the soil samples sent to the laboratory for analyses represented composite samples consisting of between 5 to 30 subsamples. Hence, the analytical data for each soil sample represent an "average" concentration obtained from multiple individual subsamples. More than one composite sample was collected at larger mine sites. Sampling was conducted to chemically characterize mine wastes but did not attempt to determine the boundaries of the mine waste piles.

Each composite mine waste and campsite sample was passed through a 2 mm sieve and only the fraction that passed through the sieve was retained for analysis. The overbank soils were not sieved. Analytical data for sieved mine waste and campsite and non-sieved overbank soil samples were retained for use in this terrestrial SLERA.

The remainder of this section describes these three sets of soil samples and how data were processed into working datasets.

2.1.1 Mine sampling

Table 2.1 summarizes the sampling effort at the mine sites (note: the Mayflower Mill includes four separate waste repositories which were considered as a single exposure area in this SLERA). Of the 35 mine sites visited by EPA during the 2015 and 2016 sampling effort, all except two were sampled from their waste rock piles. The Kittimack Tailings site and the Howardsville Colorado Goldfields Tailings site are the exception; they were sampled for tailings (i.e., ground-up ore rock). It is recognized that mine wastes may have monetary mineral value and are the personal property of claim owners. Therefore, the use of the terms “mine wastes” and “waste rock” throughout this terrestrial SLERA should not be interpreted to mean “worthless geologic material”.

Figure 2.1 shows the location of the sampled mine sites highlighted in yellow. EPA did not sample a dozen of the 48 NPL-listed mine features during its 2015-2016 field campaign due to lack of access by private land owners or inability to physically reach remote mine locations high in the mountains away from roads. Some of these mining sites have been sampled by others over the years under different programs and QAPPs but their soil analytical data were not available for use in this terrestrial SLERA.

Appendix 1 summarizes all of the available total recoverable metals analytical data (and pH) for the 35 mine sites sampled in 2015 and 2016. Note that these sites are not organized by watershed but instead are presented in alphabetical order.

2.1.2 Overbank soil sampling

Table 2.2 summarizes the 2016 sampling effort to collect overbank soil samples. **Figures 2.2** to **2.4** show the various overbank sampling locations. The Exposure Units (EUs) presented in **Table 2.2** and the three figures are discussed in greater detail in Section 5.1. This effort focused primarily on banks and floodplains of local rivers, streams, and gulches within the BPMD NPL site. These soil materials were carried to those locations mostly by flowing water from further upstream and were deposited along the banks and floodplains during past periods of high water (e.g., snowmelt). Therefore, overbank soil samples likely represent a mix of mining-related materials from up gradient sources.

Appendix 2 summarizes all of the available total recoverable metals analytical data for the overbank soil samples collected in 2016. For ease of interpretation, these analytical data are organized and presented by aquatic EUs. Note that pH was not measured in any of these soil samples.

2.1.3 Campsite sampling

Table 2.3 summarizes the 2016 soil sampling efforts at 12 public campsites scattered throughout the BPMD. **Figure 2.5** shows the location of these sites. EPA collected one composite soil samples from each of these locations. Public campsites CMP 9, CMP 13, CMP

14, and CMP 15 have not previously been identified as reference (i.e., non-impacted) areas, even though they do not appear to be located downgradient from named mines. Many of the public campsites are found in the vicinity of mine workings or located in floodplain areas and may therefore be potentially impacted by mine wastes.

Campsites contained grasses, forbs, bushes, trees, rocks, and other natural features that may attract wildlife or serve as wildlife forage or refuge. As such, campsites may provide habitat for plant, invertebrates, and wildlife species that tolerant to human activities. Sampled campsites were mostly located in undeveloped areas and along the fringes of natural riparian and forested areas. As stated above, campsites were located in or very near floodplain areas. Public campsites were assessed as individual exposure areas to characterize risk to receptors exposed to soils in areas that are more upland than overbank areas but not likely seasonally flooded.

Appendix 3 summarizes all of the available total recoverable metals analytical data for the public campsite soil samples collected in 2016. Note that pH was not measured in any of these soil samples.

2.2 Evaluation of qualified and coded data

All results assigned qualifiers indicating that an analyte was positively detected or presumptively present (e.g., data qualified as J, D or EB) were retained as detected results in the analytical database and used as reported. All results assigned qualifiers indicating that the analyte was not positively detected (i.e., U, UJ) were retained only as non-detected results in the analytical database and included at half of their analytical detection limits (DLs). Finally, any result considered of inadequate quality for use in this SLERA (i.e., data qualified as R) was omitted from the database.

2.3 Compiling a database for use in the SLERA

The final product of the data evaluation and summarization process is a comprehensive database for all the soil analytical data collected in 2015 and 2016 throughout the BPMD NPL site. Individual soil data sets were developed by compiling analytical results for each terrestrial exposure area (i.e., the 35 mine sites, the 25 overbank soil EUs, and the 12 public campsites). Analytical data from duplicate samples collected for quality control purposes were not retained in the databases.

Note that this terrestrial SLERA uses two different terms to designate the exposure locations retained for risk evaluation. As explained in Section 5.1, EPA collected overbank soils throughout the floodplains of Cement Creek, Mineral Creek, the Animas River, and several of their major tributaries. These overbank soil samples were grouped into large but distinct exposure areas that directly overlap with the aquatic EUs established in the final aquatic BERA WP (TechLaw, 2016b). For continuity, and to avoid misunderstanding, this SLERA consistently uses the term “overbank soil EUs” when referring to these locations. On the other hand, the term “exposure area” is used more generally to refer to the mine sites, overbank soil EUs, and campsites.

3.0 CONCEPTUAL SITE MODEL

The CSM illustrates the problem formulation process and is a tool used to develop assessment and measurement endpoints. The model shows how mining-related COPECs are expected to move from their source(s) to the various receptor groups of concern via release and transport mechanisms, contact points and exposure media, and routes of entry. Each of these elements are described in this section before presenting the screening-level BPMD CSM (**Figure 3.1**).

3.1 Contaminant fate and transport

The goal of a contaminant fate and transport evaluation is to identify the major elements of a complete exposure pathway, which consists of the following components.

- Source(s) of contamination,
- Release and transport mechanisms,
- Contact points and exposure media,
- Routes of entry, and
- Key receptors.

Each of these components is discussed in the following bullets.

- **Primary sources of contamination**

The primary sources of contamination relating to past mining activities throughout the BPMD NPL site consist of the following:

- waste/overburden rock piles,
- tailings piles,
- smelter waste piles and deposition areas,
- flowing adits, and
- overbank soils located in the vicinity of waterways

- **Release and transport mechanisms**

Several release and transport mechanisms may potentially affect the levels and spatial distribution of metals in the terrestrial habitats of the BPMD NPL site, as follows:

- physical dispersal of mine waste rock piles or tailings material in the surrounding terrestrial habitats or floodplains by runoff associated with rain events or snow melt or past containment failures,
- overland dispersal of metals via groundwater flowing out of mine adits,
- transport and deposition of contaminated sediment from waterways to nearby overbank locations during periods of high water flow (e.g., snow melt or rain storms), and
- trophic transfer of metals incorporated in terrestrial food chains.

- **Contact point and exposure media**

The SLERA evaluates the contact points associated with the terrestrial habitats at and around waste rock piles, tailings piles, overbank soils, and other mining-related soils throughout the BPMD NPL site. The exposure media are as follows:

- soil (which includes tailings material)
- prey items

- **Routes of entry**

The main routes of entry evaluated in this SLERA for terrestrial community-level receptors and wildlife receptors feeding on those community-level receptors and other prey items, are as follows:

- direct contact with soil (terrestrial community-level receptors).
- incidental soil ingestion (wildlife receptors)
- ingestion of contaminated terrestrial food items (wildlife receptors).

This SLERA evaluates the complete exposure pathways for direct contact with soil by terrestrial community-level receptor groups, and ingestion of soil and terrestrial food items by wildlife receptors feeding on and around the mine waste piles, the overbank soil EUs, and public campsites. The SLERA omits exposure to metals by wildlife receptors via inhalation or dermal uptake because they are considered to be minor compared to the ingestion route. Note also that exposure to wildlife receptors from drinking surface water from local mine-impacted waterways is not evaluated. If warranted, more complete exposure models will be used to refine risk estimates in the terrestrial BERA.

- **Key receptors**

  - **Terrestrial community-level receptors**

  This SLERA assumes that terrestrial plants and invertebrates are directly exposed to mining-related metals associated with waste piles at mine sites, overbank soils along the shorelines of local waterways, and soils at public campsites.

  - **Wildlife receptors feeding on terrestrial food items**

  This SLERA assumes that the following general types of bird and mammal receptors may become exposed to mining-related metals in the terrestrial habitats associated with mine waste piles, overbank soils, and public campsites scattered around the BPMD NPL site: (a) herbivorous birds and mammals, (b) omnivorous birds and mammals, and (c) carnivorous birds and mammals.

3.2 Ecosystems potentially at risk

The terrestrial ecosystems potentially at risk evaluated in this SLERA consist of mine waste piles, overbank soils along local waterways, and public campsites where metal levels could be high and the potential for exposures severe.

The numerous mining features found in the BPMD NPL site are located at elevations ranging from around 9,000 ft up to 13,500 ft in the San Juan Mountains. The climate at that altitude is harsh. The first snows of the season typically fall in late September-early October. The spring snowmelt starts in mid to late May and extends well into June. Hence, the growing season is limited to 3-4 months per year. The tree line extends to about 11,000 ft. The vegetation above the tree line consists entirely of tough tundra-like grasses and small shrubs.

3.3 Exposure pathways

An exposure pathway is considered incomplete unless all four of the following elements are present:

- A source of contamination (e.g., tailings, overbank soil).
- An environmental transport and/or exposure medium (e.g., soil erosion, deposition along stream banks during high-flow events)
- A point of exposure at which the contaminant can interact with a receptor (e.g., direct contact, soil ingestion, contaminated food).
- A receptor and a likely route of exposure at the exposure point (e.g., plant growing in contaminated soil, a small mammal feeding on soil invertebrates).

This SLERA assumes that all four factors are present at the BPMD NPL site.

Routes of exposure are the means by which metals can be transferred from a contaminated medium to ecological receptors. The principal receptor groups of concern and routes of exposure evaluated in the terrestrial SLERA are as follows:

- Terrestrial plants and invertebrates: direct contact with mine-impacted soils.
- Birds and mammals: incidental ingestion of mine-impacted soil and consumption of terrestrial food items (e.g., plants, invertebrates, or small avian and mammalian prey) directly or indirectly exposed to mine-impacted soil.

3.4 Conceptual Site Model

The CSM provides the foundation of the SLERA. It is formulated based on knowledge of sources, contaminants, complete exposure pathways, and receptor groups at a site. The model shows how metals move from the various contaminant sources through the exposure media to the receptors. **Figure 3.1** presents the CSM for the terrestrial SLERA at the BPMD NPL site.

The mine waste piles scattered across the BPMD NPL site are the primary sources of contamination to terrestrial community-level and wildlife receptor groups. The overbank soils and soils at the public campsites represent secondary sources of contamination. Plants and terrestrial invertebrates can become exposed to the contaminated soils via direct contact. The wildlife receptors can become exposed via the incidental ingestion of mining-impacted soils or by feeding on plants, invertebrates or small bird and mammal prey which have taken up metals in their tissues via direct contact or by ingesting food items that have accumulated metals.

4.0 ENDPOINT SELECTION

4.1 Introduction

Endpoints are selected to help quantify the risks to representative receptors that may be exposed to mining-related metals associated with past or on-going releases at the BPMD NPL site.

Assessment endpoints represent explicit expressions of the key ecological resources to be protected from harm. They generally reflect sensitive populations, communities, or trophic guilds. Three general criteria for selecting the proposed assessment endpoints for this SLERA are listed below. The ecological resource should:

- be susceptible to the stressors of concern,
- have biological, social, and/or economic value, and
- be relevant to the risk management goals for the site.

By carefully considering these selection criteria, risks identified to one or more of the assessment endpoints will influence the risk management decision process at the BPMD NPL site.

Measurement endpoints are measurable ecological characteristics, quantified through laboratory or field experimentation, which can be related back to the valued ecological resources chosen as the assessment endpoints. Measurement endpoints are required because it is often not possible to directly quantify risk to an assessment endpoint. The measurement endpoints should represent the same exposure pathway(s) and mechanisms of toxicity as the assessment endpoints in order to be relevant and useful.

Risk questions establish a link between assessment endpoints and their predicted responses when exposed to the COPECs. The risk questions should provide a basis to develop the study design and evaluate the results of the site investigation in the analysis phase and during risk characterization (EPA, 1997).

4.2 Selecting representative assessment endpoint species or communities

It is neither practical nor possible to evaluate the potential for ecological risk to all of the individual parts of the local terrestrial ecosystem at the BPMD NPL site potentially affected by mining-related contamination. Instead, key components are identified to select those species or groups most likely to experience exposure to the stressors.

4.2.1 Community-level terrestrial receptor groups

Terrestrial plants

The mining-impacted soils at the BPMD NPL site should be able to support a diverse native plant community. Plants form an integral link in most terrestrial ecosystems. Their roots hold the top soil together, thereby limiting the effects of erosion. The annual die-back of plant material (leaves, branches, roots, etc.) provides sustenance for decomposers and enriches the surface soil with organic material. Plants also provide food and shelter for a host of invertebrates, birds, and mammals.

Metals may harm plants via direct toxicity, and also have the potential to bioaccumulate in plant tissues from where they can be transferred into grazers and further up the food chain, thereby harming higher trophic-level receptors.

Soil invertebrates

The mining-impacted soils at the BMPD NPL site should be able to support a healthy and diverse native terrestrial invertebrate community, consisting of worms, ants, beetles, spiders, crickets, and other related species. The terrestrial environment should provide such a community with a diverse food base, suitable feeding areas, shelter, and other essential environmental services.

The presence of mining-derived metals in soil can impair the local terrestrial invertebrate community by increasing mortality in response to direct or indirect exposure to metals. Metals can also bioaccumulate in invertebrate tissues from where they can be transferred up the food chain to birds and mammals.

4.2.2 Wildlife receptors

This terrestrial SLERA does not perform site-specific food chain modeling to calculate Estimated Daily Doses (in units of mg/kg-day) for comparison against published bird or mammal Toxicity Reference Values (TRVs, also in units of mg/kg-day). Instead, the metal concentrations (in units of mg/kg) measured in mining-impacted soils collected throughout the BPMD NPL site are compared directly to published metal-specific soil Ecological Screening Values (ESVs; also in units of mg/kg) derived to be protective of terrestrial birds and mammals from the ingestion of contaminated soil and food items. Hence, this SLERA evaluates the potential for ecological risk to “generic” bird and mammal wildlife receptors, instead of specific species.

4.3 Selecting endpoints

4.3.1 Assessment endpoints and risk questions

This SLERA uses the following assessment endpoints to evaluate the potential risks to terrestrial plants and invertebrates, and wildlife receptors feeding on these plants and invertebrates, or on local small birds and mammals. A risk question is appended to each assessment endpoint.

It is assumed that by evaluating and protecting these target receptor groups, all of the terrestrial community-levels receptors, and the wildlife receptors feeding on them, will be protected as well.

- **Maintain a stable and healthy terrestrial plant community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial plants?*

- **Maintain a stable and healthy terrestrial invertebrate community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial invertebrates?*

- **Maintain a stable and healthy bird community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial birds?*

- **Maintain a stable and healthy mammal community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial mammals?*

4.3.2 Measurement endpoints

<u>Assessment endpoint #1</u>:

- **Maintain a stable and healthy terrestrial plant community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial plants?*

The SLERA uses one measurement endpoint to assess the potential impacts of metals to this receptor group, as follows:

1.A Compare the maximum metal levels measured in soil samples collected from the three exposure areas at the BPMD NPL site (i.e., mine sites, overbank soil EUs, public campsites) to soil no-effect ESVs protective of terrestrial plants.

Assessment endpoint #2:

- **Maintain a stable and healthy terrestrial invertebrate community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial invertebrates?*

This SLERA uses one measurement endpoint to assess the potential impacts of metals to this receptor group, as follows:

2.A Compare the maximum metal levels measured in soil samples collected from the three exposure areas at the BPMD NPL site (i.e., mine sites, overbank soil EUs, public campsites) to soil no-effect ESVs protective of terrestrial invertebrates.

Assessment endpoint #3:

- **Maintain a stable and healthy bird community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial birds?*

This SLERA uses one measurement endpoint to assess the potential impacts of metals ingested by this receptor group, as follows:

3.A Compare the maximum metal levels measured in soil samples collected from the three exposure areas at the BPMD NPL site (i.e., mine sites, overbank soil EUs, public campsites) to soil no-effect ESVs protective of terrestrial birds.

Assessment endpoint #4:

- **Maintain a stable and healthy small mammal community**: *Are the metal levels in the mining-impacted soils high enough to affect the survival, growth, or reproduction of terrestrial mammals?*

This SLERA uses one measurement endpoint to assess the potential impacts of metals ingested by this receptor group, as follows:

4.A Compare maximum metal levels measured in soil samples collected from the three exposure areas at the BPMD NPL site (i.e., mine sites, overbank soil EUs, public campsites) to soil no-effect ESVs protective of terrestrial mammals.

5.0 EFFECTS ANALYSIS AND SELECTING SOIL COPECS

5.1 Terrestrial exposure areas

This SLERA identifies discrete terrestrial exposure areas to summarize the soil analytical data for selecting COPECs and for use in risk characterization. It would be inappropriate to combine all of the analytical data across the mining sites, the overbank soil EUs, and public campsites into a single dataset because these areas represent distinct exposure environments that require separate risk evaluations. The terrestrial exposure areas are therefore defined as follows:

- This SLERA assesses 35 mine sites scattered across the BPMD as individual exposure areas. All of the soil samples collected in 2015 and 2016 from each mine site are combined into individual datasets for use in risk characterization. See **Table 2.1** and **Figure 2.1** for more details.

- This SLERA uses the aquatic EUs established in the final BERA WP (TechLaw, 2016b) to organize the overbank soil data into distinct exposure areas. All of the overbank soil samples collected in 2016 in the vicinity of the aquatic EUs are combined into individual datasets for use in risk characterization.

  The EUs established in the BERA WP are as follows (see **Figure 5.1**):

  - **EU-01** Mineral Creek - from the confluence with the Animas River upstream to the confluence with South Fork Mineral Creek
  - **EU-02** Mineral Creek - from the confluence with the South Fork Mineral Creek upstream to the confluence with the Middle Fork Mineral Creek
  - **EU-03** Mineral Creek - from the confluence with the Middle Fork Mineral Creek upstream to the confluence with Mill Creek
  - **EU-04** Mineral Creek - from the confluence with Mill Creek upstream to the source
  - **EU-05** South Fork Mineral Creek - from the confluence with Mineral Creek upstream to the source
  - **EU-06** Middle Fork Mineral Creek – from the confluence with Mineral Creek upstream to the source
  - **EU-07** Animas River - from the confluence with Arrastra Creek upstream to the confluence with Cunningham Creek in Howardsville
  - **EU-08** Cunningham Creek - from the confluence with the Animas River upstream to the source
  - **EU-09** Animas River - from the confluence with Cunningham Creek in Howardsville upstream to the confluence with Minnie Gulch
  - **EU-10** Animas River – from the confluence with Minnie Gulch upstream to the confluence with mainstem South Fork Animas River in Eureka

- **EU-11** South Fork Animas River – from the confluence with Eureka Gulch upstream to the source
- **EU-12** Eureka Gulch –from the confluence with the South Fork Animas River upstream to the source
- **EU-13** Mainstem South Fork Animas River – from the confluence with the Animas River in Eureka upstream to the confluence of Eureka Gulch
- **EU-14** Animas River – from the confluence with mainstem South Fork Animas River in Eureka upstream to the confluence with mainstem West Fork Animas River in Animas Forks
- **EU-15** West Fork Animas River - from the confluence with Animas River to Placer Gulch confluence
- **EU-16** Placer Gulch – from the confluence with the West Fork Animas River upstream to the source
- **EU-17** Mainstem West Fork Animas River/California Gulch - from the Placer Gulch confluence upstream to the source
- **EU-18** North Fork Animas River - from West Fork Animas River upstream to the confluence with Burrows Creek
- **EU-19** Burrows Creek - from the confluence with the North Fork Animas River upstream to its source

The final aquatic BERA WP (TechLaw, 2016b) did not include Cement Creek or Browns Gulch on Mineral Creek in its evaluation. However, the various overbank soils collected within these watersheds are included in this terrestrial SLERA. These additional six EUs associated with Cement and Mineral Creek are as follows:

- **EU-20** Cement Creek – from the first sampling location (CC48) about 1 mile up from of the confluence with the Animas River upstream to the confluence with Prospect Gulch
- **EU-21** Prospect Gulch – from the confluence with Cement Creek up to the headwaters of the gulch
- **EU-22** Cement Creek – from the confluence with Prospect Gulch up to the Red and Bonita Mining complex
- **EU-23** South Fork Cement Creek – from the confluence with Cement Creek up to the headwaters of the gulch
- **EU-24** Cement Creek –from the Red and Bonita Mining complex up to the headwaters of Cement Creek
- **EU-3.5** Browns Gulch – from the confluence with Mineral Creek to the source

Table 5.1 summarizes the numbers and locations of overbank soils collected from within each of these EUs.

- This SLERA assesses the potential for ecological risk at 12 public campsites scattered across the BPMD as individual exposure areas. The soil samples collected in 2016 from each of the public campsites are combined into individual datasets for use in the terrestrial SLERA.

Table 2.3 summarizes the number of soil samples collected from 12 public campsites located in the BPMD NPL site.

5.2 Matrices of concern

This terrestrial SLERA only uses the analytical data from soil samples collected in 2015 and 2016 in order to assess "current" exposure conditions to terrestrial receptors at the BPMD NPL site. Older soil data, even if available, are excluded from the analysis.

Note that the term "soil" is broadly defined in this SLERA. It includes different types of mining wastes, overbank soils located along rivers and streams away from mining sites, and tailings that may have spilled out into floodplains during past runoff events.

5.3 Identifying soil ESVs for use as toxicity values

Table 5.2 provides the soil ESVs retained to select the COPECs (right-hand column) and to calculate the potential for ecological risk to the four individual terrestrial receptors groups of interest to this terrestrial SLERA. Note that these values represent no-effect ESVs, which are concentrations to which the four terrestrial receptor groups can be exposed without resulting in negative effects on populations or communities.

The wildlife soil ESVs were derived by their authors using conservative input parameters, including assumptions about the exposure conditions (e.g., diet composition, food ingestion rates, soil ingestion rates) and TRVs. The soil benchmark sources outlined below provide ESVs for several bird and mammal species representing different terrestrial feeding guilds. The wildlife soil ESVs for each analyte shown in **Table 5.2** represent the *lowest* of the values developed for birds and mammals in order to protect sensitive birds and mammals.

The two major sources of soil ESVs are as follows (in order of preference):

- EPA (2003a) Ecological Soil Screening Levels (EcoSSLs). Available at https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents

- Los Alamos National Laboratory ([LANL], 2016) no-effect ecological screening levels. Available at https://lanl.gov/environment/protection/eco-risk-assessment.php

Two other sources of soil ESVs were also used to fill in a few missing benchmarks:

- Two soil ESVs for molybdenum were obtained from Table 4 in EPA (2015b) Region 4 *Soil Screening Values for Hazardous Waste Sites*, available at https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance

- One soil ESV for chromium was obtained from Oak Ridge National Laboratory (Efroymson *et al.*, 1997). *Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2*, available at https://rais.ornl.gov/guidance/tm.html

5.4 Soil COPEC selection process

5.4.1 Introduction

COPECs are analytes present at concentrations that could negatively affect ecological receptors. The soil COPECs for this SLERA are identified by calculating Hazard Quotient (HQs) based on dividing an Exposure Point Concentration (EPC), represented by the maximum concentrations for each metal, or the maximum DL for a non-detected metal, by the conservative soil no-effect ESVs discussed above, as follows:

$$HQ = \text{exposure} \div \text{toxicity}$$

Where:

HQ	= hazard quotient (unitless)
Exposure	= the maximum EPC for a metal measured in soil (mg/kg)
Toxicity	= the soil no-effect ESV (mg/kg)

In order to streamline and facilitate the selection process, this SLERA identifies the COPECs for the three exposure area groups, namely: (a) soils collected at the 35 mine sites, (b) the overland soils associated with the 25 aquatic EUs, and (c) the soils collected from the 12 public campsites.

The following decision criteria are used to identify the soil COPECs.

Decision Criterion 1: A metal is retained as a soil COPEC if one of the following conditions is met:

- The maximum-detected concentration, or the maximum DL for a non-detected metal, equals or exceeds its soil no-effect ESV (i.e., HQ $\geq$ 1.0).

- A metal is present above its DL but lacks a soil no-effect ESV.

Decision Criterion 2: A metal is excluded as a COPEC if one of the following conditions is met:

- The maximum concentration falls below its soil no-effect ESV (i.e., HQ < 1.0).

- The maximum DL for a non-detected metal falls below its soil no-effect ESV (i.e., HQ < 1.0).

Note that this SLERA automatically eliminated calcium, magnesium, potassium, and sodium as COPECs because these four metals represent essential physiological electrolytes that are not expected to cause toxicity at prevailing concentrations (EPA, 2001).

The COPEC-selection process for the terrestrial SLERA is organized as follows:

- Separate COPECs are selected for the three major exposure areas at the BPMD NPL site, i.e., the 35 mine-waste sites combined, the 25 overbank soil EUs combined, and the 12 public campsites combined.
- If two or more soil samples were collected from a particular location within an exposure area, then only the maximum concentration for each analyte is retained for use in COPEC selection.
- The *lowest-available* soil no-effect ESVs for the analytes shown in **Table 5.2** are used to select a COPEC.

This approach is highly conservative but ensures that no metal is eliminated as a COPEC if it has the potential to cause any ecological risk.

5.4.2 Soil COPECs for mine waste sites

Table 5.3 summarizes the soil COPECs identified for the 35 mine sites combined. All metals with benchmarks are retained as COPECs, except for nickel which has a maximum concentration which falls below its conservative ESV. Aluminum and iron are also COPECs, even though they lack published soil ESVs. These two metals are discussed in the uncertainty analysis.

5.4.3 Soil COPECs for the overbank soil EUs

Table 5.4 summarizes the soil COPECs identified for the 25 overbank soil EUs combined. All metals with benchmarks are retained as COPECs because their maximum concentrations exceeded their conservative benchmarks. Aluminum and iron are also COPECs, even though they lack published soil ESVs. These two metals are discussed in the uncertainty analysis.

5.4.4 Soil COPECs for the public campsites

Table 5.5 summarizes the soil COPECs identified for the 12 public campsites combined. All metals with benchmarks are retained as COPECs, except for beryllium and nickel which have maximum concentrations that fall below their conservative ESVs. Aluminum and iron are also COPECs, even though they lack published soil ESVs. These two metals are discussed in the uncertainty analysis.

6.0 EXPOSURE ANALYSIS

6.1 Exposure Point Concentrations

The exposure analysis identifies soil COPEC levels representing conservative exposure conditions that can be expected at each of the 35 mine sites, 25 overbank soil EUs, and 12 public campsites. Two or more composite soil samples were collected at many of the mine sites and overbank soil EUs (but not at the public campsites which are each represented by a single composite soil sample). To keep this terrestrial SLERA conservative, the maximum concentration of each soil COPEC identified in these multiple samples was selected to represent the exposure conditions at the mine sites and overbank soil EUs.

Also, the wildlife soil ESVs provided in **Table 5.2** were developed to be protective of birds and mammals. These ESVs represent metal concentrations in soil, back-calculated using conservative food chain modeling assumptions and no-effect TRVs, at which no risk is expected to occur to sensitive bird and mammal species exposed indefinitely to these metals via food ingestion and soil ingestion. Hence, food chain modeling is not required in the exposure analysis to calculate species-specific daily doses.

This SLERA uses Reasonable Maximum Exposures (RMEs) represented by the maximum concentration at exposure area to derive EPCs. RMEs were used so that no potential ecological risks were overlooked. Also note that many exposure areas were only represented by a single composite soil sample, which precluded use of additional exposure metrics. Use of RMEs is also consistent with the goal of this SLERA, namely to identify COPECs and rank sites. The future terrestrial BERA for the BPMD NPL site will implement more refined exposure and toxicity assumptions.

7.0 RISK CHARACTERIZATION

7.1 General Introduction

The terrestrial SLERA quantifies the potential for ecological risk during risk characterization. This phase, which represents the last stage of the SLERA, is built around three sequential steps: 1) risk estimation, 2) risk ranking and 3) uncertainty analysis.

The exposure and effects analysis described in the two previous sections of this report are integrated during risk estimation to determine the likelihood of adverse effects to the four assessment endpoints, given the assumptions inherent in the analysis phase. The risk ranking provides a simplified approach to classify the exposure areas at the mine sites, the overbank soil EUs, and public campsites based on their total risk. Finally, the uncertainty analysis provides context for the influences of those assumptions on the risk characterization process.

An HQ table was prepared for each exposure area to summarize the potential for ecological risk to terrestrial plants, soil invertebrates, birds and mammals exposed to the 20 soil COPECs. These risk tables can be interpreted in two separate and distinct ways, as follows:

- A typical approach entails individually discussing each of the 72 exposure areas evaluated in this SLERA in terms of their potential for ecological risk by COPEC to the four terrestrial receptor groups.

- A "risk ranking" approach discusses each exposure area in terms of its relative risk within the mine site, overbank soil EU, and public campsite groups *but without focusing specifically on individual COPECs, receptor groups or HQs.*

The decision was made not to discuss the potential for ecological risk using the typical approach outlined above because (1) it would generate much text with little relevance to actual conditions in the exposure areas, (2) the EPCs (= max concentrations) are highly-conservative values and therefore generate unrealistic risk estimates which were not further refined in this SLERA, and (3) many of the exposure areas may not represent viable or desirable terrestrial habitat, particularly at the mine sites and the campsites. Note, however, that the risk tables for each of the 72 exposure areas are presented in this section for review and consideration by risk managers.

Instead, the risk characterization follows a risk ranking method. This alternative approach has several advantages: (1) the supporting text is more succinct because the focus is on assessing the total risk at each exposure area, (2) the focus shifts from discussing individual HQs or receptor groups to showing how an exposure area ranks compared to its peers, (3) the discussion emphasizes a handful of risk ranking summary tables (one each for the mine site, overbank soil, and campsite exposure areas) instead of the 72 risk tables for the individual exposure areas, and (4) the total risk concept is used to logically divide the exposure areas into three generic risk categories, called higher-risk exposure areas, moderate-risk exposure areas, and lower-risk exposure areas (see Section 7.3 for more details).

The end result is a clear and logical way for risk managers to objectively look at all the exposure areas evaluated in this SLERA, determine the risk categories in which they fall, and assess which could be left untouched, which may need further investigation, and which may require remedial attention.

7.2 Risk estimation

The risk estimation is performed for each individual exposure area using the maximum EPC for each of the soil COPECs.

The HQ method is then used to compare the maximum EPCs to their corresponding soil ESVs protective of the four terrestrial receptor groups, consisting of plants, invertebrates, birds, and mammals.

A COPEC-specific HQ is calculated as follows:

HQ = maximum EPC/receptor-specific soil ESV (equation 1)

Where:

HQ	=	hazard quotient (unitless)
EPC	=	exposure point concentration (mg/Kg)
ESV	=	no-effect ecological screening value (mg/Kg)

HQs are not probabilistic estimates. For example, an HQ of 0.01 does not imply a 1 in 100 chance of an adverse effect but simply indicates that the exposure is 100 times lower than the corresponding ESV. An HQ of 1.0 indicates that the exposure equals the toxicity value. An HQ of 10 indicates that exposure exceeds the toxicity value by a factor of 10. The terrestrial SLERA assumes that a potential for risk may be present if an HQ exceeds 1.0. An HQ of 10 versus 1.0 is not interpreted to mean that the risk is ten times higher because the relationship may not be linear. Instead, this SLERA assumes that the potential for risk qualitatively increases with higher HQs.

As explained in Section 7.1, the focus of the risk characterization is on risk ranking. However, **Table 7.0** was prepared to summarize the maximum HQs for the four terrestrial receptor groups exposed to the COPECs at the mine site, overbank, and campsite sampling areas. Two major observations can be made based on a review of these data:

- A relatively small number of soil COPECs are responsible for most of the terrestrial ecological risk identified in the three exposure area groups. Lead and zinc are the primary risk drivers for most of the sampling locations but there is also some contribution to risk, although to a lesser extent, from antimony, arsenic, cadmium, manganese, and mercury. With a few exceptions, the remaining COPECs, which consist of barium, beryllium, chromium, cobalt, copper, molybdenum, selenium, silver, thallium, and vanadium, only play a marginal role.

- Birds are systematically the most at risk (i.e., highest HQs) of the four terrestrial receptor groups evaluated in this SLERA. This observation is due to two inter-related elements: (a) lead and zinc are the two principal risk drivers because of their high soil concentrations, and (b) the bird ESVs for these two COPECs are the lowest of the four receptor groups, indicating the high sensitivity of birds to these metals (see **Table 5.2**). This evidence is important in interpreting the risk rankings discussed in Section 7.3. The reason is that many of the exposure areas with high lead and zinc soil levels may be too toxic to allow plants or soil invertebrates to thrive, thereby eliminating the necessary forage base needed to attract birds. While highly contaminated mine wastes and tailings areas do not provide ideal habitat, some bird species could be attracted to these areas while looking for grit to ingest.

7.3 Risk ranking

7.3.1 Introduction

The risk ranking approach of the 72 exposure areas included in the terrestrial SLERA consists of five sequential steps, as follows:

- *Step 1*: Calculate the COPEC-specific plant, invertebrate, bird, and mammal HQs using equation 1 above.

  These HQs, which supports the risk estimation, determine the potential for ecological risks to each of the four terrestrial receptor groups at each exposure area under maximum exposure conditions.

- *Step 2*: Sum the HQs for each COPEC across the four terrestrial receptor groups, as follows:

  ΣCOPEC HQs = plant HQ + invertebrate HQ + bird HQ + mammal HQ (equation 2)

- *Step 3*: Add all the ΣCOPEC HQs to calculate a “total risk” for each exposure area, as follows:

  Total risk = sum ($\Sigma COPEC_1$ HQs + $\Sigma COPEC_2$ HQs + $\Sigma COPEC_3$ HQs + …) (equation 3)

  Note that summing HQs as described in steps 2 and 3 above does ***<u>NOT</u>*** imply in any way that this SLERA assumes that risk is additive across the four receptor groups and 20

COPECs. Instead, this mathematical approach is used only as a simple and convenient tool to represent each exposure area by a single standardized value (“total risk”). This total risk value can then be directly compared against the total risks calculated for all the other exposure areas within a group.

- *Step 4*: Calculate the percent of the total risk associated with each ΣCOPEC HQs, as follows:

  % of total risk = $\Sigma COPEC_x$ HQs/total risk * 100 (equation 4)

  The % of total risk shows which of the COPECs are responsible for the most risk at a particular exposure area.

- *Step 5*: Assign the exposure areas to one of three risk categories

  The total risks calculated in Step 3 above are then used to organize the exposure areas into three broad risk categories called higher-risk exposure areas, moderate-risk exposure areas, and lower-risk exposure areas. As described earlier, categorizing the exposure areas helps to streamline the risk characterization discussion. The three risk categories were assigned by identifying natural breaks and patterns in the total risk datasets.

  These three risk categories were determined based on the following observation: most exposure areas with a total risk below 200 had 5 or less individual HQs for plants, invertebrates, birds, and mammals above 10. On the other hand, most exposure areas with a total risk above 500 had 10 or more individual HQs above 10.

  The three broad risk categories are defined as follows:

  - Lower-risk exposure areas: total risk less than 200
  - Moderate-risk exposure areas: total risk between 200 and 500
  - Higher-risk exposure areas: total risk above 500

These three risk categories represent a potential range of ecological risk associated with the presence of the soil COPECs. It is not possible to know, without much additional research, what actual ecological effects may be associated with the presence of the soil COPECs at the lower-risk exposure areas. However, it is deemed quite likely that whatever ecological risks are present at the lower-risk exposure areas would increase substantially in the moderate-risk and higher-risk exposure areas. Hence, the risk-ranking results should not be viewed as absolute values because they only show the potential for ecological risk in relative terms. That is the reason that the words “lower-risk” and “higher risk” are used further below instead of “low-risk” and “high-risk”.

7.3.2 Risk ranking of the 35 mine sites

Tables 7.1.1 to 7.1.35 provide the receptor-specific HQs calculated for each of the mine sites. **Table 7.1.36** provides the risk ranking for these exposure areas. This risk-ranking information can be summarized as follows:

- Thirty of the 35 mine sites represent higher-risk exposure areas (total risk > 500) and five represent moderate-risk exposure areas (total risk ranging between 200 and 500). None of the mine sites fall into the lower-risk exposure area category (total risk < 200).

- With a few exceptions, lead is the main risk driver ("risk driver 1" in **Table 7.1.36**) at the mine site exposure areas, with zinc as a strong secondary risk driver ("risk driver 2" in **Table 7.1.36**). The range of maximum lead and zinc concentrations in the higher-risk and moderate-risk categories are as follows:

    - *Higher-risk exposure areas:* lead = 2,210 mg/kg to 35,700 mg/kg; zinc = 321 mg/kg to 66,800 mg/kg

    - *Moderate-risk exposure areas:* lead = 502 mg/kg to 2,800 mg/kg; zinc = 248 mg/kg to 1,040 mg/kg

- Arsenic is identified as the primary risk driver at Koehler Tunnel (maximum EPC = 13,700 mg/kg) and Longfellow Mine (maximum EPC = 3,160 mg/kg).

- With a few exceptions, the top three risk drivers across the three risk categories systematically account for over 70% of the total potential for ecological risk at the mine site exposure areas.

7.3.3 Risk ranking of the 25 overbank soil EUs

Tables 7.2.1 to **7.2.25** provide the receptor-specific HQs calculated for the 25 overbank soil EUs. **Table 7.2.26** provides the risk ranking for these EUs. This risk-ranking information can be summarized as follows:

- Twelve of the 25 overbank soil EUs represent higher-risk areas (total risk > 500), six represent moderate-risk areas (total risk ranging between 200 and 500), and seven represent lower-risk areas (total risk < 200).

- With exceptions, lead and zinc are the two main risk drivers (see "risk driver 1" and "risk driver 2" in **Table 7.2.26**) in the overbank soil EUs. The range of maximum concentrations for these two metals in the three risk categories are as follows:

  - *Higher-risk exposure areas:* lead = 1,250 mg/kg to 10,500 mg/kg; zinc = 446 mg/kg to 30,200 mg/kg

  - *Moderate-risk exposure areas:* lead = 349 mg/kg to 1,760 mg/kg; zinc = 577 mg/kg to 4,120 mg/kg

  - *Lower-risk exposure areas:* lead = 162 mg/kg to 508 mg/kg; zinc = 176 mg/kg to 813 mg/kg

- The top three risk drivers across the three risk categories systematically account for over half of the total risk at the overbank soil EUs.

7.3.4 Risk ranking of the 12 public campsites

Tables 7.3.1 to **7.3.12** provide the receptor-specific HQs calculated for each of the 12 public campsites. **Table 7.3.13** provides the risk ranking for these exposure areas. This information can be summarized as follows:

- Three of the 12 public campsites represent higher-risk exposure areas (total risk > 500), two represent moderate-risk exposure areas (total risk ranging between 200 and 500), and seven represent lower-risk exposure areas (total risk < 200).

- With exceptions, lead and zinc are the two main risk drivers (see “risk driver 1” and “risk driver 2” in **Table 7.3.13**) at the public campsites. The range of concentrations for these two metals in the three risk categories are as follows:

  - *Higher-risk exposure areas:* lead = 2,880 mg/kg to 44,200 mg/kg; zinc = 740 mg/kg to 17,300 mg/kg
  - *Moderate-risk exposure areas:* lead = 761 mg/kg to 1,330 mg/kg; zinc = 540 mg/kg to 1,520 mg/kg
  - *Lower-risk exposure areas:* lead = 73.6 mg/kg to 530 mg/kg; zinc = 74.3 mg/kg to 874 mg/kg

- The top three risk drivers across the three risk categories systematically account for over half of the total risk at the campsites exposure areas.

7.3.5 Risk ranking discussion

The risk ranking procedure for the 72 exposure areas included in this terrestrial SLERA identifies several broad patterns, as follows:

- The mine sites have the highest proportion of exposure areas ranked in the higher-risk category (30 out of 35, or 86%), followed by the overbank soil EUs (12 out of 25, or

48%), and the public campsites (3 out of 12, or 25%). This finding is not surprising when one considers that the mine waste piles represent a major direct and indirect source of contamination to the terrestrial and aquatic ecosystems at the BPMD NPL site. Hence, as an aggregate, they represent some of the highest levels of potential terrestrial ecological risk.

- Conversely, the public campsites have the highest proportion of exposure areas ranked in the lower-risk category (7 out of 12, or 58%), followed by the overbank soil EUs (7 out of 25, or 28%), and the mine site exposure areas (0 out of 35, or 0%). This evidence indicates that, as an aggregate, more of the public campsites have a lower potential for terrestrial ecological risk compared to the two other groups of exposure areas.

- The cumulative risk associated with antimony is driven entirely by the mammal ESV (note: a bird ESV is not available). This value, which equals 0.27 mg/kg (see **Table 5.2**) is 41 times and 289 times lower than the plant and invertebrate ESVs, respectively.

7.3.6 Uncertainty analysis

An integral part of the SLERA process is to identify and understand sources of uncertainty. Multiple choices and assumptions were made in the exposure and effects characterization, any one of which can affect the outcome of the risk characterization. A key component of the process is to identify the major sources of uncertainty and see how they could affect the HQs. This information is provided to offer a better understanding of how the risk conclusions should be interpreted during the risk management decision-making process.

7.3.6.1 Characterization of exposure

General

- The 2015-2016 sampling effort focused specifically on areas that would maximize the chances of finding high levels of metals in soil. These targeted areas consisted of waste rock piles, tailings piles, overbank soils, and public campsites believed to be impacted directly or indirectly by past mining activities. As a result, the samples used for calculating the EPCs represent "worst-case" exposure conditions that would be experienced by terrestrial receptor groups living and/or foraging throughout the BPMD NPL site.

- As is appropriate for a conservative SLERA, exposure was quantified based on the maximum-detected concentrations of metals (or the maximum analytical DL for non-detected metals) measured in soil samples obtained from the BPMD NPL site. Maximum soil concentrations, by definition, represent high-level exposures which may not represent realistic conditions experienced by terrestrial receptor groups. Nonetheless, this approach ensures that no ecological risk is overlooked if it has the potential to be present.

- On the other hand, all the soil samples evaluated in this terrestrial SLERA represent composites made up of multiple individual subsamples. Hence, the maximum concentrations used as the EPCs in the risk calculations are tempered because they are actually an “average” made up of multiple subsamples.

- The risk analysis assumes that 100% of the soil COPECs measured by the chemical analyses represents the bioavailable fraction accessible for uptake by the ecological receptors. This assumption may be unrealistic. The difference between the reported metal concentrations in soil and the actual bioavailable fraction is not known but may be quite large. Therefore, assuming 100% bioavailability is expected to have overestimated the potential for ecological risk.

- The EPCs represent the maximum soil concentrations measured in each exposure area, which is a source of uncertainty. Using Central Tendency Exposures (CTEs; i.e., arithmetic means) would have resulted in lower HQs for most exposure areas. Note, however, that this change would not have affected all of the exposure areas equally since many of the mine sites and all of the public campsites were represented by single composite soil samples. A review of the analytical data presented in **Appendices 1, 2** and **3** does not suggest that the *relative* risk ranking among the exposure areas would have changed substantially when using CTEs. Hence, ranking the exposure areas based on the maximum EPCs, instead of the RME or CTE EPCs, appears to represent a relatively minor uncertainty.

- As per the available ERA guidance (EPA, 1997), SLERAs should not consider background levels in the risk calculations. As such, including background metals data in the risk characterization fell outside the scope of this report and was also not needed to identify COPECs or assess risk at high exposure areas impacted by past mining activities. Given the mineralized nature of BPMD, background area soils may have naturally high metal levels. The issue of how soil background levels may affect the risk conclusions will be investigated in the future terrestrial BERA.

- Many physical, chemical, and site-specific factors affect metals bioavailability in mine wastes, including particle size, sulfide content, pH, weathering history, mineralogical composition, and texture, among others (Schaider *et al.*, 2007). It is not possible to accurately predict what the actual bioavailability might be for the metals measured in the BPMD soils without further testing, except to say that it will be less than the assumed 100%. Hence, the current assumption of 100% bioavailability is expected to overestimate risk to the four terrestrial receptor groups.

Plants and invertebrates

- The mining-related waste piles consist of chunks of overburden rocks and/or sterile, ground-up ore-bearing tailings; some of this material may also be compacted into a hard crusty layer. The lack of vegetation or invertebrates may be due not just to metals toxicity, but also because these waste materials do not provide the required physical properties needed to promote seed germination, plant growth, or the presence of invertebrates. The SLERA only assesses ecological risk from exposure to COPECs by comparing metal concentrations to soil ESVs and assumes that this approach accounts for all possible responses, even those not associated with metal toxicity. As such, this SLERA does not consider the potential impacts of the "physical" properties of the mine wastes (i.e., compaction, ability to retain soil moisture, lack of nutrients, lack of an organic matrix, and/or lack of a viable soil microbial community) on the local plants and invertebrates. This missing information represents a data gap that results in additional uncertainty.

Wildlife receptors

- The food chain models used to derive the published soil no-effect ESVs protective of birds and mammals use an Area Use Factor (AUF) of 1.0. Such an AUF assumes that the receptor species receive 100% of their daily dose exclusively from the location of maximum concentration at each exposure area. This assumption may be overprotective for larger home-range receptors. HQs are quite sensitive to the magnitude of the AUF used in the food chain model calculations. For example, decreasing the AUF by a factor of two (say, from 1.0 to 0.5) directly decreases the associated HQ by a factor of two. Hence, an AUF of 1.0 is highly conservative and yields HQs that may overestimate risks, particularly to mobile bird and mammal species with home ranges that are larger than the individual sampling areas.

- This SLERA did not assess the risk associated with two potentially complete exposure pathways, namely dermal contact and inhalation of contaminated soil/dust by birds and mammals. EPA (2003a) reports that current information is insufficient to evaluate dermal exposure for the EcoSSL contaminants, most of which consist of metals. EPA (2003a) estimates that, for most contaminants, the dermal exposure contributes <1% to 11 % of the total risk compared to oral exposures. EPA (2003a) also considers that burrowing animals could receive substantial levels of exposure from inhaling volatile organic compounds or some of the more volatile polycyclic aromatic hydrocarbons, but not metals. Finally, EPA (2003a) estimates that inhalation of contaminants associated with dust particles (e.g., metals) is expected to contribute less than 0.1% of total risk compared to oral exposures. Based on this body of information, ignoring dermal and inhalation exposures is not expected to substantially change the risk estimates derived from ingestion alone.

7.3.6.2 Characterization of effect

General

- Three of the four receptor groups have one or more missing soil ESVs, as follows (note: aluminum and iron are discussed separately in greater detail below):

  - plants: chromium
  - invertebrates: cobalt, molybdenum, silver, thallium and vanadium
  - birds: antimony and beryllium

  As discussed in Section 7.2, most of these metals (except for antimony) are considered minor soil COPECs to other receptors for which ESVs are available. As such, the uncertainty associated with these missing ESVs appears small.

- Aluminum and iron are the only two COPECs which lack reliable soil ESVs for all four terrestrial receptor groups.

  EPA (2003b) makes the following statement about aluminum toxicity in soil:

  "Because the measurement of total aluminum in soils is not considered suitable or reliable for the prediction of potential toxicity and bioaccumulation, an alternative procedure is recommended for screening aluminum in soils. The procedure is intended as a practical approach for determining if aluminum in site soils could pose a potential risk to ecological receptors. This alternative procedure replaces the derivation of numeric EcoSSL values for aluminum. Potential ecological risks associated with aluminum are identified based on the measured soil pH. Aluminum is identified as a COPC only at sites where the soil pH is less than 5.5"

  A review of the available analytical data for mine site soils presented in **Appendix 1** shows that soil pH exceeds 5.5, and hence that aluminum is not a soil COPEC, at the following nine mines: Bandora Mine, Boston Mine, Gold King Mine, Henrietta Mine, Koehler Tunnel, Longfellow Mine, Pride of the West Mine, Red Cloud Mine, and Vermillion Mine. Conversely, aluminum is retained as a COPEC at the 26 other mines sampled in 2015 and 2016 because one or more of their composite soil samples had pH values at or below 5.5. However, it is not possible to calculate HQs for this metal at these 26 mines due to the lack of a reliable soil ESV, which represents an uncertainty. Regardless, it appears possible that the total risk for these 26 mine sites may be higher than reported in this SLERA because of the unquantified toxicity of aluminum in low-pH soils to one or more of the terrestrial receptor groups. Note that the same analysis cannot be performed for the overbank soil EUs or the public campsites because pH was not measured in any of the soil samples collected from these locations. This lack of information represents a data gap and an unquantifiable uncertainty.

The situation is even less clear for iron. EPA (2003c) makes the following general statement about iron toxicity in soil:

"Currently, identifying a specific benchmark for iron in soils is difficult since iron's bioavailability to plants and resulting toxicity are dependent upon site-specific soil conditions (pH, Eh, soil-water conditions). To evaluate site-specific conditions and potential toxicity of iron to plants, it is recommended that the site-specific measured pH and Eh (collected concurrently in the field) be used to determine the expected valence state of the iron and associated chemical compound and resulting bioavailability and toxicity in the environmental setting. In well-aerated soils between pH 5 and 8, the iron demand of plants is higher than the amount available. Because of this limitation, plants have evolved various mechanisms to enhance iron uptake. Under these soil conditions, iron is not expected to be toxic to plants."

While pH values have been obtained for many of the mine soils (see **Appendix 1**), none of these samples were analyzed for Eh (redox potential) or soil-water conditions. Hence, not enough data are available to determine the presence or absence of iron toxicity to plants and invertebrates in soil. Additionally, the lack of reliable soil ESVs for this metal makes it impossible to calculate HQs. It is noteworthy that EPA (2003c) does not mention the potential for toxicity of iron to birds and mammals, but instead focuses most of its concerns on plants. The lack of Eh data represents a data gap which results in an unquantifiable uncertainty in this SLERA.

Wildlife receptors

- The SLERA did not quantify the potential for ecological risk for any particular wildlife receptor species. Instead, risk was evaluated by comparing maximum soil concentrations to published soil no-effect ESVs protective of the most sensitive of the available bird or mammal feeding guilds (i.e., herbivores, omnivores, carnivores). This approach may have limited application to the specific wildlife receptors that use the terrestrial habitats in the San Juan Mountains. The highly-conservative exposure characterization (i.e., use of maximum soil concentrations as the EPCs), and the fact that the lowest of the COPEC-specific no-effect soil ESVs for birds and mammals were retained to calculate the HQs, ensured that risk to sensitive BPMD species was not likely overlooked.

The available evidence indicates that several of the major assumptions used in this SLERA resulted in conservative estimates for both terrestrial community-level receptor groups and the bird and mammal wildlife species. This inherent conservatism is acceptable in a SLERA because it ensures that COPECs and receptors that require further evaluation are not prematurely eliminated from further consideration.

In conclusion, this terrestrial SLERA identified several mining-related metals that have the potential to adversely impact plant, invertebrate, bird, and mammal receptors. As such, the COPECs and potentially affected receptors warrant further evaluation. It is recommended that EPA draft a terrestrial BERA WP for the BPMD NPL site to select site-specific risk assessment and measurement endpoints and document steps that will be taken to refine the screening-level exposure and effects analyses in the final BERA.

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Tables

Table 2.1 Mine Sites Sampled for Soil
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

BPMD NPL Mine Site Name	Sampled by EPA/ESAT in 2015-2016?	Sample Matrix	# of Composite Samples Collected for Analysis	Analysis
American Tunnel	*no*	--	--	--
Amy Tunnel	*no*	--	--	--
Anglo Saxon Mine	yes	waste rock	2	
Aspen Mine	*no*	--	--	--
Bandora Mine	yes	waste rock	4	total recoverable metals
Ben Butler Mine	yes	waste rock	1	total recoverable metals
Ben Franklin Mine	yes	waste rock	1	total recoverable metals
Boston Mine	yes	waste rock	1	total recoverable metals
Brooklyn Mine	yes	waste rock	3	total recoverable metals
Clipper Mine	yes	waste rock	1	total recoverable metals
Columbus Mine	yes	waste rock	1	total recoverable metals
Dewitt Mine	yes	waste rock	1	total recoverable metals
Forest Queen Mine	yes	waste rock	3	total recoverable metals
Frisco/Bagley Tunnel	yes	waste rock	2	total recoverable metals
Gold King Mine	yes	waste rock	1	total recoverable metals
Grand Mogul Mine	yes	waste rock	2	total recoverable metals
Henrietta Mine	yes	waste rock	1	total recoverable metals
Howardsville Colo Goldfields Tailings	yes	mill tailings	2	total recoverable metals
Joe and Johns Mine	yes	waste rock	1	total recoverable metals
Junction Mine	yes	waste rock	1	total recoverable metals
Kittimack Tailings	yes	mill tailings	8	total recoverable metals
Koehler Tunnel	yes	waste rock	1	total recoverable metals
Lark Mine	yes	waste rock	1	total recoverable metals
Little Nation Mine	*no*	--	--	--
London Mine	yes	waste rock	3	total recoverable metals
Longfellow Mine	yes	waste rock	1	total recoverable metals
Mammoth Tunnel	*no*	--	--	--
Mayflower Mill Repositories #1 to #4	*no*	--	--	--
Mogul Mine	yes	waste rock	2	total recoverable metals
Mountain Queen Mine	yes	waste rock	1	total recoverable metals
Natalie/Occidental Mine	yes	waste rock	2	total recoverable metals
Paradise Mine	yes	waste rock	3	total recoverable metals
Pride of the West Mine	yes	waste rock	2	total recoverable metals
Prospect Gulch Study Area	*no*	--	--	--
Red and Bonita Mine	yes	waste rock	1	total recoverable metals
Red Cloud Mine	yes	waste rock	1	total recoverable metals
Senator Mine	*no*	--	--	--
Silver Ledge Mine	*no*	--	--	--
Silver Wing Mine	yes	waste rock	2	total recoverable metals
Sunbank Group Mine	yes	waste rock	2	total recoverable metals
Sunnyside Mine	yes	waste rock	3	total recoverable metals
Sunnyside Mine Pool Study Area	*no*	--	--	--
Terry Tunnel	*no*	--	--	--
Tom Moore Mine	yes	waste rock	1	total recoverable metals
Vermillion Mine	yes	waste rock	1	total recoverable metals
Wynona Mine	*no*	--	--	--
Yukon Tunnel (Gold Hub)	yes	waste rock	1	total recoverable metals

Table 2.2 Exposure Units Sampled for Overbank Soil
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

BPMD Exposure Unit	Sample Matrix	# of Composite Samples Collected for Analysis	Analysis
MINERAL CREEK OVERBANK SOIL EXPOSURE UNITS			
EU-01	overbank soil	4	total recoverable metals
EU-02	overbank soil	2	total recoverable metals
EU-03	overbank soil	7	total recoverable metals
EU-3.5	overbank soil	8	total recoverable metals
EU-04	overbank soil	10	total recoverable metals
EU-05	overbank soil	7	total recoverable metals
EU-06	overbank soil	12	total recoverable metals
ANIMAS RIVER OVERBANK SOIL EXPOSURE UNITS			
EU-07	overbank soil	4	total recoverable metals
EU-08	overbank soil	3	total recoverable metals
EU-09	overbank soil	4	total recoverable metals
EU-10	overbank soil	3	total recoverable metals
EU-11	overbank soil	1	total recoverable metals
EU-12	overbank soil	11	total recoverable metals
EU-13	overbank soil	2	total recoverable metals
EU-14	overbank soil	4	total recoverable metals
EU-15	overbank soil	5	total recoverable metals
EU-16	overbank soil	3	total recoverable metals
EU-17	overbank soil	2	total recoverable metals
EU-18	overbank soil	3	total recoverable metals
EU-19	overbank soil	10	total recoverable metals
CEMENT CREEK OVERBANK SOIL EXPOSURE UNITS			
EU-20	overbank soil	13	total recoverable metals
EU-21	overbank soil	14	total recoverable metals
EU-22	overbank soil	11	total recoverable metals
EU-23	overbank soil	4	total recoverable metals
EU-24	overbank soil	16	total recoverable metals

Table 2.3 Public Campsites Sampled for Soil
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

BPMD Sample Location ID	Sample Matrix	# of Composite Samples Collected for Analysis	Analysis	Comments
CMP2	soil	1	total recoverable metals	Just above Silver Lake Mill #2 in the Arrastra Creek watershed of the Animas River
CMP4	soil	1	total recoverable metals	Near Pride of the West Mill #2 in the mainstem Animas River floodplain
CMP5	soil	1	total recoverable metals	Just south of the Kittimack tailings area near the Maggie Gulch Animas River confluence
CMP7	soil	1	total recoverable metals	Near the Grouse Gulch/Upper Animas River confluence near the Eclipse Smelter
CMP9	soil	1	total recoverable metals	Near the Hancock Gulch/Cement Creek confluence; Likely in the Cement Creek floodplain
CMP10	soil	1	total recoverable metals	At the Niagara Gulch/Cement Creek confluence; Not located near a named mine but could be in the floodplain
CMP11	soil	1	total recoverable metals	At the South Fork Mineral Creek confluence; Likely in the Mineral Creek floodplain
CMP12	soil	1	total recoverable metals	Just up river from the South Fork Mineral Creek confluence; Likely in the Mineral Creek floodplain
CMP13	soil	1	total recoverable metals	Located on South Fork Mineral Creek; Likely in the South Fork Mineral Creek floodplain
CMP14	soil	1	total recoverable metals	Located on South Fork Mineral Creek at the National Forest Service South Mineral Creek Campground
CMP15	soil	1	total recoverable metals	Located on South Fork Mineral Creek about 1/2 mile up stream from Bandora Mine
CMP15a	soil	1	total recoverable metals	Located on South Fork Mineral Creek just down from Bandora Mine; May be in the floodplain

Table 5.1 Sampling Location Description for the Overbank Soils
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Sample #	Site Type	EU	EU Description	Sampling Location Description
MINERAL CREEK OVERBANK SOIL EXPOSURE UNITS				
M34	mainstem	EU-01	Mineral Creek - Animas River to South Fork	At mouth of Mineral Creek before confluence with Animas River
M33	mainstem	EU-01	Mineral Creek - Animas River to South Fork	Mineral Creek below North Star #7 Level
M32	mainstem	EU-01	Mineral Creek - Animas River to South Fork	Mineral Creek above North Star #7 Level
M29	mainstem	EU-01	Mineral Creek - Animas River to South Fork	Mineral Creek below South Fork Mineral Creek confluence
M27	mainstem	EU-02	Mineral Creek - South Fork to Middle Fork	Mineral Creek above South Fork Mineral Creek confluence
M27A2	mainstem	EU-02	Mineral Creek - South Fork to Middle Fork	Mineral Creek between M27 and M27A
M27A	mainstem	EU-02	Mineral Creek - South Fork to Middle Fork	Mineral Creek below Middle Fork Mineral Creek confluence
M14B	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek above Middle Fork Mineral Creek confluence
M14	unnamed gulch	EU-03	Mineral Creek - Middle Fork to Mill Creek	Unnamed Gulch just east of Middle Fork Mineral Creek confluence
M14A	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek above unnamed gulch at Ophir Pass Road
M13D	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek below Browns Gulch confluence
M13B	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek above Browns Gulch confluence
M13A	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek above Imogene Mine
M11	mainstem	EU-03	Mineral Creek - Middle Fork to Mill Creek	Mineral Creek below Mill Creek confluence
M12	named gulch	EU-03.5	Browns Gulch	Browns Gulch just upstream of Mineral Creek confluence
M12A	named gulch	EU-03.5	Browns Gulch	Just down gradient from Brooklyn Mine waste rock area
M12D	named gulch	EU-03.5	Browns Gulch	Brooklyn Mine waste rock area
M12E	named gulch	EU-03.5	Browns Gulch	Brooklyn Mine waste rock area
M12C	named gulch	EU-03.5	Browns Gulch	Brooklyn Mine waste rock area
M12F	pond	EU-03.5	Browns Gulch	At one of the two ponds just off US Basin Road
M12G	pond	EU-03.5	Browns Gulch	At one of the two ponds just off US Basin Road
M12B	named gulch	EU-03.5	Browns Gulch	Just up from Brooklyn Mine waste rock area, down gradient from upper Brooklyn Mine
M10A	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek above Mill Creek confluence
M07	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek above Chattanooga
M10B	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek about 100 feet upriver from Mill Creek confluence
M05	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek below Carbon Lakes tributary
M03	mainstem tributary	EU-04	Mineral Creek - Mill Creek to headwaters	Carbon Lakes Stream at confluence
M04	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek above Carbon Lakes confluence
M02	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek just below Longfellow Mine and Koehler Tunnel
M01	mainstem	EU-04	Mineral Creek - Mill Creek to headwaters	Mineral Creek headwaters
LFK9	pond	EU-04	Mineral Creek - Mill Creek to headwaters	Pooled/ponded area located next to Longfellow and Koehler Mines
M02L	pond	EU-04	Mineral Creek - Mill Creek to headwaters	Pooled/ponded area just up gradient from Longfellow Mine
M28	mainstem tributary	EU-05	South Fork Mineral Creek	Near Mineral Creek confluence
M26D	mainstem tributary	EU-05	South Fork Mineral Creek	Just upstream from M28
M26B	mainstem tributary	EU-05	South Fork Mineral Creek	Just downstream from South Mineral Creek Campground
M26	named gulch	EU-05	South Fork Mineral Creek	Clear Lake Creek just above South Fork of Mineral Creek confluence
M25	mainstem tributary	EU-05	South Fork Mineral Creek	Just downstream from Bandora Mine
M24D	mine drainage	EU-05	South Fork Mineral Creek	In Bandora Mine drainage area
M23	mainstem tributary	EU-05	South Fork Mineral Creek	Just upstream from Bandora Mine
M22	mainstem tributary	EU-06	Middle Fork Mineral Creek	Near Mineral Creek confluence
M20	mainstem tributary	EU-06	Middle Fork Mineral Creek	Just upstream from M22
M19	mainstem tributary	EU-06	Middle Fork Mineral Creek	Just downstream from Red Tributary
M18	named gulch	EU-06	Middle Fork Mineral Creek	Red Tributary just above Middle Fork Mineral Creek confluence
M17A	mainstem tributary	EU-06	Middle Fork Mineral Creek	Just upstream from Red Tributary
M17	mainstem tributary	EU-06	Middle Fork Mineral Creek	Downstream from Paradise Mine
M16H	mainstem tributary	EU-06	Middle Fork Mineral Creek	Just downstream from Paradise Mine
M16F	named gulch	EU-06	Middle Fork Mineral Creek	Crystal Creek just up from confluence at Paradise Mine
M15	named gulch	EU-06	Middle Fork Mineral Creek	Crystal Creek near switchback
M16A	mine drainage	EU-06	Middle Fork Mineral Creek	Paradise mine drainage
M16E	mainstem tributary	EU-06	Middle Fork Mineral Creek	Upstream from Paradise Mine Adit #1 and just below Paradise Mine Adits #2, #3, and #4
M16G	mainstem tributary	EU-06	Middle Fork Mineral Creek	About 1/4 mile upstream from Paradise Mine
ANIMAS RIVER OVERBANK SOIL EXPOSURE UNITS				
A47	named gulch	EU-07	Animas River - confluence with Arrastra Creek to Howardsville	Hematite Gulch just upstream from Animas River confluence
A55	mainstem	EU-07	Animas River - confluence with Arrastra Creek to Howardsville	Near Pride of the West Mill #2
A55a	mainstem	EU-07	Animas River - confluence with Arrastra Creek to Howardsville	About the middle of EU-07
A56	mainstem	EU-07	Animas River - confluence with Arrastra Creek to Howardsville	Just upstream from Arrastra Creek confluence
A48	mainstem	EU-08	Cunningham Creek	At mouth just upstream from Animas River confluence
CU4a	mainstem	EU-08	Cunningham Creek	About 2 miles upstream from Animas River confluence
CU4	mainstem	EU-08	Cunningham Creek	About 2.5 miles upstream from Animas River confluence
A42	mainstem tributary	EU-09	Animas River - Howardsville to Minnie Gulch	On Pole Creek just upstream from the Animas River confluence
A41A	mainstem	EU-09	Animas River - Howardsville to Minnie Gulch	Just downstream from Minnie Gulch confluence
LA3	mainstem	EU-09	Animas River - Howardsville to Minnie Gulch	Next to Hamlet Mill
A45	mainstem	EU-09	Animas River - Howardsville to Minnie Gulch	Above Cunningham Creek confluence, just upstream from Howardsville Colorado Goldfields Tailings area
A35	mainstem	EU-10	Animas River - Minnie Gulch to Eureka Gulch	Near Eureka Fluvial Tailings area
A40A	mainstem	EU-10	Animas River - Minnie Gulch to Eureka Gulch	Upstream from Minnie Gulch confluence
A40	mainstem	EU-10	Animas River - Minnie Gulch to Eureka Gulch	Just upstream from Minnie Gulch confluence
A36	mainstem	EU-11	Upper South Fork Animas River	Just upstream from the Eureka Gulch confluence
A37	named gulch	EU-12	Eureka Gulch	Just upstream from Upper South Fork Animas River confluence
EG6	named gulch	EU-12	Eureka Gulch	Just downstream from Terry Tunnel
MC0	named gulch	EU-12	Eureka Gulch	Adjacent to Terry Tunnel
A39	named gulch	EU-12	Eureka Gulch	Just upstream from Terry Tunnel
EG5	named gulch	EU-12	Eureka Gulch	Just downstream from Ben Franklin Mine
EG4	named gulch	EU-12	Eureka Gulch	Upstream from Ben Franklin Mine
EG2A	named gulch	EU-12	Eureka Gulch	Downstream down from the Sunnyside-Thompson Mill area
EG3A	unnamed gulch	EU-12	Eureka Gulch	Left fork off of Eureka Gulch downstream of Clipper Mine
EG3	unnamed gulch	EU-12	Eureka Gulch	Left fork off of Eureka Gulch downstream of Clipper Mine
EG1	unnamed gulch	EU-12	Eureka Gulch	Left fork off of Eureka Gulch up gradient from Clipper Mine
EG2	unnamed gulch	EU-12	Eureka Gulch	Just downstream from all of the Sunnyside-Thompson Mill area
A34	mainstem	EU-13	South Fork Animas River	Just upstream from South Fork before confluence
EG9	mainstem	EU-13	South Fork Animas River	Downstream from Sunnyside Mill #1
A14	mainstem	EU-14	Animas River - Eureka to Animas Forks	Just downstream from West Fork Animas River confluence
A31	mainstem	EU-14	Animas River - Eureka to Animas Forks	Just upstream from Sunnyside Eureka Mill
A32	named gulch	EU-14	Animas River - Eureka to Animas Forks	In Niagara Gulch just upstream from Animas River confluence
A33	mainstem	EU-14	Animas River - Eureka to Animas Forks	Just upstream from South Fork Animas River confluence
A10	mainstem	EU-15	West Fork Animas River	Just upstream from Animas River confluence near Columbus Mill/Mine
CG11	mainstem	EU-15	West Fork Animas River	Adjacent to Columbus Mill/Mine
A11	mainstem	EU-15	West Fork Animas River	Downstream from Frisco/Bagley Tunnel/Mill
CG9	mainstem	EU-15	West Fork Animas River	Downstream from Frisco/Bagley Tunnel/Mill
A13	mainstem	EU-15	West Fork Animas River	Upstream from Frisco/Bagley Tunnel/Mill
A20	named gulch	EU-16	Placer Gulch	Just upstream from West Fork Animas River confluence
A21	named gulch	EU-16	Placer Gulch	Just downstream from Sunbank Group/Evening Star Mine
A22	named gulch	EU-16	Placer Gulch	Just upstream from Sunbank Group/Evening Star Mine
A15	mainstem	EU-17	Upper West Fork Animas River	Upstream from Placer Gulch
CG6	mainstem	EU-17	Upper West Fork Animas River	Just downstream from Vermillion Tunnel
A08	mainstem	EU-18	North Fork Animas River	Just downstream from Burrows Creek confluence
UA5	mainstem	EU-18	North Fork Animas River	Between West Fork Animas River and Burrows Creek
A09	mainstem	EU-18	North Fork Animas River	Just upstream from West Fork Animas River confluence
A07	mainstem	EU-19	Burrows Creek	Just upstream from North Fork Animas River confluence
BG4	mainstem	EU-19	Burrows Creek	Upstream from North Fork Animas River confluence
A07A	mainstem	EU-19	Burrows Creek	Downstream from Ben Butler and Prairie Mine drainages
A07B	mainstem	EU-19	Burrows Creek	Adjacent to London Mine
A07D	mainstem	EU-19	Burrows Creek	Downstream from Boston Mine but upstream from Dewitt Mine
A07E	mainstem	EU-19	Burrows Creek	Upstream from Boston Mine
A07F	mainstem	EU-19	Burrows Creek	Adjacent to Red Cloud Mine.
A07G	mainstem	EU-19	Burrows Creek	At confluence with Sewell Mine drainage
BG1A	mainstem	EU-19	Burrows Creek	Burrow Gulch headwaters
BB2	unnamed gulch	EU-19	Burrows Creek	Between Ben Butler Mine and Burrows Creek
CEMENT CREEK OVERBANK SOIL EXPOSURE UNITS				
CC48	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Adjacent to Kendrick-Gelder Smelter (Ross)
CC47C	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Near Soda Gulch
CC46B	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Near Hancock Gulch
CC43E	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Just downstream from Yukon Tunnel/Mill
CC43D	mine drainage	EU-20	Cement Creek - Silverton to Prospect Gulch	Near pond adjacent to Yukon Tunnel/Mill
CC42	named gulch	EU-20	Cement Creek - Silverton to Prospect Gulch	Illinois Gulch just upstream from Cement Creek confluence
CC41	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Near Ohio Gulch
CC39	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Just downstream from Porcupine Gulch confluence
CC38	named gulch	EU-20	Cement Creek - Silverton to Prospect Gulch	Porcupine Gulch just upstream from Cement Creek confluence
CC38D	named gulch	EU-20	Cement Creek - Silverton to Prospect Gulch	Porcupine Gulch downstream from Anglo Saxon Mine (upper level)
CC38C	named gulch	EU-20	Cement Creek - Silverton to Prospect Gulch	Porcupine Gulch upstream from Anglo Saxon Mine (upper level)
CC39B	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Upstream from Porcupine Gulch confluence
CC27	mainstem	EU-20	Cement Creek - Silverton to Prospect Gulch	Downstream from Prospect Gulch confluence
CC26	named gulch	EU-21	Prospect Gulch	Just upstream from Cement Creek confluence
CC25	named gulch	EU-21	Prospect Gulch	Just upstream from Henrietta Mine #9 Level
CC25B	named gulch	EU-21	Prospect Gulch	Adjacent to Joe and Johns Mine
CC24C	named gulch	EU-21	Prospect Gulch	Just upstream from Lark and Mine
CC24	named gulch	EU-21	Prospect Gulch	Adjacent to Henrietta Mine #7 Level
CC24B	named gulch	EU-21	Prospect Gulch	Downstream from Henrietta Mine #7 Level waste pile
CC22B	named gulch	EU-21	Prospect Gulch	Adjacent to Henrietta Mine #8 Level
CC22D	named gulch	EU-21	Prospect Gulch	Just upstream from Henrietta Mine #7 and #8 Levels
CC23	named gulch	EU-21	Prospect Gulch	Downstream from Hercules Mine
CC23C	named gulch	EU-21	Prospect Gulch	Downstream from Hercules Mine
CC23D	named gulch	EU-21	Prospect Gulch	Downstream from Hercules Mine
CC23I	mine drainage	EU-21	Prospect Gulch	Just upstream from Hercules Mine, downstream from JSP Mine
CC23B	named gulch	EU-21	Prospect Gulch	Downstream from Hercules Mine
CC22	named gulch	EU-21	Prospect Gulch	Adjacent, but up gradient from Lark Mine

Table 5.1 Sampling Location Description for the Overbank Soils
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Sample #	Site Type	EU	EU Description	Sampling Location Description
CC21B	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Downstream of Dry Gulch confluence
CC21D	named gulch	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Dry Gulch below Wynona Mine just upstream from Cement Creek confluence
CC21	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Downstream from South Fork Cement Creek confluence
CC20	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Just upstream of South Fork Cement Creek confluence
CC18	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Adjacent to American Tunnel and Gold King Mill
CC18B	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Just downstream from North Fork Cement Creek confluence
CC07	mainstem tributary	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	North Fork Cement Creek downstream from Gold King Mine (#7 Level)
CC04	mainstem tributary	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	North Fork Cement Creek just upstream from Gold King Mine (#7 Level)
CC03	mainstem	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Just upstream from North Fork Cement Creek confluence.
CC03D	mine drainage	EU-22	Cement Creek - Prospect Gulch to Red & Bonita Mine	Red & Bonita Mill/Mine drainage
CC17	mainstem tributary	EU-23	South Fork of Cement Creek	Upstream from the Cement Creek confluence
CC16	mainstem tributary	EU-23	South Fork of Cement Creek	Mainstem South Fork Cement Creek
CC16B	mainstem tributary	EU-23	South Fork of Cement Creek	Downstream from the Big Colorado Mine
CC15	mainstem tributary	EU-23	South Fork of Cement Creek	Just upstream from the Natalie/Occidental (Silver Ledge) Mine
CC15A	mainstem tributary	EU-23	South Fork of Cement Creek	Just downstream from the Natalie/Occidental (Silver Ledge) Mine
CC03B	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Immediately upstream of Red and Bonita Mine drainage confluence
CC03BF	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Upstream of Red and Bonita Mine drainage confluence
CC02	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Adjacent to Pride of Bonita Mine drainage confluence
CC03A	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Downstream from Mogul Mine area
FD-1	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Downstream from Mogul Mine area
MTD-4	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Downstream from Mogul Mine area
CC02C	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Adjacent from Mogul Mine area
CC01U	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Downstream from Mogul North Mine
CC02I	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Downstream from Mogul North Mine
CC01T	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Upstream from Mogul North Mine
CC01S	mainstem tributary	EU-24	Cement Creek - Red & Bonita Mine to headwaters	On Queen Anne Mine tributary, just upstream Cement Creek confluence
CC01H	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Just upstream of Queen Anne Mine tributary confluence
CC01C2	mainstem	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Just upstream of Queen Anne Mine tributary confluence
CC01C	mine drainage	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Grand Mogul mine adit area
CC01C1	mine drainage	EU-24	Cement Creek - Red & Bonita Mine to headwaters	Grand Mogul mine adit area
CC01F	named gulch	EU-24	just above Grand Mogul Mine tailings; well downgradient from Lower Ross Basin Mine	Ross Basin Gulch upstream of Grand Mogul Mine

Table 5.2 Soil No-Effect ESVs for the Four Terrestrial Ecological Receptor Groups
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site,
San Juan County, CO

Analyte	Soil No-effect Ecological Screening Values (mg/kg)								COPEC Selection
	Plants	Source	Invertebrates	Source	Birds	Source	Mammals	Source	
aluminum[1]	--	a	--	a	--		--		--
antimony	11	b	78	a	--		0.27	a	0.27
arsenic	18	a	6.8	b	43	a	46	a	6.8
barium	110	b	330	a	820	b	2,000	a	110
beryllium	2.5	b	40	a	--		21	a	2.5
cadmium	32	a	140	a	0.77	a	0.36	a	0.36
chromium	--		0.4	d	26[#]	a	34[*]	a	0.4
cobalt	13	a	--		120	a	230	a	13
copper	70	a	80	a	28	a	49	a	28
iron[2]	--[2]	a	--[2]	a	--		--		--
lead	120	a	1,700	a	11	a	56	a	11
manganese	220	a	450	a	4,300	a	4,000	a	220
mercury[@]	34	b	0.05	b	0.013	b	1.7	b	0.013
molybdenum	2.0	c	--		17	b	4.8	c	2.0
nickel	38	a	280	a	210	a	130	a	38
selenium	0.52	a	4.1	a	1.2	a	0.63	a	0.52
silver	560	b	--		4.2	a	14	a	4.2
thallium	0.05	b	--		6.3	b	0.22	b	0.05
vanadium	60	b	--		7.8	a	280	a	7.8
zinc	160	a	120	a	46	a	79	a	46

COPEC = contaminant of potential ecological concern; ESV = ecological screening value
Sources for the ESVs:
[a] EPA's Ecological Soil Screening Levels (EcoSSLs). Available at https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents
[b] Los Alamos National Laboratory (LANL) no-effect ecological screening levels. Available at https://lanl.gov/environment/protection/eco-risk-assessment.php
[c] EPA Region 4 soil screening values for hazardous waste sites (Table 4). Available at https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance
[d] Oak Ridge National Laboratory (ORNL), Preliminary remediation goals for ecological endpoints. ES/ER/TM-162/R2. Available at https://rais.ornl.gov/guidance/tm.html

[1] Aluminum is considered to be a COPEC when soil pH falls below 5.5
[2] Iron toxicity in soil depends on soil pH and Eh

[#] this ESV is for Cr^{3+} (no EcoSSL is available for Cr^{6+})
[*] This ESV is for Cr^{3+} (the EcoSSL for Cr^{6+} equals 130 mg/kg)
[@] These ESVs are for inorganic Hg

prepared by: SJP (1/9/17)
reviewed by:

Table 5.3 Soil COPECs for the Mine Waste Sites
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Analyte	Min. Detected Value (mg/kg)	Max. Detected Value (mg/kg)	Station ID of Max Detect. Value	Mine Name	Soil ESV (mg/kg)	HQ	Soil COPEC?	Reason Code
aluminum	800	16,100	WR1-M16	Paradise Mine	NA	--	Y	c
antimony	0.57	332	AE-1	Mountain Queen Mine	0.27	**1,230**	Y	a
arsenic	3.7	13,700	WR-M02C	Koehler Tunnel	6.8	**2,015**	Y	a
barium	8.6	1,110	WR2-M24	Bandora Mine	110	**10**	Y	a
beryllium	0.034	4.0	WR4-M24	Bandora Mine	2.5	**2**	Y	a
cadmium	0.15	160	WR4-M24	Bandora Mine	0.36	**444**	Y	a
chromium	0.65	16.5	WR-M02D	Junction Mine	0.4	**41**	Y	a
cobalt	0.26	117	WR4-M24	Bandora Mine	13.0	**9**	Y	a
copper	38	3,830	AE32a	Silver Wing Mine	28.0	**137**	Y	a
iron	5,690	262,000	WR2-M16	Paradise Mine	NA	**--**	Y	c
lead	36.3	35,700	AE-1	Mountain Queen Mine	11	**3,245**	Y	a
manganese	43	72,100	WR4-M24	Bandora Mine	220	**328**	Y	a
mercury	0.015	7.6	WR-M02D	Junction Mine	0.013	**585**	Y	a
molybdenum	0.91	159	WR-TM	Tom Moore Mine	2.0	**80**	Y	a
nickel	0.15	34.6	WR4-M24	Bandora Mine	38.0	0.9	N	b
selenium	0.57	32.3	AE-1	Mountain Queen Mine	0.52	**62**	Y	a
silver	0.247	93.7	WR-BB	Ben Butler Mine	4.2	**22**	Y	a
thallium	0.097	4.6	AE45	Sunbank Group Mine	0.05	**92**	Y	a
vanadium	1.3	70.3	WR-M02C	Koehler Tunnel	7.8	**9**	Y	a
zinc	23.6	66,800	WR3-M24	Bandora Mine	46.0	**1,452**	Y	a

COPEC = contaminant of potential ecological concern; ESV = ecological screening value; HQ = hazard quotient

Reason code:

a = HQ > 1

b = HQ < 1

c = analyte was detected but has no ESV

prepared by: SJP (1/26/17)

reviewed by: CC (2/1/17)

Table 5.4 Soil COPECs for the Overbank Soils
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Analyte	Min. Detected Value (mg/kg)	Max. Detected Value (mg/kg)	EU with Max Detected Value	Soil ESV (mg/kg)	HQ	Soil COPEC?	Reason Code
aluminum	3,920	48,300	EU-19	NA	**--**	Y	c
antimony	0.016	26.5	EU-10	0.27	**98**	Y	a
arsenic	0.095	831	EU-04	6.8	**122**	Y	a
barium	10.7	357	EU-15	110	**3.2**	Y	a
beryllium	0.11	9.0	EU-15	2.5	**3.6**	Y	a
cadmium	0.11	216	EU-15	0.36	**600**	Y	a
chromium	0.12	27	EU-13	0.4	**68**	Y	a
cobalt	0.65	81.5	EU-24	13.0	**6.3**	Y	a
copper	4.5	2,890	EU-15	28.0	**103**	Y	a
iron	13,000	317,000	EU-03	NA	**--**	Y	c
lead	0.92	10,500	EU-10	11	**955**	Y	a
manganese	73.3	55,900	EU-15	220	**254**	Y	a
mercury	0.0044	2.6	EU-15	0.013	**200**	Y	a
molybdenum	0.11	81.8	EU-15	2.0	**41**	Y	a
nickel	0.59	63.7	EU-13	38.0	**1.7**	Y	a
selenium	0.5	7	EU-06	0.52	**13**	Y	a
silver	0.0145	47.9	EU-10	4.2	**11**	Y	a
thallium	0.02	3.3	EU-19	0.05	**66**	Y	a
vanadium	0.52	76.1	EU-01	7.8	**10**	Y	a
zinc	18.7	30,200	EU-15	46.0	**657**	Y	a

COPEC = contaminant of potential ecological concern; ESV = ecological screening value; EU = exposure unit; HQ = hazard quotient

Reason code:

a = HQ > 1

b = HQ < 1

c = analyte was detected but has no ESV

prepared by: CC (2/7/17)

reviewed by:

Table 5.5 Soil COPECs for the Public Campsites
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Analyte	Min. Detected Value (mg/kg)		Max. Detected Value (mg/kg)		Location of Max Detected Value	Soil ESV (mg/kg)	HQ	Soil COPEC?	Reason Code
aluminum	7,050		14,100		CMP5	NA	--	Y	c
antimony	0.57		46.8		CMP4	0.27	**173**	Y	a
arsenic	7.7	J-	86.9	J-	CMP7	6.8	**13**	Y	a
barium	75.7		193		CMP10	110	**1.8**	Y	a
beryllium	0.19		1.4		CMP15a	2.5	<1	N	b
cadmium	0.18		94.3		CMP4	0.36	**262**	Y	a
chromium	4.1		10.5		CMP9	0.4	**26**	Y	a
cobalt	2.6		29.7		CMP15a	13.0	**2**	Y	a
copper	20.4		2,510		CMP4	28.0	**90**	Y	a
iron	19,000	J	48,100	J	CMP11	NA	--	Y	c
lead	73.6		44,200		CMP4	11	**4,018**	Y	a
manganese	202		9,030		CMP15a	220	**41**	Y	a
mercury	0.016	J	6.0		CMP4	0.013	**462**	Y	a
molybdenum	1.1		118	J	CMP4	2.0	**59**	Y	a
nickel	2.2		18.6		CMP15a	38.0	<1	N	b
selenium	0.69		7.1		CMP4	0.52	**14**	Y	a
silver	0.58		96.9		CMP4	4.2	**23**	Y	a
thallium	0.14		0.43		CMP7	0.05	**9**	Y	a
vanadium	15.4		45		CMP15a	7.8	**6**	Y	a
zinc	74.3		17,300		CMP4	46.0	**376**	Y	a

COPEC = contaminant of potential ecological concern; ESV = ecological screening value; HQ = hazard quotient

Reason code:

a = HQ > 1

b = HQ < 1

c = analyte was detected but has no ESV

prepared by: SJP (1/23/17)

reviewed by: CC (1/30/17)

Table 7.0 Maximum HQs for the Four Terrestrial Receptor Groups at the Three Exposure Areas
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Mine Sites Maximum HQs				Overbank Soils Maximum HQs				Campsites Maximum HQs			
	Plants	Inverts	Birds	Mammals	Plants	Inverts	Birds	Mammals	Plants	Inverts	Birds	Mammals
antimony	30	4	--	1,230	2	<1	--	98	4	<1	--	173
arsenic	761	2,015	319	298	46	122	19	18	5	13	2	2
barium	10	3	1.4	<1	3	1.1	<1	<1	2	<1	<1	<1
beryllium	2	<1	--	<1	4	<1	--	<1	<1	<1	--	<1
cadmium	5	1.1	208	444	7	2	281	600	3	<1	122	262
chromium	--	41	<1	<1	--	68	1.0	<1	--	28	<1	<1
cobalt	9	--	<1	<1	6	--	0.7	<1	2	--	<1	<1
copper	55	48	137	78	41	36	103	59	36	31	90	51
lead	298	21	3,245	638	88	6	955	188	368	26	4,018	789
manganese	328	160	17	18	254	124	13	14	41	20	2	2
mercury	<1	152	585	4	<1	52	200	2	<1	120	462	4
molybdenum	80	--	9	33	41	--	5	17	59	--	7	25
nickel	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1
selenium	62	8	27	51	13	2	6	11	14	2	6	11
silver	<1	--	22	7	<1	--	11	3	<1	--	23	7
thallium	92	--	<1	21	66	--	<1	15	9	--	<1	2
vanadium	1.1	--	9	<1	1.3	--	10	<1	<1	--	6	<1
zinc	418	557	1,452	846	189	252	657	382	108	144	376	219

COPEC = contaminant of potential ecological concern; HQ = hazard quotient
-- = a soil benchmark is not available to calculate an HQ

prepared by: MC (2/23/17)
reviewed by: SJP (2/24/17)

Table 7.1.1 HQs for the Four Terrestrial Receptor Groups at the Anglo-Saxon Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of Total Risk
aluminum*	10,400	--	--	--	--	--	--
antimony	58.7	**5.3**	0.8	**--**	**217**	223	14
arsenic	143	**7.9**	**21**	**3.3**	**3.1**	35	2.2
barium	118	**1.1**	0.4	0.1	0.06	2	0.1
beryllium	0.48	0.2	0.01	**--**	0.02	0.2	0.01
cadmium	4.3	0.1	0.03	**5.6**	**12**	18	1.1
chromium	4.4	**--**	**11**	0.2	0.1	11	0.7
cobalt	35.5	**2.7**	**--**	0.3	0.2	3	0.2
copper	283	**4.0**	**3.5**	0.1	**5.8**	14	0.9
iron	87,200	**--**	**--**	**--**	**--**	--	--
lead	3,340	**28**	**2.0**	**945**	**60**	1,035	66
manganese	3,780	**17**	**8.4**	0.9	0.9	27	1.7
mercury	0.42	0.01	**8.4**	**32**	0.2	41	2.6
molybdenum	22.6	**11**	**--**	**1.3**	**4.7**	17	1.1
selenium	10.1	**19**	**2.5**	**8.4**	**16**	46	2.9
silver	14.2	0.03	**--**	**3.4**	**1.0**	4	0.3
thallium	0.46	**9.2**	**--**	0.07	**2.1**	11	0.7
vanadium	31.5	0.5	**--**	**4.0**	0.1	5	0.3
zinc	1,650	**10**	**14**	**36**	**21**	81	5.1
					Total Risk	1,575	100.0

* aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.2 HQs for the Four Terrestrial Receptor Groups at the Bandora Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	12,700	--	--	--	--	--	--
antimony	176	**16**	**2.3**	--	**652**	670	7.9
arsenic	150	**8.3**	**22**	**3.5**	**3.3**	37	0.4
barium	1,110	**10**	**3.4**	**1.4**	0.6	15	0.2
beryllium	4	**1.6**	0.1	--	0.2	2	0.02
cadmium	160	**5.0**	**1.1**	**208**	**444**	658	7.8
chromium	7.1	--	**18**	0.3	0.2	18	0.2
cobalt	117	**9.0**	--	1.0	0.5	10	0.1
copper	2,790	**40**	**35**	**100**	**57**	231	2.7
iron	126,000	--	--	--	--	--	--
lead	24,400	**203**	**14**	**2,218**	**436**	2,872	34
manganese	72,100	**328**	**160**	**17**	**18**	523	6.2
mercury	0.71	0.02	**14**	**55**	0.4	69	0.8
molybdenum	48.8	**24**	--	**2.9**	**10**	37	0.4
selenium	7.7	**15**	**1.9**	**6.4**	**12**	35	0.4
silver	92.4	0.2	--	**22**	**6.6**	29	0.3
thallium	0.33	**6.6**	--	0.05	**1.5**	8	0.1
vanadium	20.6	0.3	--	**2.6**	0.07	3	0.04
zinc	66,800	**418**	**557**	**1,452**	**846**	3,272	39
					Total Risk	8,491	100.0

* aluminum is not retained as a COPEC because the four composite soil samples collected at this mine had pH $\geq$ 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.3 HQs for the Four Terrestrial Receptor Groups at the Ben Butler Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	6,720	--	--	--	--	--	--
antimony	128	**12**	**1.6**	--	**474**	487	10
arsenic	207	**12**	**30**	**4.8**	**4.5**	51	1.1
barium	58.6	0.5	0.2	0.07	0.03	0.8	0.02
beryllium	0.14	0.06	0.004	--	0.007	0.1	0.001
cadmium	29.3	0.9	0.2	**38**	**81**	121	2.6
chromium	2.1	--	**5.3**	0.08	0.06	5	0.1
cobalt	0.97	0.07	--	0.008	0.004	0.1	0.002
copper	435	**6.2**	**5.4**	**16**	**8.9**	36	0.8
iron	35,500	--	--	--	--	--	--
lead	24,000	**200**	**14**	**2,182**	**429**	2,825	60
manganese	194	0.9	0.4	0.05	0.05	1	0.03
mercury	0.77	0.02	**15**	**59**	0.5	75	1.6
molybdenum	49.8	**25**	--	**2.9**	**10**	38	0.8
selenium	1.2	**2.3**	0.3	1.0	**1.9**	6	0.1
silver	93.7	0.2	--	**22**	**6.7**	29	0.6
thallium	2.3	**46**	--	0.4	**10**	57	1.2
vanadium	10	0.2	--	**1.3**	0.04	1	0.03
zinc	20,200	**126**	**168**	**439**	**256**	989	21
					Total Risk	4,723	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.4 HQs for the Four Terrestrial Receptor Groups at the Ben Franklin Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	3,610	--	--	--	--	--	--
antimony	12.6	**1.1**	0.2	--	**47**	48	4.1
arsenic	57.3	**3.2**	**8.4**	**1.3**	**1.2**	14	1.2
barium	40.4	0.4	0.1	0.05	0.02	0.6	0.05
beryllium	0.1	0.04	0.003	--	0.005	0.0	0.004
cadmium	6.4	0.2	0.05	**8.3**	**18**	26	2.3
chromium	2.9	--	**7.3**	0.1	0.09	7	0.6
cobalt	3.8	0.3	--	0.03	0.02	0.3	0.03
copper	475	**6.8**	**5.9**	**17**	**9.7**	39	3.4
iron	49,100	--	--	--	--	--	--
lead	6,770	**56**	**4.0**	**615**	**121**	797	69
manganese	1,130	**5.1**	**2.5**	0.3	0.3	8	0.7
mercury	0.47	0.01	**9.4**	**36**	0.3	46	4.0
molybdenum	no data	--	--	--	--	--	--
selenium	1.7	**3.3**	0.4	**1.4**	**2.7**	8	0.7
silver	34.8	0.06	--	**8.3**	**2.5**	11	0.9
thallium	0.37	**7.4**	--	0.06	**1.7**	9	0.8
vanadium	15.6	0.3	--	**2.0**	0.06	2	0.2
zinc	2,870	**18**	**24**	**62**	**36**	141	12
					Total Risk	1,158	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.5 HQs for the Four Terrestrial Receptor Groups at the Boston Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	3,270	--	--	--	--	--	--
antimony	81.1	**7.4**	**1.0**	--	**300**	309	20
arsenic	245	**14**	**36**	**5.7**	**5.3**	61	3.9
barium	191	**1.7**	0.6	0.2	0.10	3	0.2
beryllium	0.11	0.04	0.003	--	0.005	0.1	0.003
cadmium	15.8	0.5	0.1	**21**	**44**	65	4.2
chromium	1.3	--	**3.3**	0.05	0.04	3	0.2
cobalt	0.5	0.04	--	0.004	0.002	0.0	0.003
copper	81.8	**1.2**	**1.0**	**2.9**	**1.7**	7	0.4
iron	25,900	--	--	--	--	--	--
lead	4,660	**39**	**2.7**	**424**	**83**	548	36
manganese	122	0.6	0.3	0.03	0.03	0.9	0.06
mercury	1.7	0.05	**34**	**131**	1.0	166	11
molybdenum	118	**59**	--	**6.9**	**25**	91	5.9
selenium	0.99	**1.9**	0.2	0.8	**1.6**	5	0.3
silver	22.4	0.04	--	**5.3**	**1.6**	7	0.5
thallium	2.3	**46**	--	0.4	**10**	57	3.7
vanadium	4.5	0.08	--	0.6	0.02	0.7	0.04
zinc	4,450	**28**	**37**	**97**	**56**	218	14
					Total Risk	1,540	100.0

* aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.6 HQs for the Four Terrestrial Receptor Groups at the Brooklyn Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	11,600	--	--	--	--	--	--
antimony	12.7	**1.2**	0.2	--	**47**	48	8.3
arsenic	137	**7.6**	**20**	**3.2**	**3.0**	34	5.8
barium	103	0.9	0.3	0.1	0.05	1	0.2
beryllium	0.22	0.09	0.006	--	0.01	0.1	0.02
cadmium	1.8	0.06	0.01	**2.3**	**5.0**	7	1.3
chromium	9.9	--	**25**	0.4	0.3	25	4.4
cobalt	4.8	0.4	--	0.04	0.02	0.4	0.07
copper	123	**1.8**	**1.5**	**4.4**	**2.5**	10	1.8
iron	65,100	--	--	--	--	--	--
lead	2,950	**25**	**1.7**	**268**	**53**	347	60
manganese	847	**3.9**	**1.9**	0.2	0.2	6	1.1
mercury	0.2	0.006	**4.0**	**15**	0.1	20	3.4
molybdenum	6.5	**3.3**	--	0.4	**1.4**	5	0.9
selenium	2	**3.8**	0.5	**1.7**	**3.2**	9	1.6
silver	27	0.05	--	**6.4**	**1.9**	8	1.4
thallium	0.4	**8.0**	--	0.06	**1.8**	10	1.7
vanadium	22.4	0.4	--	**2.9**	0.08	3	0.6
zinc	903	**5.6**	**7.5**	**20**	**11**	44	7.6
					Total Risk	580	100.0

[*] aluminum is retained as a COPEC because the three composite soil samples collected at this mine all had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.7 HQs for the Four Terrestrial Receptor Groups at the Clipper Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	922	--	--	--	--	--	--
antimony	62.9	**5.7**	0.8	--	**233**	239	5.0
arsenic	31.7	**1.8**	**4.7**	0.7	0.7	8	0.2
barium	19.4	0.2	0.06	0.02	0.010	0.3	0.01
beryllium	0.034	0.01	0.0	--	0.002	0.0	0.0003
cadmium	34.6	**1.1**	0.2	**45**	**96**	142	3.0
chromium	0.65	--	**1.6**	0.03	0.02	2	0.03
cobalt	0.7	0.05	--	0.006	0.003	0.1	0.001
copper	749	**11**	**9.4**	**27**	**15**	62	1.3
iron	33,000	--	--	--	--	--	--
lead	28,400	**237**	**17**	**2,582**	**507**	3,342	70
manganese	528	**2.4**	**1.2**	0.1	0.1	4	0.08
mercury	0.7	0.02	**14**	**54**	0.4	68	1.4
molybdenum	no data	--	--	--	--	--	--
selenium	1.6	**3.1**	0.4	**1.3**	**2.5**	7	0.2
silver	34.7	0.06	--	**8.3**	**2.5**	11	0.2
thallium	0.76	**15**	--	0.1	**3.5**	19	0.4
vanadium	4.4	0.07	--	0.6	0.02	0.7	0.01
zinc	18,300	**114**	**153**	**398**	**232**	896	18.7
					Total Risk	4,802	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.8 HQs for the Four Terrestrial Receptor Groups at the Columbus Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	6,000	--	--	--	--	--	--
antimony	5.6	0.5	0.07	--	**21**	21	2.1
arsenic	91.9	**5.1**	**14**	**2.1**	**2.0**	23	2.2
barium	38.3	0.3	0.1	0.05	0.02	0.5	0.05
beryllium	0.002	0.0	0.0	--	0.0	0.0	0.0001
cadmium	6.4	0.2	0.05	**8.3**	**18**	26	2.5
chromium	5	--	**13**	0.2	0.1	13	1.2
cobalt	5.8	0.4	--	0.05	0.03	0.5	0.05
copper	512	**7.3**	**6.4**	**18**	**10**	42	4.1
iron	41,700	--	--	--	--	--	--
lead	6,060	**51**	**3.6**	**551**	**108**	713	69
manganese	1,160	**5.3**	**2.6**	0.3	0.3	8	0.81
mercury	0.74	0.02	**15**	**57**	0.4	72	7.0
molybdenum	no data	--	--	--	--	--	--
selenium	0.085	0.2	0.02	0.07	0.1	0.4	0.0
silver	17.7	0.03	--	**4.2**	**1.3**	6	0.5
thallium	0.81	**16**	--	0.1	**3.7**	20	1.9
vanadium	20.1	0.3	--	**2.6**	0.07	3	0.3
zinc	1,750	**11**	**15**	**38**	**22**	86	8.3
					Total Risk	1,035	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.9 HQs for the Four Terrestrial Receptor Groups at the Dewitt Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	9,320	--	--	--	--	--	--
antimony	23.7	**2.2**	0.3	--	**88**	90	9.2
arsenic	169	**9.4**	**25**	**3.9**	**3.7**	42	4.3
barium	37.3	0.3	0.1	0.05	0.02	0.5	0.05
beryllium	0.56	0.2	0.01	--	0.03	0.3	0.03
cadmium	1.1	0.03	0.008	**1.4**	**3.1**	5	0.5
chromium	2.8	--	**7.0**	0.1	0.08	7	0.7
cobalt	5.2	0.4	--	0.04	0.02	0.5	0.05
copper	167	**2.4**	**2.1**	**6.0**	**3.4**	14	1.4
iron	33,300	--	--	--	--	--	--
lead	5,840	**49**	**3.4**	**531**	**104**	687	70
manganese	939	**4.3**	**2.1**	0.2	0.2	7	0.7
mercury	0.22	0.006	**4.4**	**17**	0.1	21	2.2
molybdenum	22.4	**11**	--	**1.3**	**4.7**	17	1.8
selenium	5.6	**11**	**1.4**	**4.7**	**8.9**	26	2.6
silver	40.8	0.07	--	**9.7**	**2.9**	13	1.3
thallium	0.71	**14**	--	0.1	**3.2**	18	1.8
vanadium	8.6	0.1	--	**1.1**	0.03	1	0.1
zinc	589	**3.7**	**4.9**	**13**	**7.5**	29	3.0
					Total Risk	978	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.10 HQs for the Four Terrestrial Receptor Groups at the Forest Queen Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	4,660	--	--	--	--	--	--
antimony	33.3	**3.0**	0.4	--	**123**	127	5.0
arsenic	50.7	**2.8**	**7.5**	**1.2**	**1.1**	13	0.5
barium	56.6	0.5	0.2	0.07	0.03	0.8	0.03
beryllium	1.7	0.7	0.04	--	0.08	0.8	0.03
cadmium	14.4	0.5	0.1	**19**	**40**	59	2.3
chromium	4.5	--	**11**	0.2	0.1	12	0
cobalt	4.5	0.3	--	0.04	0.02	0.4	0.02
copper	1,670	**24**	**21**	**60**	**34**	138	5.4
iron	26,100	--	--	--	--	--	--
lead	13,700	**114**	**8.1**	**1,245**	**245**	1,612	63
manganese	49,100	**223**	**109**	**11**	**12**	356	14
mercury	0.53	0.02	**11**	**41**	0.3	52	2.0
molybdenum	no data	--	--	--	--	--	--
selenium	1.5	**2.9**	0.4	**1.3**	**2.4**	7	0.3
silver	26.8	0.05	--	**6.4**	**1.9**	8	0.3
thallium	0.0035	0.07	--	0.0	0.02	0.1	0.003
vanadium	10.8	0.2	--	**1.4**	0.04	2	0.1
zinc	3,480	**22**	**29**	**76**	**44**	170	6.7
					Total Risk	2,558	100.0

* aluminum is retained as a COPEC because two of the three composite soil samples collected at this mine had a pH ≤ 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.11 HQs for the Four Terrestrial Receptor Groups at the Frisco/Bagley Tunnel
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	3,810	--	--	--	--	--	--
antimony	13.8	**1.3**	0.2	--	**51**	53	3.8
arsenic	174	**9.7**	**26**	**4.0**	**3.8**	43	3.2
barium	91.9	0.8	0.3	0.1	0.05	1	0.09
beryllium	0.73	0.3	0.02	--	0.03	0.3	0.03
cadmium	14.9	0.5	0.1	**19**	**41**	61	4.5
chromium	1.5	--	**3.8**	0.06	0.04	4	0.3
cobalt	6.6	0.5	--	0.06	0.03	0.6	0.04
copper	337	**4.8**	**4.2**	**12**	**6.9**	28	2.0
iron	37,600	--	--	--	--	--	--
lead	7,040	**59**	**4.1**	**640**	**126**	829	61
manganese	4,040	**18**	**9.0**	0.9	**1.0**	29	2.1
mercury	1.2	0.04	**24**	**92**	0.7	117	8.6
molybdenum	no data	--	--	--	--	--	--
selenium	0.085	0.2	0.02	0.07	0.1	0.4	0.03
silver	27.1	0.05	--	**6.5**	**1.9**	8	0.6
thallium	1.4	**28**	--	0.2	**6.4**	35	2.5
vanadium	8.1	0.1	--	**1.0**	0.03	1	0.1
zinc	3,200	**20**	**27**	**70**	**41**	157	11
					Total Risk	1,367	100.0

* aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.12 HQs for the Four Terrestrial Receptor Groups at the Gold King Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	11,300	--	--	--	--	--	--
antimony	3.9	0.4	0.05	**--**	**14**	15	3.2
arsenic	22.8	**1.3**	**3.4**	0.5	0.5	6	1.2
barium	51.9	0.5	0.2	0.06	0.03	0.7	0.2
beryllium	0.74	0.3	0.02	**--**	0.04	0.3	0.08
cadmium	0.97	0.03	0.007	**1.3**	**2.7**	4	0.9
chromium	4.3	**--**	**11**	0.2	0.1	11	2.4
cobalt	0.94	0.07	**--**	0.008	0.004	0.1	0.02
copper	146	**2.1**	**1.8**	**5.2**	**3.0**	12	2.6
iron	24,000	**--**	**--**	**--**	**--**	--	--
lead	2,800	**23**	**1.6**	**255**	**50**	330	71
manganese	1,130	**5.1**	**2.5**	0.3	0.3	8	1.8
mercury	0.14	0.004	**2.8**	**11**	0.08	14	2.9
molybdenum	9.4	**4.7**	**--**	0.6	**2.0**	7	1.6
selenium	4.7	**9.0**	**1.1**	**3.9**	**7.5**	22	4.6
silver	11.1	0.02	**--**	**2.6**	0.8	3	0.7
thallium	0.34	**6.8**	**--**	0.05	**1.5**	8	1.8
vanadium	19.6	0.3	**--**	**2.5**	0.07	3	0.6
zinc	409	**2.6**	**3.4**	**8.9**	**5.2**	20	4.3
					Total Risk	464	100.0

[*] aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.13 HQs for the Four Terrestrial Receptor Groups at the Grand Mogul Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	4,970	--	--	--	--	--	--
antimony	65.8	**6.0**	0.8	--	**244**	251	6.3
arsenic	106	**5.9**	**16**	**2.5**	**2.3**	26	0.7
barium	66.1	0.6	0.2	0.08	0.03	0.9	0.02
beryllium	0.27	0.1	0.007	--	0.01	0.1	0.003
cadmium	20.1	0.6	0.1	**26**	**56**	83	2.1
chromium	3.8	--	**9.5**	0.1	0.1	10	0.2
cobalt	1	0.08	--	0.008	0.004	0.1	0.002
copper	2,050	**29**	**26**	**73**	**42**	170	4.3
iron	40,800	--	--	--	--	--	--
lead	19,900	**166**	**12**	**1,809**	**355**	2,342	59
manganese	977	**4.4**	**2.2**	0.2	0.2	7	0.2
mercury	1.5	0.04	**30**	**115**	0.9	146	3.7
molybdenum	15.4	**7.7**	--	0.9	**3.2**	12	0.3
selenium	4.4	**8.5**	**1.1**	**3.7**	**7.0**	20	0.5
silver	32.1	0.06	--	**7.6**	**2.3**	10	0.3
thallium	0.45	**9.0**	--	0.07	**2.0**	11	0.3
vanadium	19.8	0.3	--	**2.5**	0.07	3	0.1
zinc	17,900	**112**	**149**	**389**	**227**	877	22
					Total Risk	3,969	100.0

[*] aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH ≤ 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.14 HQs for the Four Terrestrial Receptor Groups at the Henriatta Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	7,330	--	--	--	--	--	--
antimony	12.9	**1.2**	0.2	--	**48**	49	4.1
arsenic	109	**6.1**	**16**	**2.5**	**2.4**	27	2.3
barium	177	**1.6**	0.5	0.2	0.09	2	0.2
beryllium	0.21	0.08	0.005	--	0.01	0.1	0.008
cadmium	5.2	0.2	0.04	**6.8**	**14**	21	1.8
chromium	3.1	--	**7.8**	0.1	0.09	8	0.7
cobalt	2.7	0.2	--	0.02	0.01	0.2	0.02
copper	264	**3.8**	**3.3**	**9.4**	**5.4**	22	1.8
iron	27,200	--	--	--	--	--	--
lead	6,700	**56**	**3.9**	**609**	**120**	789	66
manganese	366	**1.7**	0.8	0.09	0.09	3	0.2
mercury	0.31	0.009	**6.2**	**24**	0.2	30	2.5
molybdenum	0.91	0.5	--	0.05	0.2	0.7	0.1
selenium	4.8	**9.2**	**1.2**	**4.0**	**7.6**	22	1.8
silver	13.8	0.02	--	**3.3**	1.0	4	0.4
thallium	0.27	**5.4**	--	0.04	**1.2**	7	0.6
vanadium	11.5	0.2	--	**1.5**	0.04	2	0.1
zinc	4,320	**27**	**36**	**94**	**55**	212	18
					Total Risk	1,199	100.0

[*] aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.15 HQs for the Four Terrestrial Receptor Groups at the Howardsville Colorado Goldfields
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	7,760	--	--	--	--	--	--
antimony	31.9	**2.9**	0.4	**--**	**118**	121	8.1
arsenic	625	**35**	**92**	**15**	**14**	155	10
barium	53.3	0.5	0.2	0.07	0.03	0.7	0.05
beryllium	0.022	0.009	0.0	**--**	0.001	0.0	0.001
cadmium	12.1	0.4	0.09	**16**	**34**	50	3.3
chromium	4.6	**--**	**12**	0.2	0.1	12	0.8
cobalt	5	0.4	**--**	0.04	0.02	0.4	0.03
copper	995	**14**	**12**	**36**	**20**	82	5.5
iron	48,900	**--**	**--**	**--**	**--**	--	--
lead	6,580	**55**	**3.9**	**598**	**118**	774	52
manganese	4,990	**23**	**11**	**1.2**	**1.2**	36	2.4
mercury	0.59	0.02	**12**	**45**	0.3	58	3.8
molybdenum	22.5	**11**	**--**	**1.3**	**4.7**	17	1.2
selenium	1.7	**3.3**	0.4	**1.4**	**2.7**	8	0.5
silver	18.5	0.03	**--**	**4.4**	**1.3**	6	0.4
thallium	0.55	**11**	**--**	0.09	**2.5**	14	0.9
vanadium	11	0.2	**--**	**1.4**	0.04	2	0.1
zinc	3,370	**21**	**28**	**73**	**43**	165	11
					Total Risk	1,501	100.0

* no soil pH data are available
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.16 HQs for the Four Terrestrial Receptor Groups at the Joe Johns Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	7,160	--	--	--	--	--	--
antimony	6.6	0.6	0.08	**--**	**24**	25	5.5
arsenic	223	**12**	**33**	**5.2**	**4.8**	55	12
barium	335	**3.0**	**1.0**	0.4	0.2	5	1.0
beryllium	0.19	0.08	0.005	**--**	0.009	0.1	0.020
cadmium	10.1	0.3	0.07	**13**	**28**	42	9.1
chromium	7.2	**--**	**18**	0.3	0.2	18	4.0
cobalt	1.5	0.1	**--**	0.01	0.007	0.1	0.03
copper	64.7	0.9	0.8	**2.3**	**1.3**	5	1.2
iron	34,600	**--**	**--**	**--**	**--**	--	--
lead	1,350	**11**	0.8	**123**	**24**	159	35
manganese	136	0.6	0.3	0.03	0.03	1.0	0.2
mercury	0.37	0.01	**7.4**	**28**	0.2	36	7.9
molybdenum	4.3	**2.2**	**--**	0.3	0.9	3	0.7
selenium	7.3	**14**	**1.8**	**6.1**	**12**	33	7.3
silver	7.5	0.01	**--**	**1.8**	0.5	2	0.5
thallium	0.69	**14**	**--**	0.1	**3.1**	17	3.7
vanadium	33.5	0.6	**--**	**4.3**	0.1	5	1.1
zinc	1,040	**6.5**	**8.7**	**23**	**13**	51	11
					Total Risk	459	100.0

[*] aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH ≤ 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.17 HQs for the Four Terrestrial Receptor Groups at the Junction Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	8,630	--	--	--	--	--	--
antimony	30.1	**2.7**	0.4	--	**111**	115	4.2
arsenic	1,720	**96**	**253**	**40**	**37**	426	15
barium	145	**1.3**	0.4	0.2	0.07	2	0.07
beryllium	0.55	0.2	0.01	--	0.03	0.3	0.009
cadmium	5.4	0.2	0.04	**7.0**	**15**	22	0.8
chromium	16.5	--	**41**	0.6	0.5	42	1.5
cobalt	5	0.4	--	0.04	0.02	0.4	0.02
copper	487	**7.0**	**6.1**	**17**	**9.9**	40	1.5
iron	75,900	--	--	--	--	--	--
lead	10,200	**85**	**6.0**	**927**	**182**	1,200	44
manganese	388	**1.8**	0.9	0.09	0.10	3	0.1
mercury	7.6	0.2	**152**	**585**	**4.5**	741	27
molybdenum	1.7	0.9	--	0.1	0.4	1	0.0
selenium	6	**12**	**1.5**	**5.0**	**9.5**	28	1.0
silver	35.9	0.06	--	**8.5**	**2.6**	11	0.4
thallium	0.89	**18**	--	0.1	**4.0**	22	0.8
vanadium	27.3	0.5	--	**3.5**	0.10	4	0.1
zinc	1,980	**12**	**17**	**43**	**25**	97	3.5
					Total Risk	2,756	100.0

[*] aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH ≤ 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.18 HQs for the Four Terrestrial Receptor Groups at the Kittimack Tailings
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	11,400	--	--	--	--	--	--
antimony	7.4	0.7	0.09	**--**	**27**	28	2.9
arsenic	14.3	0.8	**2.1**	0.3	0.3	4	0.4
barium	46.9	0.4	0.1	0.06	0.02	0.6	0.07
beryllium	0.61	0.2	0.02	**--**	0.03	0.3	0.03
cadmium	4.3	0.1	0.03	**5.6**	**12**	18	1.8
chromium	4.85	**--**	**12**	0.2	0.1	12	1.3
cobalt	6.5	0.5	**--**	0.05	0.03	0.6	0.06
copper	750	**11**	**9.4**	**27**	**15**	62	6.5
iron	39,800	**--**	**--**	**--**	**--**	--	--
lead	5,470	**46**	**3.2**	**497**	**98**	644	67
manganese	1,190	**5.4**	**2.6**	0.3	0.3	9	0.9
mercury	0.25	0.007	**5.0**	**19**	0.1	24	2.5
molybdenum	65.8	**33**	**--**	**3.9**	**14**	50	5.3
selenium	1.3	**2.5**	0.3	**1.1**	**2.1**	6	0.6
silver	20.8	0.04	**--**	**5.0**	**1.5**	6	0.7
thallium	1.04	**21**	**--**	0.2	**4.7**	26	2.7
vanadium	9.1	0.2	**--**	**1.2**	0.03	1	0.1
zinc	1,360	**8.5**	**11**	**30**	**17**	67	6.9
					Total Risk	959	100.0

[*] aluminum is retained as a COPEC because one of the two composite soil sample analyzed for acidity had a pH $\leq$ 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.19 HQs for the Four Terrestrial Receptor Groups at the Koehler Tunnel
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	6,300	--	--	--	--	--	--
antimony	18.5	**1.7**	0.2	--	**69**	70	1.6
arsenic	13,700	**761**	**2,015**	**319**	**298**	3,392	76
barium	101	0.9	0.3	0.1	0.05	1	0.03
beryllium	0.9	0.4	0.02	--	0.04	0.4	0.01
cadmium	3.3	0.1	0.02	**4.3**	**9.2**	14	0.3
chromium	6.2	--	**16**	0.2	0.2	16	0.4
cobalt	8.9	0.7	--	0.07	0.04	0.8	0.02
copper	539	**7.7**	**6.7**	**19**	**11**	45	1.0
iron	160,000	--	--	--	--	--	--
lead	3,740	**31**	**2.2**	**340**	**67**	440	10
manganese	1,700	**7.7**	**3.8**	0.4	0.4	12	0.3
mercury	3	0.09	**60**	**231**	**1.8**	293	6.6
molybdenum	4.6	**2.3**	--	0.3	1.0	4	0.1
selenium	3	**5.8**	0.7	**2.5**	**4.8**	14	0.3
silver	14.6	0.03	--	**3.5**	**1.0**	5	0.1
thallium	3.4	**68**	--	0.5	**15**	84	1.9
vanadium	70.3	**1.2**	--	**9.0**	0.3	10	0.2
zinc	910	**5.7**	**7.6**	**20**	**12**	45	1.0
					Total Risk	4,445	100.0

* aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.20 HQs for the Four Terrestrial Receptor Groups at the Lark Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	8,050	--	--	--	--	--	--
antimony	7.3	0.7	0.09	**--**	**27**	28	13
arsenic	112	**6.2**	**16**	**2.6**	**2.4**	28	13
barium	179	**1.6**	0.5	0.2	0.09	2	1.2
beryllium	0.13	0.05	0.003	**--**	0.006	0.1	0.03
cadmium	1.2	0.04	0.009	**1.6**	**3.3**	5	2.4
chromium	4	**--**	**10**	0.2	0.1	10	4.9
cobalt	2.3	0.2	**--**	0.02	0.01	0.2	0.1
copper	67	1.0	0.8	**2.4**	**1.4**	6	2.7
iron	35,800	**--**	**--**	**--**	**--**	--	--
lead	502	**4.2**	0.3	**46**	**9.0**	59	28
manganese	358	**1.6**	0.8	0.08	0.09	3	1.2
mercury	0.19	0.006	**3.8**	**15**	0.1	19	8.9
molybdenum	2.1	**1.1**	**--**	0.1	0.4	2	0.8
selenium	5.3	**10**	**1.3**	**4.4**	**8.4**	24	12
silver	2.4	0.004	**--**	0.6	0.2	0.7	0.4
thallium	0.31	**6.2**	**--**	0.05	**1.4**	8	3.7
vanadium	18.4	0.3	**--**	**2.4**	0.07	3	1.3
zinc	248	**1.6**	**2.1**	**5.4**	**3.1**	12	5.8
					Total Risk	208	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.21 HQs for the Four Terrestrial Receptor Groups at the London Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	4,980	--	--	--	--	--	--
antimony	155	**14**	**2.0**	--	**574**	590	28
arsenic	169	**9.4**	**25**	**3.9**	**3.7**	42	2.0
barium	73	0.7	0.2	0.09	0.04	1	0.05
beryllium	0.19	0.08	0.005	--	0.009	0.1	0.004
cadmium	34.7	**1.1**	0.2	**45**	**96**	143	6.7
chromium	2.3	--	**5.8**	0.09	0.07	6	0.3
cobalt	2.1	0.2	--	0.02	0.009	0.2	0.009
copper	197	**2.8**	**2.5**	**7.0**	**4.0**	16	0.8
iron	28,900	--	--	--	--	--	--
lead	5,660	**47**	**3.3**	**515**	**101**	666	31
manganese	713	**3.2**	**1.6**	0.2	0.2	5	0.2
mercury	0.66	0.02	**13**	**51**	0.4	64	3.0
molybdenum	48.9	**24**	--	**2.9**	**10**	38	1.8
selenium	2.9	**5.6**	0.7	**2.4**	**4.6**	13	0.6
silver	47.4	0.08	--	**11**	**3.4**	15	0.7
thallium	2	**40**	--	0.3	**9.1**	49	2.3
vanadium	12	0.2	--	**1.5**	0.04	2	0.1
zinc	9,680	**61**	**81**	**210**	**123**	474	22
					Total Risk	2,125	100.0

* aluminum is retained as a COPEC because two of the three composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.22 HQs for the Four Terrestrial Receptor Groups at the Long Fellow Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	5,920	--	--	--	--	--	--
antimony	49.2	**4.5**	0.6	--	**182**	187	11
arsenic	3,160	**176**	**465**	**73**	**69**	782	47
barium	133	**1.2**	0.4	0.2	0.07	2	0.1
beryllium	0.15	0.06	0.004	--	0.007	0.1	0.004
cadmium	4.8	0.2	0.03	**6.2**	**13**	20	1.2
chromium	3.8	--	**9.5**	0.1	0.1	10	0.6
cobalt	4.9	0.4	--	0.04	0.02	0.4	0.03
copper	669	**9.6**	**8.4**	**24**	**14**	55	3.4
iron	45,700	--	--	--	--	--	--
lead	3,680	**31**	**2.2**	**335**	**66**	433	26
manganese	528	**2.4**	**1.2**	0.1	0.1	4	0.2
mercury	0.56	0.02	**11**	**43**	0.3	55	3.3
molybdenum	5.2	**2.6**	--	0.3	**1.1**	4	0.2
selenium	1.9	**3.7**	0.5	**1.6**	**3.0**	9	0.5
silver	27.2	0.05	--	**6.5**	**1.9**	8	0.5
thallium	0.54	**11**	--	0.09	**2.5**	13	0.8
vanadium	11	0.2	--	**1.4**	0.04	2	0.1
zinc	1,340	**8.4**	**11**	**29**	**17**	66	4.0
					Total Risk	1,650	100.0

* aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.23 HQs for the Four Terrestrial Receptor Groups at the Mogul Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	4,390	--	--	--	--	--	--
antimony	28.8	**2.6**	0.4	--	**107**	110	3.2
arsenic	72.9	**4.1**	**11**	**1.7**	**1.6**	18	0.5
barium	132	**1.2**	0.4	0.2	0.07	2	0.05
beryllium	0.21	0.08	0.005	--	0.01	0.1	0.003
cadmium	20.7	0.6	0.1	**27**	**58**	85	2.5
chromium	1.6	--	**4.0**	0.06	0.05	4	0.1
cobalt	0.47	0.04	--	0.004	0.002	0.0	0.001
copper	924	**13**	**12**	**33**	**19**	77	2.2
iron	35,600	--	--	--	--	--	--
lead	21,400	**178**	**13**	**1,945**	**382**	2,519	74
manganese	570	**2.6**	**1.3**	0.1	0.1	4	0.1
mercury	0.54	0.02	**11**	**42**	0.3	53	1.5
molybdenum	25	**13**	--	**1.5**	**5.2**	19	0.6
selenium	3.8	**7.3**	0.9	**3.2**	**6.0**	17	0.5
silver	25.1	0.04	--	**6.0**	**1.8**	8	0.2
thallium	0.39	**7.8**	--	0.06	**1.8**	10	0.3
vanadium	10.2	0.2	--	**1.3**	0.04	2	0.04
zinc	10,200	**64**	**85**	**222**	**129**	500	15
					Total Risk	3,426	100.0

* aluminum is retained as a COPEC because both composite soil sample collected at this mine had a pH ≤ 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.24 HQs for the Four Terrestrial Receptor Groups at the Mountain Queen Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	1,920	--	--	--	--	--	--
antimony	332	**30**	**4.3**	--	**1,230**	1,264	18
arsenic	227	**13**	**33**	**5.3**	**4.9**	56	0.8
barium	182	**1.7**	0.6	0.2	0.09	3	0.04
beryllium	0.002	0.0	0.0	--	0.0	0.0	0.00001
cadmium	95.8	**3.0**	0.7	**124**	**266**	394	5.7
chromium	1	--	**2.5**	0.04	0.03	3	0.04
cobalt	0.26	0.02	--	0.002	0.001	0.0	0.0003
copper	664	**9.5**	**8.3**	**24**	**14**	55	0.8
iron	32,000	--	--	--	--	--	--
lead	35,700	**298**	**21**	**3,245**	**638**	4,201	61
manganese	54.3	0.2	0.1	0.01	0.01	0.4	0.0
mercury	1.5	0.04	**30**	**115**	0.9	146	2.1
molybdenum	no data	--	--	--	--	--	--
selenium	32.3	**62**	**7.9**	**27**	**51**	148	2.15
silver	16	0.03	--	**3.8**	**1.1**	5	0.1
thallium	0.0015	0.03	--	0.0	0.007	0.0	0.001
vanadium	5.4	0.09	--	0.7	0.02	0.8	0.01
zinc	12,400	**78**	**103**	**270**	**157**	607	8.8
					Total Risk	6,884	100.0

[*] aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.25 HQs for the Four Terrestrial Receptor Groups at the Natalie/OccidentalMine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	11,200	--	--	--	--	--	--
antimony	2.5	0.2	0.03	**--**	**9.3**	10	3.8
arsenic	35.9	**2.0**	**5.3**	0.8	0.8	9	3.6
barium	67.5	0.6	0.2	0.08	0.03	0.9	0.4
beryllium	0.28	0.1	0.007	**--**	0.01	0.1	0.053
cadmium	0.29	0.009	0.002	0.4	0.8	1	0.5
chromium	6.2	**--**	**16**	0.2	0.2	16	6.4
cobalt	6.7	0.5	**--**	0.06	0.03	0.6	0.2
copper	71.4	**1.0**	0.9	**2.6**	**1.5**	6	2.4
iron	59,800	**--**	**--**	**--**	**--**	--	--
lead	845	**7.0**	0.5	**77**	**15**	99	40
manganese	712	**3.2**	**1.6**	0.2	0.2	5	2.1
mercury	0.18	0.005	**3.6**	**14**	0.1	18	7.1
molybdenum	37.9	**19**	**--**	**2.2**	**7.9**	29	12
selenium	5.3	**10**	**1.3**	**4.4**	**8.4**	24	9.8
silver	12.5	0.02	**--**	**3.0**	0.9	4	1.6
thallium	0.24	**4.8**	**--**	0.04	**1.1**	6	2.4
vanadium	30.5	0.5	**--**	**3.9**	0.1	5	1.8
zinc	310	**1.9**	**2.6**	**6.7**	**3.9**	15	6.1
					Total Risk	248	100.0

* aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.26 HQs for the Four Terrestrial Receptor Groups at the Paradise Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	16,100	--	--	--	--	--	--
antimony	16.8	**1.5**	0.2	**--**	**62**	64	2.9
arsenic	61.5	**3.4**	**9.0**	**1.4**	**1.3**	15	0.7
barium	174	**1.6**	0.5	0.2	0.09	2	0.11
beryllium	0.27	0.1	0.007	**--**	0.01	0.1	0.006
cadmium	0.85	0.03	0.006	**1.1**	**2.4**	3	0.2
chromium	3.8	**--**	**9.5**	0.1	0.1	10	0.4
cobalt	8	0.6	**--**	0.07	0.03	0.7	0.033
copper	38	0.5	0.5	**1.4**	0.8	3	0.1
iron	262,000	**--**	**--**	**--**	**--**	--	--
lead	16,200	**135**	**9.5**	**1,473**	**289**	1,907	87
manganese	1,070	**4.9**	**2.4**	0.2	0.3	8	0.4
mercury	0.52	0.02	**10**	**40**	0.3	51	2.3
molybdenum	15	**7.5**	**--**	0.9	**3.1**	12	0.5
selenium	16.4	**32**	**4.0**	**14**	**26**	75	3.4
silver	26.4	0.05	**--**	**6.3**	**1.9**	8	0.4
thallium	0.27	**5.4**	**--**	0.04	**1.2**	7	0.3
vanadium	34.7	0.6	**--**	**4.4**	0.1	5	0.2
zinc	321	**2.0**	**2.7**	**7.0**	**4.1**	16	0.7
					Total Risk	2,186	100.0

[*] aluminum is retained as a COPEC because all three composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.27 HQs for the Four Terrestrial Receptor Groups at the Pride of the West Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	9,090	--	--	--	--	--	--
antimony	33.7	**3.1**	0.4	--	**125**	128	4.0
arsenic	85.7	**4.8**	**13**	**2.0**	**1.9**	21	0.7
barium	61.8	0.6	0.2	0.08	0.03	0.9	0.03
beryllium	0.97	0.4	0.02	--	0.05	0.5	0.014
cadmium	46.8	**1.5**	0.3	**61**	**130**	193	6.0
chromium	5.4	--	**14**	0.2	0.2	14	0.4
cobalt	10.6	0.8	--	0.09	0.05	0.9	0.030
copper	1,640	**23**	**21**	**59**	**33**	136	4.3
iron	42,700	--	--	--	--	--	--
lead	16,300	**136**	**9.6**	**1,482**	**291**	1,918	60
manganese	5,860	**27**	**13**	**1.4**	**1.5**	42	1.3
mercury	0.27	0.008	**5.4**	**21**	0.2	26	0.8
molybdenum	101	**51**	--	**5.9**	**21**	77	2.4
selenium	3	**5.8**	0.7	**2.5**	**4.8**	14	0.43
silver	50.4	0.09	--	**12**	**3.6**	16	0.5
thallium	0.29	**5.8**	--	0.05	**1.3**	7	0.2
vanadium	14	0.2	--	**1.8**	0.05	2	0.1
zinc	12,100	**76**	**101**	**263**	**153**	593	19
					Total Risk	3,190	100.0

[*] aluminum is not retained as a COPEC because both composite soil samples collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.28 HQs for the Four Terrestrial Receptor Groups at the Red Bonita Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	6,340	--	--	--	--	--	--
antimony	1.1	0.1	0.01	**--**	**4.1**	4	1.3
arsenic	24.8	**1.4**	**3.6**	0.6	0.5	6	1.9
barium	40.6	0.4	0.1	0.05	0.02	0.6	0.17
beryllium	0.59	0.2	0.01	**--**	0.03	0.3	0.086
cadmium	1.3	0.04	0.009	**1.7**	**3.6**	5	1.7
chromium	1.6	**--**	**4.0**	0.06	0.05	4	1.3
cobalt	0.69	0.05	**--**	0.006	0.003	0.1	0.019
copper	104	**1.5**	**1.3**	**3.7**	**2.1**	9	2.7
iron	257,000	**--**	**--**	**--**	**--**	--	--
lead	1,970	**16**	**1.2**	**179**	**35**	232	72
manganese	350	**1.6**	0.8	0.08	0.09	3	0.8
mercury	0.22	0.006	**4.4**	**17**	0.1	21	6.6
molybdenum	6.3	**3.2**	**--**	0.4	**1.3**	5	1.5
selenium	2.1	**4.0**	0.5	**1.8**	**3.3**	10	3.0
silver	3.1	0.006	**--**	0.7	0.2	1.0	0.3
thallium	0.097	**1.9**	**--**	0.02	0.4	2	0.7
vanadium	13.1	0.2	**--**	**1.7**	0.05	2	0.6
zinc	388	**2.4**	**3.2**	**8.4**	**4.9**	19	5.9
					Total Risk	324	100.0

[*] aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.29 HQs for the Four Terrestrial Receptor Groups at the Red Cloud Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	2,440	--	--	--	--	--	--
antimony	209	**19**	**2.7**	**--**	**774**	796	19
arsenic	369	**21**	**54**	**8.6**	**8.0**	91	2.2
barium	300	**2.7**	0.9	0.4	0.2	4	0.10
beryllium	0.12	0.05	0.003	**--**	0.006	0.1	0.001
cadmium	22.1	0.7	0.2	**29**	**61**	91	2.2
chromium	0.8	**--**	**2.0**	0.03	0.02	2	0.05
cobalt	0.31	0.02	**--**	0.003	0.001	0.0	0.001
copper	251	**3.6**	**3.1**	**9.0**	**5.1**	21	0.5
iron	32,700	**--**	**--**	**--**	**--**	--	--
lead	19,100	**159**	**11**	**1,736**	**341**	2,248	54
manganese	43	0.2	0.10	0.01	0.01	0.3	0.01
mercury	3.6	0.1	**72**	**277**	**2.1**	351	8.4
molybdenum	18.3	**9.2**	**--**	**1.1**	**3.8**	14	0.3
selenium	3.7	**7.1**	0.9	**3.1**	**5.9**	17	0.41
silver	34.4	0.06	**--**	**8.2**	**2.5**	11	0.3
thallium	1.5	**30**	**--**	0.2	**6.8**	37	0.9
vanadium	3.3	0.06	**--**	0.4	0.01	0.5	0.01
zinc	10,300	**64**	**86**	**224**	**130**	505	12
					Total Risk	4,188	100.0

[*] aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.30 HQs for the Four Terrestrial Receptor Groups at the Silver Wing Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	1,480	--	--	--	--	--	--
antimony	273	**25**	**3.5**	**--**	**1,011**	1,039	40
arsenic	729	**41**	**107**	**17**	**16**	181	7.0
barium	86.3	0.8	0.3	0.1	0.04	1	0.05
beryllium	0.002	0.0	0.0	**--**	0.0	0.0	0.00004
cadmium	10.5	0.3	0.08	**14**	**29**	43	1.7
chromium	2.7	**--**	**6.8**	0.1	0.08	7	0.3
cobalt	2.2	0.2	**--**	0.02	0.010	0.2	0.008
copper	3,830	**55**	**48**	**137**	**78**	318	12
iron	43,400	**--**	**--**	**--**	**--**	--	--
lead	7,010	**58**	**4.1**	**637**	**125**	825	32
manganese	357	**1.6**	0.8	0.08	0.09	3	0.1
mercury	0.51	0.02	**10**	**39**	0.3	50	1.9
molybdenum	no data	**--**	**--**	**--**	**--**	--	--
selenium	4.3	**8.3**	**1.0**	**3.6**	**6.8**	20	0.76
silver	17.6	0.03	**--**	**4.2**	**1.3**	5	0.2
thallium	0.0015	0.03	**--**	0.0	0.007	0.0	0.0
vanadium	12.4	0.2	**--**	**1.6**	0.04	2	0.1
zinc	1,970	**12**	**16**	**43**	**25**	96	3.7
					Total Risk	2,590	100.0

[*] aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.31 HQs for the Four Terrestrial Receptor Groups at the Sunbank Group Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	6,350	--	--	--	--	--	--
antimony	101	**9.2**	**1.3**	--	**374**	385	39
arsenic	148	**8.2**	**22**	**3.4**	**3.2**	37	3.7
barium	93.4	0.8	0.3	0.1	0.05	1	0.13
beryllium	0.64	0.3	0.02	--	0.03	0.3	0.031
cadmium	2.7	0.08	0.02	**3.5**	**7.5**	11	1.1
chromium	4.9	--	**12**	0.2	0.1	13	1.3
cobalt	21.5	**1.7**	--	0.2	0.09	2	0.196
copper	422	**6.0**	**5.3**	**15**	**8.6**	35	3.6
iron	55,100	--	--	--	--	--	--
lead	2,210	**18**	**1.3**	**201**	**39**	260	27
manganese	8,240	**37**	**18**	**1.9**	**2.1**	60	6.1
mercury	0.24	0.007	**4.8**	**18**	0.1	23	2.4
molybdenum	no data	--	--	--	--	--	--
selenium	0.1	0.2	0.02	0.08	0.2	0.5	0.05
silver	20.3	0.04	--	**4.8**	**1.5**	6	0.6
thallium	4.6	**92**	--	0.7	**21**	114	11.6
vanadium	17.7	0.3	--	**2.3**	0.06	3	0.3
zinc	640	**4.0**	**5.3**	**14**	**8.1**	31	3.2
					Total Risk	981	100.0

[*] aluminum is retained as a COPEC because both composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.32 HQs for the Four Terrestrial Receptor Groups at the Sunnyside Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	9,240	--	--	--	--	--	--
antimony	36.7	**3.3**	0.5	--	**136**	140	3.5
arsenic	64.3	**3.6**	**9.5**	**1.5**	**1.4**	16	0.4
barium	100	0.9	0.3	0.1	0.05	1	0.03
beryllium	0.68	0.3	0.02	--	0.03	0.3	0.008
cadmium	104	**3.3**	0.7	**135**	**289**	428	11
chromium	7.4	--	**19**	0.3	0.2	19	0.5
cobalt	18.9	**1.5**	--	0.2	0.08	2	0.043
copper	1,400	**20**	**18**	**50**	**29**	116	2.9
iron	46,200	--	--	--	--	--	--
lead	17,100	**143**	**10**	**1,555**	**305**	2,012	51
manganese	18,500	**84**	**41**	**4.3**	**4.6**	134	3.4
mercury	0.95	0.03	**19**	**73**	0.6	93	2.3
molybdenum	no data	--	--	--	--	--	--
selenium	1.4	**2.7**	0.3	**1.2**	**2.2**	6	0.16
silver	51.7	0.09	--	**12**	**3.7**	16	0.4
thallium	0.86	**17**	--	0.1	**3.9**	21	0.5
vanadium	25.5	0.4	--	**3.3**	0.09	4	0.1
zinc	19,900	**124**	**166**	**433**	**252**	975	24
					Total Risk	3,984	100.0

[*] aluminum is retained as a COPEC because all three composite soil samples collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.33 HQs for the Four Terrestrial Receptor Groups at the Tom Moore Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	4,690	--	--	--	--	--	--
antimony	14.9	**1.4**	0.2	--	**55**	57	3.8
arsenic	361	**20**	**53**	**8.4**	**7.8**	89	5.9
barium	30.8	0.3	0.09	0.04	0.02	0.4	0.03
beryllium	0.13	0.05	0.003	--	0.006	0.1	0.004
cadmium	7.6	0.2	0.05	**9.9**	**21**	31	2.1
chromium	1.6	--	**4.0**	0.06	0.05	4	0.3
cobalt	0.71	0.05	--	0.006	0.003	0.1	0.004
copper	106	**1.5**	**1.3**	**3.8**	**2.2**	9	0.6
iron	42,400	--	--	--	--	--	--
lead	8,180	**68**	**4.8**	**744**	**146**	963	64
manganese	837	**3.8**	**1.9**	0.2	0.2	6	0.4
mercury	0.14	0.004	**2.8**	**11**	0.08	14	0.9
molybdenum	159	**80**	--	**9.4**	**33**	122	8.1
selenium	1.1	**2.1**	0.3	0.9	**1.7**	5	0.34
silver	10.4	0.02	--	**2.5**	0.7	3	0.2
thallium	1.9	**38**	--	0.3	**8.6**	47	3.1
vanadium	11.4	0.2	--	**1.5**	0.04	2	0.1
zinc	3,080	**19**	**26**	**67**	**39**	151	10
					Total Risk	1,503	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.34 HQs for the Four Terrestrial Receptor Groups at the Vermillion Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	2,610	--	--	--	--	--	--
antimony	20	**1.8**	0.3	**--**	**74**	76	3.7
arsenic	147	**8.2**	**22**	**3.4**	**3.2**	36	1.8
barium	59.3	0.5	0.2	0.07	0.03	0.8	0.04
beryllium	0.16	0.06	0.004	**--**	0.008	0.1	0.004
cadmium	23.8	0.7	0.2	**31**	**66**	98	4.7
chromium	1	**--**	**2.5**	0.04	0.03	3	0.1
cobalt	0.27	0.02	**--**	0.002	0.001	0.0	0.001
copper	213	**3.0**	**2.7**	**7.6**	**4.3**	18	0.9
iron	25,800	**--**	**--**	**--**	**--**	--	--
lead	10,400	**87**	**6.1**	**945**	**186**	1,224	59
manganese	60.4	0.3	0.1	0.01	0.02	0.4	0.02
mercury	1.1	0.03	**22**	**85**	0.6	107	5.2
molybdenum	41.2	**21**	**--**	**2.4**	**8.6**	32	1.5
selenium	2.9	**5.6**	0.7	**2.4**	**4.6**	13	0.64
silver	45.1	0.08	**--**	**11**	**3.2**	14	0.7
thallium	1	**20**	**--**	0.2	**4.5**	25	1.2
vanadium	5.1	0.09	**--**	0.7	0.02	0.8	0.04
zinc	8,520	**53**	**71**	**185**	**108**	417	20
					Total Risk	2,065	100.0

[*] aluminum is not retained as a COPEC because the one composite soil sample collected at this mine had a pH > 5.5
note: an empty space in the HQ columns indicates the lack of a concentration value or ESV
COPEC = contaminant of potential ecological concern
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (2/1/17)

Table 7.1.35 HQs for the Four Terrestrial Receptor Groups at the Yukon Mine
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum*	9,750	--	--	--	--	--	--
antimony	13	**1.2**	0.2	--	**48**	49	5.8
arsenic	51.8	**2.9**	**7.6**	**1.2**	**1.1**	13	1.5
barium	52.3	0.5	0.2	0.06	0.03	0.7	0.08
beryllium	0.083	0.03	0.002	--	0.004	0.0	0.005
cadmium	3.5	0.1	0.03	**4.5**	**9.7**	14	1.7
chromium	3.4	--	**8.5**	0.1	0.1	9	1.0
cobalt	4.2	0.3	--	0.04	0.02	0.4	0.04
copper	2,580	**37**	**32**	**92**	**53**	214	25
iron	69,800	--	--	--	--	--	--
lead	3,160	**26**	**1.9**	**287**	**56**	372	43
manganese	711	**3.2**	**1.6**	0.2	0.2	5	0.6
mercury	0.26	0.008	**5.2**	**20**	0.2	25	3.0
molybdenum	45.8	**23**	--	**2.7**	**9.5**	35	4.1
selenium	13.4	**26**	**3.3**	**11**	**21**	61	7.2
silver	16.3	0.03	--	**3.9**	**1.2**	5	0.6
thallium	0.38	**7.6**	--	0.06	**1.7**	9	1.1
vanadium	23.8	0.4	--	**3.1**	0.09	4	0.4
zinc	844	**5.3**	**7.0**	**18**	**11**	41	4.8
					Total Risk	859	100.0

* aluminum is retained as a COPEC because the one composite soil sample collected at this mine had a pH < 5.5

note: an empty space in the HQ columns indicates the lack of a concentration value or ESV

COPEC = contaminant of potential ecological concern

EPC = exposure point concentration

ESV = ecological screening value

HQ = hazard quotient

shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)

reviewed by: CC (2/1/17)

Table 7.1.36 Risk Ranking of the Mine Sites
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Risk Ranking	NPL Mine Site Name	Total Risk	Top 3 risk drivers						Fraction of total risk (%)[b]
			risk driver 1	ΣHQ[a]	risk driver 2	ΣHQ[a]	risk driver 3	ΣHQ[a]	
HIGHER-RISK EXPOSURE AREAS									
1	Bandora Mine	8,491	zinc	3,272	lead	2,872	antimony	670	80
2	Mountain Queen Mine	6,884	lead	4,201	antimony	1,264	zinc	607	88
3	Clipper Mine	4,802	lead	3,342	zinc	896	antimony	239	93
4	Ben Butler Mine	4,723	lead	2,825	zinc	989	antimony	487	91
5	Koehler Tunnel	4,445	arsenic	3,392	lead	440	mercury	293	93
6	Red Cloud Mine	4,188	lead	2,248	antimony	796	zinc	505	85
7	Sunnyside Mine	3,984	lead	2,012	zinc	975	cadmium	428	86
8	Grand Mogul Mine	3,969	lead	2,342	zinc	877	antimony	251	87
9	Mogul Mine	3,626	lead	2,519	zinc	500	antimony	110	86
10	Pride of the West Mine	3,190	lead	1,918	zinc	593	cadmium	193	85
11	Junction Mine	2,756	lead	1,200	mercury	741	arsenic	426	86
12	Silver Wing Mine	2,590	antimony	1,039	lead	825	copper	318	84
13	Forest Queen Mine	2,558	lead	1,612	manganese	356	zinc	170	84
14	Paradise Mine	2,186	lead	1,907	selenium	75	antimony	64	94
15	London Mine	2,125	lead	666	antimony	590	zinc	474	81
16	Vermillion Mine	2,065	lead	1,224	zinc	417	mercury	107	85
17	Longfellow Mine	1,650	arsenic	782	lead	433	antimony	187	85
18	Anglo Saxon Mine	1,575	lead	1,035	antimony	223	zinc	81	85
19	Boston Mine	1,540	lead	548	antimony	309	zinc	218	70
20	Tom Moore Mine	1,503	lead	963	zinc	151	molybdenum	122	82
21	Howardsville Colo Goldfields Tailings	1,501	lead	774	zinc	165	arsenic	155	73
22	Frisco/Bagley Tunnel	1,367	lead	829	zinc	157	mercury	117	81
23	Henrietta Mine	1,199	lead	789	zinc	212	antimony	49	88
24	Ben Franklin Mine	1,158	lead	797	zinc	141	antimony	48	85
25	Columbus Mine	1,035	lead	713	zinc	86	mercury	72	84
26	Sunbank Group Mine	981	antimony	385	lead	260	thallium	114	77
27	Dewitt Mine	978	lead	687	antimony	90	arsenic	42	84
28	Kittimack Tailings	959	lead	644	zinc	67	copper	62	81
29	Yukon Tunnel (Gold Hub)	859	lead	372	copper	214	selenium	61	75
30	Brooklyn Mine	580	lead	347	antimony	48	zinc	44	76
MODERATE-RISK EXPOSURE AREAS									
31	Gold King Mine	464	lead	330	selenium	22	zinc	20	80
32	Joe and Johns Mine	459	lead	159	arsenic	55	zinc	51	58
33	Red and Bonita Mine	324	lead	232	mercury	21	zinc	19	84
34	Natalie/Occidental Mine	248	lead	99	selenium	24	mercury	18	57
35	Lark Mine	208	lead	59	antimony	28	arsenic	28	55

[a] ΣHQ = sum of the plant, invertebrate, bird and mammal HQs for each risk driver
[b] fraction of total risk = sum ofΣHQ of top 3 risk drivers/total risk
note: none of the mine sites fall into the lower-risk category
higher-risk sites: total risk > 500
moderate-risk sites: total risk between 200 and 500
lower-risk sites: total risk < 200

prepared by: SJP 2/7/17
reviewed by:

Table 7.2.1 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-01
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	17,200	--	--	--	--	--	--
antimony	9.9	0.9	0.1	**--**	**37**	38	11.8
arsenic	45.4	**2.5**	**6.7**	**1.1**	1.0	11	3.5
barium	167	**1.5**	0.5	0.2	0.08	2	0.7
beryllium	0.55	0.2	0.01		0.03	0.3	0.1
cadmium	4.0	0.1	0.03	**5.2**	**11**	16	5.1
chromium	7.7	**--**	**19**	0.3	0.2	20	6.2
cobalt	12.5	1.0	**--**	0.1	0.05	1	0.4
copper	356	**5.1**	**4.5**	**13**	**7.3**	30	9.2
iron	132,000	**--**	**--**	**--**	**--**	--	--
lead	673	**5.6**	0.4	**61**	**12**	79	24.8
manganese	2130	**9.7**	**4.7**	0.5	0.5	15	4.8
mercury	0.37	0.01	**7.4**	**28**	0.2	36	11.3
molybdenum	4.8	**2.4**	**--**	0.3	**1.0**	4	1.2
nickel	6.1	0.2	0.02	0.03	0.05	0.3	0.1
selenium	3.0	**5.8**	0.7	**2.5**	**4.8**	14	4.3
silver	3.9	0.007	**--**	0.9	0.3	1	0.4
thallium	0.029	0.6	**--**	0.005	0.1	0.7	0.2
vanadium	76.1	**1.3**	**--**	**9.8**	0.3	11	3.5
zinc	816	**5.1**	**6.8**	**18**	**10**	40	12.5
					Total Risk	320	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.2 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-02
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	12,300	--	--	--	--	--	--
antimony	0.74	0.07	0.009	--	**2.7**	3	2.6
arsenic	27	**1.5**	**4.0**	0.6	0.6	7	6.1
barium	202	**1.8**	0.6	0.2	0.1	3	2.6
beryllium	0.24	0.10	0.006	--	0.01	0.1	0.1
cadmium	1.6	0.05	0.01	**2.1**	**4.4**	7	6.0
chromium	3.5	--	**8.8**	0.1	0.1	9	8.2
cobalt	6.6	0.5	--	0.06	0.03	0.6	0.5
copper	46.8	0.7	0.6	**1.7**	1.0	4	3.5
iron	54,900	--	--	--	--	--	--
lead	270	**2.3**	0.2	**25**	**4.8**	32	29.0
manganese	705	**3.2**	**1.6**	0.2	0.2	5	4.7
mercury	0.03	0.0	0.6	**2.3**	0.02	3	2.7
molybdenum	5.6	**2.8**	--	0.3	**1.2**	4	3.9
nickel	2.2	0.06	0.008	0.01	0.02	0.1	0.1
selenium	1.7	**3.3**	0.4	**1.4**	**2.7**	8	7.1
silver	0.0165	0.00003	--	0.004	0.001	0.0	0.005
thallium	0.023	0.5	--	0.004	0.1	0.6	0.5
vanadium	17.6	0.3	--	**2.3**	0.06	3	2.4
zinc	446	**2.8**	**3.7**	**9.7**	**5.6**	22	20.0
					Total Risk	109	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.3 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-03
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	14,100	--	--	--	--	--	--
antimony	0.035	0.003	0.0004	--	0.1	0.1	0.04
arsenic	70.9	**3.9**	**10**	**1.6**	**1.5**	18	5.6
barium	227	**2.1**	0.7	0.3	0.1	3	1.0
beryllium	0.047	0.02	0.001	--	0.002	0.0	0.01
cadmium	2.3	0.07	0.02	**3.0**	**6.4**	9	3.0
chromium	12	--	**30**	0.5	0.4	31	9.8
cobalt	11.6	0.9	--	0.10	0.05	1	0.3
copper	127	**1.8**	**1.6**	**4.5**	**2.6**	11	3.4
iron	317,000	--	--	--	--	--	--
lead	1,040	**8.7**	0.6	**95**	**19**	122	39.0
manganese	8,120	**37**	**18**	**1.9**	**2.0**	59	18.7
mercury	0.15	0.004	**3.0**	**12**	0.09	15	4.7
molybdenum	2.7	**1.4**	--	0.2	0.6	2	0.7
nickel	5.8	0.2	0.02	0.03	0.04	0.2	0.1
selenium	2.0	**3.8**	0.5	**1.7**	**3.2**	9	2.9
silver	2.5	0.004	--	0.6	0.2	0.8	0.2
thallium	0.0445	0.9	--	0.007	0.2	1	0.3
vanadium	26.6	0.4	--	**3.4**	0.10	4	1.3
zinc	577	**3.6**	**4.8**	**13**	**7.3**	28	9.0
					Total Risk	314	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/7/17)

Table 7.2.4 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-3.5
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	22,600	--	--	--	--	--	--
antimony	3.5	0.3	0.04	--	**13**	13	2.0
arsenic	103	**5.7**	**15**	**2.4**	**2.2**	26	3.8
barium	170	**1.5**	0.5	0.2	0.09	2	0.4
beryllium	0.27	0.1	0.007	--	0.01	0.1	0.02
cadmium	1.9	0.06	0.01	**2.5**	**5.3**	8	1.2
chromium	10.5	--	**26**	0.4	0.3	27	4.0
cobalt	19.1	**1.5**	--	0.2	0.08	2	0.3
copper	99.2	**1.4**	**1.2**	**3.5**	**2.0**	8	1.2
iron	56,200	--	--	--	--	--	--
lead	3,370	**28**	**2.0**	**306**	**60**	397	59.2
manganese	3,520	**16**	**7.8**	0.8	0.9	26	3.8
mercury	1.2	0.04	**24**	**92**	0.7	117	17.5
molybdenum	3.8	**1.9**	--	0.2	0.8	3	0.4
nickel	12.3	0.3	0.04	0.06	0.09	0.5	0.1
selenium	2.1	**4.0**	0.5	**1.8**	**3.3**	10	1.4
silver	18.2	0.03	--	**4.3**	**1.3**	6	0.8
thallium	0.0255	0.5	--	0.004	0.1	0.6	0.1
vanadium	27.1	0.5	--	**3.5**	0.10	4	0.6
zinc	446	**2.8**	**3.7**	**9.7**	**5.6**	22	3.3
					Total Risk	670	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.5 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-04
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	20,400	--	--	--	--	--	--
antimony	2.5	0.2	0.03	--	**9.3**	10	1.3
arsenic	831	**46**	**122**	**19**	**18**	206	27.3
barium	183	**1.7**	0.6	0.2	0.09	3	0.3
beryllium	0.78	0.3	0.02	--	0.04	0.4	0.05
cadmium	3.7	0.1	0.03	**4.8**	**10**	15	2.0
chromium	7.4	--	**19**	0.3	0.2	19	2.5
cobalt	17.7	**1.4**	--	0.1	0.08	2	0.2
copper	967	**14**	**12**	**35**	**20**	80	10.6
iron	85,000	--	--	--	--	--	--
lead	1,960	**16**	**1.2**	**178**	**35**	231	30.5
manganese	1,710	**7.8**	**3.8**	0.4	0.4	12	1.6
mercury	0.67	0.02	**13**	**52**	0.4	65	8.7
molybdenum	2.5	**1.3**	--	0.1	0.5	2	0.3
nickel	12.9	0.3	0.05	0.06	0	0.5	0.1
selenium	2.6	**5.0**	0.6	**2.2**	**4.1**	12	1.6
silver	4.7	0.008	--	**1.1**	0.3	1	0.2
thallium	0.0325	0.7	--	0.005	0.1	0.8	0.1
vanadium	25.1	0.4	--	**3.2**	0.09	4	0.5
zinc	1,880	**12**	**16**	**41**	**24**	92	12.2
					Total Risk	755	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.6 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-05
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	21,300	--	--	--	--	--	--
antimony	0.85	0.08	0.01	--	**3.1**	3	0.7
arsenic	27.9	**1.6**	**4.1**	0.6	0.6	7	1.4
barium	165	**1.5**	0.5	0.2	0.08	2	0.5
beryllium	0.79	0.3	0.02	--	0.04	0.4	0.08
cadmium	21.1	0.7	0.2	**27**	**59**	87	17.9
chromium	6.7	--	**17**	0.3	0.2	17	3.5
cobalt	11.1	0.9	--	0.09	0.05	1.0	0.2
copper	197	**2.8**	**2.5**	**7.0**	**4.0**	16	3.4
iron	167,000	--	--	--	--	--	--
lead	349	**2.9**	0.2	**32**	**6.2**	41	8.4
manganese	6,020	**27**	**13**	**1.4**	**1.5**	44	9.0
mercury	0.23	0.007	**4.6**	**18**	0.1	22	4.6
molybdenum	3.8	**1.9**	--	0.2	0.8	3	0.6
nickel	10.2	0.3	0.04	0.05	0.08	0.4	0.1
selenium	6.6	**13**	**1.6**	**5.5**	**10**	30	6.2
silver	1.6	0.003	--	0.4	0.1	0.5	0.1
thallium	0.0385	0.8	--	0.006	0.2	1.0	0.2
vanadium	54.7	0.9	--	**7.0**	0.2	8	1.7
zinc	4,120	**26**	**34**	**90**	**52**	202	41.5
					Total Risk	486	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.7 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-06
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	24,400	--	--	--	--	--	--
antimony	0.89	0.08	0.01	--	**3.3**	3	1.8
arsenic	26.4	**1.5**	**3.9**	0.6	0.6	7	3.5
barium	225	**2.0**	0.7	0.3	0.1	3	1.7
beryllium	1.4	0.6	0.04	--	0.07	0.7	0.4
cadmium	1.1	0.03	0.008	**1.4**	**3.1**	5	2.4
chromium	5.0	--	**13**	0.2	0.1	13	6.9
cobalt	69.8	**5.4**	--	0.6	0.3	6	3.4
copper	21.2	0.3	0.3	0.8	0.4	2	0.9
iron	118,000	--	--	--	--	--	--
lead	174	**1.5**	0.1	**16**	**3.1**	20	11.1
manganese	5,780	**26**	**13**	**1.3**	**1.4**	42	22.6
mercury	0.077	0.002	**1.5**	**5.9**	0.05	8	4.1
molybdenum	18.8	**9.4**	--	**1.1**	**3.9**	14	7.8
nickel	9.9	0.3	0.04	0.05	0.08	0.4	0.2
selenium	7.0	**13**	**1.7**	**5.8**	**11**	32	17.3
silver	1.2	0.002	--	0.3	0.09	0.4	0.2
thallium	0.048	1.0	--	0.008	0.2	1	0.6
vanadium	44.3	0.7	--	**5.7**	0.2	7	3.6
zinc	430	**2.7**	**3.6**	**9.3**	**5.4**	21	11.4
					Total Risk	185	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.8 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-07
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	19,000	--	--	--	--	--	--
antimony	0.0175	0.002	0.0	--	0.06	0.1	0.04
arsenic	15	0.8	**2.2**	0.3	0.3	4	2.1
barium	92.7	0.8	0.3	0.1	0.05	1	0.7
beryllium	1.2	0.5	0.03	--	0.06	0.6	0.33
cadmium	2.5	0.08	0.02	**3.2**	**6.9**	10	5.9
chromium	8.8	--	**22**	0.3	0.3	23	13.0
cobalt	25.1	**1.9**	--	0.2	0.1	2	1.3
copper	130	**1.9**	**1.6**	**4.6**	**2.7**	11	6.2
iron	41,200	--	--	--	--	--	--
lead	508	**4.2**	0.3	**46**	**9.1**	60	34.4
manganese	1,810	**8.2**	**4.0**	0.4	0.5	13	7.5
mercury	0.041	0.001	0.8	**3.2**	0.02	4	2.3
molybdenum	6.3	**3.2**	--	0.4	**1.3**	5	2.8
nickel	9.7	0.3	0.03	0.05	0.07	0.4	0.2
selenium	1.6	**3.1**	0.4	**1.3**	**2.5**	7	4.2
silver	1.3	0.002	--	0.3	0.09	0.4	0.2
thallium	0.022	0.4	--	0.003	0.1	0.5	0.3
vanadium	31.4	0.5	--	**4.0**	0.1	5	2.7
zinc	559	**3.5**	**4.7**	**12**	**7.1**	27	15.7
					Total Risk	174	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.9 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-08
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	13,000	--	--	--	--	--	--
antimony	3.8	0.3	0.05	--	**14**	14	4.4
arsenic	23.4	**1.3**	**3.4**	0.5	0.5	6	1.8
barium	115	**1.0**	0.3	0.1	0.06	2	0.5
beryllium	0.0245	0.010	0.0	--	0.001	0.0	0.004
cadmium	2.2	0.07	0.02	**2.9**	**6.1**	9	2.7
chromium	4.8	--	**12**	0.2	0.1	12	3.7
cobalt	9.3	0.7	--	0.08	0.04	0.8	0.3
copper	105	**1.5**	**1.3**	**3.8**	**2.1**	9	2.6
iron	30,200	--	--	--	--	--	--
lead	1,760	**15**	**1.0**	**160**	**31**	207	62.7
manganese	2,210	**10**	**4.9**	0.5	0.6	16	4.8
mercury	0.015	0.0	0.3	**1.2**	0.009	1	0.4
molybdenum	7.1	**3.6**	--	0.4	**1.5**	5	1.6
nickel	3.9	0.1	0.01	0.02	0.03	0.2	0.05
selenium	1.9	**3.7**	0.5	**1.6**	**3.0**	9	2.6
silver	2.4	0.004	--	0.6	0.2	0.7	0.2
thallium	0.023	0.5	--	0.004	0.1	0.6	0.2
vanadium	32.1	0.5	--	**4.1**	0.1	5	1.4
zinc	665	**4.2**	**5.5**	**14**	**8.4**	33	9.9
					Total Risk	330	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.10 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-09
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	10,700	--	--	--	--	--	--
antimony	2.7	0.2	0.03	--	**10**	10	1.8
arsenic	26.7	**1.5**	**3.9**	0.6	0.6	7	1.2
barium	104	0.9	0.3	0.1	0.05	1	0.3
beryllium	1.7	0.7	0.04	--	0.08	0.8	0.1
cadmium	10.8	0.3	0.08	**14**	**30**	44	7.9
chromium	3.6	--	**9.0**	0.1	0.1	9	1.6
cobalt	11.2	0.9	--	0.09	0.05	1	0.2
copper	331	**4.7**	**4.1**	**12**	**6.8**	27	4.9
iron	30,000	--	--	--	--	--	--
lead	1,860	**16**	**1.1**	**169**	**33**	219	39.0
manganese	12,200	**55**	**27**	**2.8**	**3.1**	88	15.8
mercury	0.049	0.001	1.0	**3.8**	0.03	5	0.9
molybdenum	6.6	**3.3**	--	0.4	**1.4**	5	0.9
nickel	6.5	0.2	0.02	0.03	0.05	0.3	0.05
selenium	1.6	**3.1**	0.4	**1.3**	**2.5**	7	1.3
silver	4.9	0.009	--	**1.2**	0.4	2	0.3
thallium	0.022	0.4	--	0.003	0.1	0.5	0.1
vanadium	18.9	0.3	--	**2.4**	0.07	3	0.5
zinc	2,660	**17**	**22**	**58**	**34**	130	23.2
					Total Risk	561	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.11 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-10
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	13,800	--	--	--	--	--	--
antimony	26.5	**2.4**	0.3	--	**98**	101	5.0
arsenic	51	**2.8**	**7.5**	**1.2**	**1.1**	13	0.6
barium	164	**1.5**	0.5	0.2	0.08	2	0.1
beryllium	1.7	0.7	0.04	--	0.08	0.8	0.04
cadmium	10.2	0.3	0.07	**13**	**28**	42	2.1
chromium	4.8	--	**12**	0.2	0.1	12	0.6
cobalt	12.1	0.9	--	0.1	0.05	1	0.1
copper	879	**13**	**11**	**31**	**18**	73	3.6
iron	31,000	--	--	--	--	--	--
lead	10,500	**88**	**6.2**	**955**	**188**	1,236	61.1
manganese	43,000	**195**	**96**	**10**	**11**	312	15.4
mercury	0.67	0.02	**13**	**52**	0.4	65	3.2
molybdenum	18.1	**9.1**	--	**1.1**	**3.8**	14	0.7
nickel	7.6	0.2	0.03	0.04	0.06	0.3	0.02
selenium	2.2	**4.2**	0.5	**1.8**	**3.5**	10	0.5
silver	47.9	0.09	--	**11**	**3.4**	15	0.7
thallium	0.026	0.5	--	0.004	0.1	0.6	0.03
vanadium	16.8	0.3	--	**2.2**	0.06	2	0.1
zinc	2,530	**16**	**21**	**55**	**32**	124	6.1
					Total Risk	2,024	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.12 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-11
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	11,100	--	--	--	--	--	--
antimony	0.016	0.001	0.0	--	0.06	0.1	0.1
arsenic	24.5	**1.4**	**3.6**	0.6	0.5	6	6.1
barium	72.3	0.7	0.2	0.09	0.04	1	1.0
beryllium	0.48	0.2	0.01	--	0.02	0.2	0.2
cadmium	0.64	0.02	0.005	0.8	**1.8**	3	2.6
chromium	8.0	--	**20**	0.3	0.2	21	20.6
cobalt	10.6	0.8	--	0.09	0.05	0.9	1.0
copper	74.5	**1.1**	0.9	**2.7**	**1.5**	6	6.2
iron	52,000	--	--	--	--	--	--
lead	164	**1.4**	0.10	**15**	**2.9**	19	19.3
manganese	1,250	**5.7**	**2.8**	0.3	0.3	9	9.1
mercury	0.0096	0.0	0.2	0.7	0.006	0.9	0.9
molybdenum	5.4	**2.7**	--	0.3	**1.1**	4	4.2
nickel	6.1	0.2	0.02	0.03	0.05	0.3	0.3
selenium	2.5	**4.8**	0.6	**2.1**	**4.0**	11	11.5
silver	0.85	0.002	--	0.2	0.06	0.3	0.3
thallium	0.0205	0.4	--	0.003	0.09	0.5	0.5
vanadium	27.4	0.5	--	**3.5**	0.10	4	4.1
zinc	247	**1.5**	**2.1**	**5.4**	**3.1**	12	12.1
					Total Risk	100	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.13 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-12
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	23,500	--	--	--	--	--	--
antimony	2.9	0.3	0.04	--	**11**	11	1.5
arsenic	42.4	**2.4**	**6.2**	1.0	0.9	10	1.4
barium	223	**2.0**	0.7	0.3	0.1	3	0.4
beryllium	1.8	0.7	0.05	--	0.09	0.9	0.1
cadmium	20.8	0.7	0.1	**27**	**58**	86	11.3
chromium	9.7	--	**24**	0.4	0.3	25	3.3
cobalt	20	**1.5**	--	0.2	0.09	2	0.2
copper	571	**8.2**	**7.1**	**20**	**12**	47	6.3
iron	67,000	--	--	--	--	--	--
lead	1,770	**15**	**1.0**	**161**	**32**	208	27.5
manganese	15,100	**69**	**34**	**3.5**	**3.8**	109	14.5
mercury	0.32	0.009	**6.4**	**25**	0.2	31	4.1
molybdenum	9.5	**4.8**	--	0.6	**2.0**	7	1.0
nickel	15.9	0.4	0.06	0.08	0.1	0.7	0.1
selenium	5.2	**10**	**1.3**	**4.3**	**8.3**	24	3.2
silver	7.6	0.01	--	**1.8**	0.5	2	0.3
thallium	0.03	0.6	--	0.005	0.1	0.7	0.1
vanadium	46	0.8	--	**5.9**	0.2	7	0.9
zinc	3,690	**23**	**31**	**80**	**47**	181	23.9
					Total Risk	757	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.14 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-13
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	15,800	--	--	--	--	--	--
antimony	10.1	0.9	0.1	--	**37**	38	3.1
arsenic	38.6	**2.1**	**5.7**	0.9	0.8	10	0.8
barium	140	**1.3**	0.4	0.2	0.07	2	0.2
beryllium	0.97	0.4	0.02	--	0.05	0.5	0.04
cadmium	14.8	0.5	0.1	**19**	**41**	61	5.0
chromium	27	--	**68**	**1.0**	0.8	69	5.7
cobalt	20.8	**1.6**	--	0.2	0.09	2	0.2
copper	485	**6.9**	**6.1**	**17**	**9.9**	40	3.3
iron	95,800	--	--	--	--	--	--
lead	4,390	**37**	**2.6**	**399**	**78**	517	42.3
manganese	11,100	**50**	**25**	**2.6**	**2.8**	80	6.6
mercury	1.9	0.06	**38**	**146**	**1.1**	185	15.2
molybdenum	7.4	**3.7**	--	0.4	**1.5**	6	0.5
nickel	63.7	**1.7**	0.2	0.3	0.5	3	0.2
selenium	3.2	**6.2**	0.8	**2.7**	**5.1**	15	1.2
silver	11.9	0.02	--	**2.8**	0.9	4	0.3
thallium	0.0235	0.5	--	0.004	0.1	0.6	0.05
vanadium	29.7	0.5	--	**3.8**	0.1	4	0.4
zinc	3,770	**24**	**31**	**82**	**48**	185	15.1
					Total Risk	1,222	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.15 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-14
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	12,100	--	--	--	--	--	--
antimony	9.6	0.9	0.1	--	**36**	37	6.6
arsenic	93.8	**5.2**	**14**	**2.2**	**2.0**	23	4.2
barium	75.6	0.7	0.2	0.09	0.04	1	0.2
beryllium	2.0	0.8	0.05	--	0.10	0.9	0.2
cadmium	10.9	0.3	0.08	**14**	**30**	45	8.0
chromium	4.9	--	**12**	0.2	0.1	13	2.3
cobalt	10.9	0.8	--	0.09	0.05	1.0	0.2
copper	405	**5.8**	**5.1**	**14**	**8.3**	34	6.0
iron	25,800	--	--	--	--	--	--
lead	1,250	**10**	0.7	**114**	**22**	147	26.4
manganese	10,200	**46**	**23**	**2.4**	**2.6**	74	13.3
mercury	0.56	0.02	**11**	**43**	0.3	55	9.8
molybdenum	7.4	**3.7**	--	0.4	**1.5**	6	1.0
nickel	6.8	0.2	0.02	0.03	0.05	0.3	0.05
selenium	2.1	**4.0**	0.5	**1.8**	**3.3**	10	1.7
silver	3.7	0.007	--	0.9	0.3	1	0.2
thallium	0.0245	0.5	--	0.004	0.1	0.6	0.1
vanadium	21.5	0.4	--	**2.8**	0.08	3	0.6
zinc	2,190	**14**	**18**	**48**	**28**	107	19.2
					Total Risk	557	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.16 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-15
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	16,900	--	--	--	--	--	--
antimony	6.1	0.6	0.08	--	**23**	23	0.6
arsenic	176	**9.8**	**26**	**4.1**	**3.8**	44	1.0
barium	357	**3.2**	**1.1**	0.4	0.2	5	0.1
beryllium	9.0	**3.6**	0.2	--	0.4	4	0.1
cadmium	216	**6.8**	**1.5**	**281**	**600**	889	21.3
chromium	6.4	--	**16**	0.2	0.2	16	0.4
cobalt	63.6	**4.9**	--	0.5	0.3	6	0.1
copper	2,890	**41**	**36**	**103**	**59**	240	5.7
iron	69,700	--	--	--	--	--	--
lead	6,000	**50**	**3.5**	**545**	**107**	706	16.9
manganese	55,900	**254**	**124**	**13**	**14**	405	9.7
mercury	2.6	0.08	**52**	**200**	**1.5**	254	6.1
molybdenum	81.8	**41**	--	**4.8**	**17**	63	1.5
nickel	53.1	**1.4**	0.2	0.3	0.4	2	0.1
selenium	5.9	**11**	**1.4**	**4.9**	**9.4**	27	0.6
silver	21.8	0.04	--	**5.2**	**1.6**	7	0.2
thallium	0.055	**1.1**	--	0.009	0.3	1	0.03
vanadium	27.1	0.5	--	**3.5**	0.10	4	0.1
zinc	30,200	**189**	**252**	**657**	**382**	1,479	35.4
					Total Risk	4,175	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.17: HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-16
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	21,200	--	--	--	--	--	--
antimony	5.8	0.5	0.07	--	**21**	22	2.5
arsenic	79.3	**4.4**	**12**	**1.8**	**1.7**	20	2.2
barium	169	**1.5**	0.5	0.2	0.08	2	0.3
beryllium	2.8	**1.1**	0.07	--	0.1	1	0.1
cadmium	9.8	0.3	0.07	**13**	**27**	40	4.5
chromium	6.7	--	**17**	0.3	0.2	17	1.9
cobalt	13.4	**1.0**	--	0.1	0.06	1	0.1
copper	518	**7.4**	**6.5**	**19**	**11**	43	4.8
iron	37,000	--	--	--	--	--	--
lead	3,390	**28**	**2.0**	**308**	**61**	399	44.4
manganese	19,600	**89**	**44**	**4.6**	**4.9**	142	15.8
mercury	0.86	0.03	**17**	**66**	0.5	84	9.3
molybdenum	7.8	**3.9**	--	0.5	**1.6**	6	0.7
nickel	6.5	0.2	0.02	0.03	0.05	0.3	0.03
selenium	3.4	**6.5**	0.8	**2.8**	**5.4**	16	1.7
silver	10.4	0.02	--	**2.5**	0.7	3	0.4
thallium	0.79	**16**	--	0.1	**3.6**	20	2.2
vanadium	21.4	0.4	--	**2.7**	0.08	3	0.4
zinc	1,600	**10**	**13**	**35**	**20**	78	8.7
					Total Risk	898	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.18 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-17
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	25,400	--	--	--	--	--	--
antimony	0.0235	0.002	0.0	--	0.09	0.1	0.05
arsenic	31.4	**1.7**	**4.6**	0.7	0.7	8	4.3
barium	57.5	0.5	0.2	0.07	0.03	0.8	0.4
beryllium	6.1	**2.4**	0.2	--	0.3	3	1.6
cadmium	1.6	0.05	0.01	**2.1**	**4.4**	7	3.6
chromium	5.9	--	**15**	0.2	0.2	15	8.3
cobalt	15.2	**1.2**	--	0.1	0.07	1	0.7
copper	156	**2.2**	**2.0**	**5.6**	**3.2**	13	7.1
iron	40,100	--	--	--	--	--	--
lead	162	**1.4**	0.10	**15**	**2.9**	19	10.5
manganese	7,020	**32**	**16**	**1.6**	**1.8**	51	27.9
mercury	0.038	0.001	0.8	**2.9**	0.02	4	2.0
molybdenum	4.7	**2.4**	--	0.3	1.0	4	2.0
nickel	7.4	0.2	0.03	0.04	0.06	0.3	0.2
selenium	2.5	**4.8**	0.6	**2.1**	**4.0**	11	6.3
silver	0.75	0.001	--	0.2	0.05	0.2	0.1
thallium	0.03	0.6	--	0.005	0.1	0.7	0.4
vanadium	32.5	0.5	--	**4.2**	0.1	5	2.6
zinc	813	**5.1**	**6.8**	**18**	**10**	40	21.8
					Total Risk	182	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.19 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-18
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	18,600	--	--	--	--	--	--
antimony	0.67	0.06	0.009	--	**2.5**	3	1.7
arsenic	34.9	**1.9**	**5.1**	0.8	0.8	9	5.9
barium	98.9	0.9	0.3	0.1	0.05	1	0.9
beryllium	0.66	0.3	0.02	--	0.03	0.3	0.21
cadmium	2.0	0.06	0.01	**2.6**	**5.6**	8	5.6
chromium	12	--	**30**	0.5	0.4	31	20.9
cobalt	6.5	0.5	--	0.05	0.03	0.6	0.4
copper	28.6	0.4	0.4	**1.0**	0.6	2	1.6
iron	24,200	--	--	--	--	--	--
lead	276	**2.3**	0.2	**25**	**4.9**	32	22.1
manganese	2,660	**12**	**5.9**	0.6	0.7	19	13.1
mercury	0.046	0.001	0.9	**3.5**	0.03	4	3.0
molybdenum	4.7	**2.4**	--	0.3	1.0	4	2.4
nickel	5.5	0.1	0.02	0.03	0.04	0.2	0.2
selenium	1.6	**3.1**	0.4	**1.3**	**2.5**	7	5.0
silver	1.3	0.002	--	0.3	0.09	0.4	0.3
thallium	0.029	0.6	--	0.005	0.1	0.7	0.5
vanadium	19	0.3	--	**2.4**	0.07	3	1.9
zinc	430	**2.7**	**3.6**	**9.3**	**5.4**	21	14.3
					Total Risk	147	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.20 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-19
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	48,300	--	--	--	--	--	--
antimony	7.6	0.7	0.10	--	**28**	29	4.5
arsenic	115	**6.4**	**17**	**2.7**	**2.5**	28	4.4
barium	94.8	0.9	0.3	0.1	0.05	1	0.2
beryllium	3.3	**1.3**	0.08	--	0.2	2	0.24
cadmium	15.2	0.5	0.1	**20**	**42**	63	9.6
chromium	6.6	--	**17**	0.3	0.2	17	2.6
cobalt	46	**3.5**	--	0.4	0.2	4	0.6
copper	325	**4.6**	**4.1**	**12**	**6.6**	27	4.1
iron	106,000	--	--	--	--	--	--
lead	1,490	**12**	0.9	**135**	**27**	175	27.0
manganese	14,400	**65**	**32**	**3.3**	**3.6**	104	16.1
mercury	0.14	0.004	**2.8**	**11**	0.08	14	2.1
molybdenum	39.6	**20**	--	**2.3**	**8.3**	30	4.7
nickel	8.9	0.2	0.03	0.04	0.07	0.4	0.1
selenium	3.5	**6.7**	0.9	**2.9**	**5.6**	16	2.5
silver	6.6	0.01	--	**1.6**	0.5	2	0.3
thallium	3.3	**66**	--	0.5	**15**	82	12.5
vanadium	19.6	0.3	--	**2.5**	0.07	3	0.4
zinc	1,070	**6.7**	**8.9**	**23**	**14**	52	8.1
					Total Risk	650	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.21 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-20
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	14,800	--	--	--	--	--	--
antimony	5.7	0.5	0.07	--	**21**	22	5.7
arsenic	73.5	**4.1**	**11**	**1.7**	**1.6**	18	4.8
barium	153	**1.4**	0.5	0.2	0.08	2	0.6
beryllium	0.3	0.1	0.008	--	0.01	0.1	0.04
cadmium	3.7	0.1	0.03	**4.8**	**10**	15	4.0
chromium	9.2	--	**23**	0.4	0.3	24	6.2
cobalt	8.8	0.7	--	0.07	0.04	0.8	0.2
copper	163	**2.3**	**2.0**	**5.8**	**3.3**	14	3.6
iron	70,500	--	--	--	--	--	--
lead	1,480	**12**	0.9	**135**	**26**	174	46.0
manganese	1,150	**5.2**	**2.6**	0.3	0.3	8	2.2
mercury	0.29	0.009	**5.8**	**22**	0.2	28	7.5
molybdenum	4.9	**2.5**	--	0.3	**1.0**	4	1.0
nickel	6.5	0.2	0.02	0.03	0.05	0.3	0.1
selenium	3.8	**7.3**	0.9	**3.2**	**6.0**	17	4.6
silver	5.1	0.009	--	**1.2**	0.4	2	0.4
thallium	0.0415	0.8	--	0.007	0.2	1	0.3
vanadium	30.7	0.5	--	**3.9**	0.1	5	1.2
zinc	904	**5.7**	**7.5**	**20**	**11**	44	11.7
					Total Risk	379	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.22 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-21
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	10,700	--	--	--	--	--	--
antimony	9.0	0.8	0.1	--	**33**	34	13.3
arsenic	91	**5.1**	**13**	**2.1**	**2.0**	23	8.8
barium	268	**2.4**	0.8	0.3	0.1	4	1.4
beryllium	0.19	0.08	0.005	--	0.009	0.1	0.03
cadmium	3.5	0.1	0.03	**4.5**	**9.7**	14	5.6
chromium	5.6	--	**14**	0.2	0.2	14	5.6
cobalt	8.7	0.7	--	0.07	0.04	0.8	0.3
copper	67.2	1.0	0.8	**2.4**	**1.4**	6	2.2
iron	46,500	--	--	--	--	--	--
lead	617	**5.1**	0.4	**56**	**11**	73	28.3
manganese	360	**1.6**	0.8	0.08	0.09	3	1.0
mercury	0.14	0.004	**2.8**	**11**	0.08	14	5.3
molybdenum	4.5	**2.3**	--	0.3	0.9	3	1.3
nickel	4.5	0.1	0.02	0.02	0.03	0.2	0.1
selenium	4.0	**7.7**	1.0	**3.3**	**6.3**	18	7.1
silver	5.8	0.01	--	**1.4**	0.4	2	0.7
thallium	0.024	0.5	--	0.004	0.1	0.6	0.2
vanadium	27.2	0.5	--	**3.5**	0.10	4	1.6
zinc	898	**5.6**	**7.5**	**20**	**11**	44	17.1
					Total Risk	257	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.23 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-22
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	12,500	--	--	--	--	--	--
antimony	7.4	0.7	0.09	--	**27**	28	4.2
arsenic	53.5	**3.0**	**7.9**	**1.2**	**1.2**	13	2.0
barium	87.4	0.8	0.3	0.1	0.04	1	0.2
beryllium	1.1	0.4	0.03	--	0.05	0.5	0.08
cadmium	4.7	0.1	0.03	**6.1**	**13**	19	2.9
chromium	7.1	--	**18**	0.3	0.2	18	2.7
cobalt	13.2	**1.0**	--	0.1	0.06	1	0.2
copper	156	**2.2**	**2.0**	**5.6**	**3.2**	13	1.9
iron	292,000	--	--	--	--	--	--
lead	2,070	**17**	**1.2**	**188**	**37**	244	36.7
manganese	2,470	**11**	**5.5**	0.6	0.6	18	2.7
mercury	0.14	0.004	**2.8**	**11**	0.08	14	2.1
molybdenum	7.2	**3.6**	--	0.4	**1.5**	6	0.8
nickel	7.0	0.2	0.03	0.03	0.05	0.3	0.0
selenium	4.7	**9.0**	**1.1**	**3.9**	**7.5**	22	3.2
silver	3.8	0.007	--	0.9	0.3	1	0.2
thallium	0.0275	0.6	--	0.004	0.1	0.7	0.1
vanadium	37.4	0.6	--	**4.8**	0.1	6	0.8
zinc	5,300	**33**	**44**	**115**	**67**	260	39.1
					Total Risk	664	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.24 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-23
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	11,600	--	--	--	--	--	--
antimony	3.2	0.3	0.04	--	**12**	12	8.8
arsenic	26.3	**1.5**	**3.9**	0.6	0.6	7	4.7
barium	79.3	0.7	0.2	0.10	0.04	1	0.8
beryllium	0.12	0.05	0.003	--	0.006	0.1	0.04
cadmium	0.026	0.0	0.0	0.03	0.07	0.1	0.1
chromium	4.5	--	**11**	0.2	0.1	12	8.3
cobalt	4.8	0.4	--	0.04	0.02	0.4	0.3
copper	43.9	0.6	0.5	**1.6**	0.9	4	2.6
iron	99,300	--	--	--	--	--	--
lead	541	**4.5**	0.3	**49**	**9.7**	64	45.8
manganese	491	**2.2**	**1.1**	0.1	0.1	4	2.6
mercury	0.057	0.002	**1.1**	**4.4**	0.03	6	4.0
molybdenum	6.7	**3.4**	--	0.4	**1.4**	5	3.7
nickel	2.3	0.06	0.008	0.01	0.02	0.1	0.1
selenium	2.4	**4.6**	0.6	**2.0**	**3.8**	11	7.9
silver	3.4	0.006	--	0.8	0.2	1	0.8
thallium	0.0235	0.5	--	0.004	0.1	0.6	0.4
vanadium	27	0.5	--	**3.5**	0.10	4	2.9
zinc	176	**1.1**	**1.5**	**3.8**	**2.2**	9	6.2
					Total Risk	139	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.25 HQs for the Four Terrestrial Receptor Groups at Overbank Soils EU-24
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	Max EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	25,300	--	--	--	--	--	--
antimony	7.2	0.7	0.09	--	**27**	27	2.2
arsenic	54.3	**3.0**	**8.0**	**1.3**	**1.2**	13	1.1
barium	204	**1.9**	0.6	0.2	0.1	3	0.2
beryllium	1.7	0.7	0.04	--	0.08	0.8	0.06
cadmium	54.5	**1.7**	0.4	**71**	**151**	224	17.8
chromium	11.4	--	**29**	0.4	0.3	29	2.3
cobalt	81.5	**6.3**	--	0.7	0.4	7	0.6
copper	995	**14**	**12**	**36**	**20**	82	6.6
iron	66,300	--	--	--	--	--	--
lead	2,140	**18**	**1.3**	**195**	**38**	252	20.0
manganese	35,900	**163**	**80**	**8.3**	**9.0**	260	20.7
mercury	0.31	0.009	**6.2**	**24**	0.2	30	2.4
molybdenum	7.9	**4.0**	--	0.5	**1.6**	6	0.5
nickel	19	0.5	0.07	0.09	0.1	0.8	0.1
selenium	3.3	**6.3**	0.8	**2.8**	**5.2**	15	1.2
silver	5.2	0.009	--	**1.2**	0.4	2	0.1
thallium	1.1	**22**	--	0.2	**5.0**	27	2.2
vanadium	37.9	0.6	--	**4.9**	0.1	6	0.4
zinc	5,560	**35**	**46**	**121**	**70**	272	21.6
					Total Risk	1,259	100.0

note: an empty space in the HQ columns indicates the lack of an ESV
EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.2.26 Risk Ranking of the Overbank Soil EUs Based on the Top 3 Risk Drivers
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Risk Ranking	EU	Total Risk	Top 3 risk drivers						Fraction of total risk (%)[b]
			risk driver 1	ΣHQ[a]	risk driver 2	ΣHQ[a]	risk driver 3	ΣHQ[a]	
HIGHER-RISK EXPOSURE AREAS									
1	EU-15	4,175	zinc	1,479	cadmium	889	lead	706	74
2	EU-10	2,024	lead	1,236	manganese	312	zinc	124	83
3	EU-24	1,259	zinc	272	manganese	260	lead	252	62
4	EU-13	1,222	lead	517	mercury	185	zinc	185	73
5	EU-16	898	lead	399	manganese	142	mercury	84	70
6	EU-12	757	lead	208	zinc	181	manganese	109	66
7	EU-04	755	lead	231	arsenic	206	zinc	92	70
8	EU-03.5	670	lead	397	mercury	117	chromium	27	81
9	EU-22	664	zinc	260	lead	244	antimony	28	80
10	EU-19	650	lead	175	manganese	104	thallium	82	56
11	EU-09	561	lead	219	zinc	130	manganese	88	78
12	EU-14	557	lead	147	zinc	107	manganese	74	59
MODERATE-RISK EXPOSURE AREAS									
13	EU-05	486	zinc	202	cadmium	87	manganese	44	68
14	EU-20	379	lead	174	zinc	44	mercury	28	65
15	EU-08	330	lead	207	zinc	33	manganese	16	77
16	EU-01	320	lead	79	zinc	40	antimony	38	49
17	EU-03	314	lead	122	manganese	59	chromium	31	68
18	EU-21	257	lead	73	zinc	44	antimony	34	59
LOWER-RISK EXPOSURE AREAS									
19	EU-06	185	manganese	42	selenium	32	zinc	21	51
20	EU-17	182	manganese	51	zinc	40	lead	19	60
21	EU-07	174	lead	60	zinc	27	chromium	23	63
22	EU-18	147	lead	32	chomium	31	zinc	21	57
23	EU-23	139	lead	64	chromium	12	antimony	12	63
24	EU-02	109	lead	32	zinc	22	selenium	8	56
25	EU-11	100	chromium	21	lead	19	zinc	12	52

[a] ΣHQ = sum of the plant, invertebrate, bird and mammal HQs for each risk driver
[b] fraction of total risk = sum of ΣHQ of top 3 risk drivers/total risk
higher-risk sites: total risk > 50(
moderate-risk sites: total risk between 200 and 50(
lower-risk sites: total risk < 20(

prepared by: CC (2/7/17)
reviewed by: SJP (2/12/17)

Table 7.3.1 HQs for the Four Terrestrial Receptor Groups at Public Campsite 2
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	11,300	--	--	--	--	--	--
antimony	4.2	0.4	0.05	**--**	**16**	16	2.9
arsenic	18.8	**1.0**	**2.8**	0.4	0.4	5	0.8
barium	134	**1.2**	0.4	0.2	0.07	2	0.3
cadmium	4.0	0.1	0.03	**5.2**	**11**	16	3.0
chromium	5.4	**--**	**14**	0.2	0.2	14	2.5
cobalt	8	0.6	**--**	0.07	0.03	0.7	0.1
copper	683	**9.8**	**8.5**	**24**	**14**	57	10.2
iron	22,000	**--**	**--**	**--**	**--**	--	--
lead	2,880	**24**	**1.7**	**262**	**51**	339	60.9
manganese	3,110	**14**	**6.9**	0.7	0.8	23	4.0
mercury	0.15	0.004	**3.0**	**12**	0.09	15	2.6
molybdenum	23.4	**12**	**--**	**1.4**	**4.9**	18	3.2
selenium	1.3	**2.5**	0.3	**1.1**	**2.1**	6	1.1
silver	11.8	0.02	**--**	**2.8**	0.8	4	0.7
thallium	0.17	**3.4**	**--**	0.03	0.8	4	0.8
vanadium	17.6	0.3	**--**	**2.3**	0.06	3	0.5
zinc	740	**4.6**	**6.2**	**16**	**9.4**	36	6.5
					Total Risk	557	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.2 HQs for the Four Terrestrial Receptor Groups at Public Campsite 4
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	8,550	--	--	--	--	--	--
antimony	46.8	**4.3**	0.6	**--**	**173**	178	2.3
arsenic	62.9	**3.5**	**9.3**	**1.5**	**1.4**	16	0.2
barium	75.7	0.7	0.2	0.09	0.04	1	0.0
cadmium	94.3	**2.9**	0.7	**122**	**262**	388	5.1
chromium	4.3	**--**	**11**	0.2	0.1	11	0.1
cobalt	9	0.7	**--**	0.08	0.04	0.8	0.0
copper	2,510	**36**	**31**	**90**	**51**	208	2.7
iron	37,400	**--**	**--**	**--**	**--**	--	--
lead	44,200	**368**	**26**	**4,018**	**789**	5,202	68.4
manganese	910	**4.1**	**2.0**	0.2	0.2	7	0.1
mercury	6	0.2	**120**	**462**	**3.5**	585	7.7
molybdenum	118	**59**	**--**	**6.9**	**25**	91	1.2
selenium	7.1	**14**	**1.7**	**5.9**	**11**	33	0.4
silver	96.9	0.2	**--**	**23**	**6.9**	30	0.4
thallium	0.3	**6.0**	**--**	0.05	**1.4**	7	0.1
vanadium	15.4	0.3	**--**	**2.0**	0.06	2	0.0
zinc	17,300	**108**	**144**	**376**	**219**	847	11.1
					Total Risk	7,607	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.3 HQs for the Four Terrestrial Receptor Groups at Public Campsite 5
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	14,100	--	--	--	--	--	--
antimony	0.76	0.07	0.010	**--**	**2.8**	3	2.5
arsenic	13.6	0.8	**2.0**	0.3	0.3	3	3.0
barium	163	**1.5**	0.5	0.2	0.08	2	2.0
cadmium	1.0	0.03	0.007	**1.3**	**2.8**	4	3.6
chromium	6.9	**--**	**17**	0.3	0.2	18	15.6
cobalt	9.3	0.7	**--**	0.08	0.04	0.8	0.7
copper	41.3	0.6	0.5	**1.5**	0.8	3	3.0
iron	25,200	**--**	**--**	**--**	**--**	--	--
lead	200	**1.7**	0.1	**18**	**3.6**	24	20.7
manganese	1,050	**4.8**	**2.3**	0.2	0.3	8	6.7
mercury	0.21	0.006	**4.2**	**16**	0.1	20	18.0
molybdenum	2	1.0	**--**	0.1	0.4	2	1.3
selenium	1.3	**2.5**	0.3	**1.1**	**2.1**	6	5.2
silver	0.72	0.001	**--**	0.2	0.05	0.2	0.2
thallium	0.15	**3.0**	**--**	0.02	0.7	4	3.3
vanadium	25.9	0.4	**--**	**3.3**	0.09	4	3.4
zinc	252	**1.6**	**2.1**	**5.5**	**3.2**	12	10.8
					Total Risk	114	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.4 HQs for the Four Terrestrial Receptor Groups at Public Campsite 7
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	13,300	--	--	--	--	--	--
antimony	42.5	**3.9**	0.5	**--**	**157**	162	8.1
arsenic	86.9	**4.8**	**13**	**2.0**	**1.9**	22	1.1
barium	180	**1.6**	0.5	0.2	0.09	2	0.1
cadmium	10.6	0.3	0.08	**14**	**29**	44	2.2
chromium	8.1	**--**	**20**	0.3	0.2	21	1.0
cobalt	5.9	0.5	**--**	0.05	0.03	0.5	0.0
copper	339	**4.8**	**4.2**	**12**	**6.9**	28	1.4
iron	23,500	**--**	**--**	**--**	**--**	--	--
lead	11,800	**98**	**6.9**	**1,073**	**211**	1,389	69.2
manganese	1,560	**7.1**	**3.5**	0.4	0.4	11	0.6
mercury	0.29	0.009	**5.8**	**22**	0.2	28	1.4
molybdenum	6.4	**3.2**	**--**	0.4	**1.3**	5	0.2
selenium	2.9	**5.6**	0.7	**2.4**	**4.6**	13	0.7
silver	26.7	0.05	**--**	**6.4**	**1.9**	8	0.4
thallium	0.43	**8.6**	**--**	0.07	**2.0**	11	0.5
vanadium	24.4	0.4	**--**	**3.1**	0.09	4	0.2
zinc	5,290	**33**	**44**	**115**	**67**	259	12.9
					Total Risk	2,007	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.5 HQs for the Four Terrestrial Receptor Groups at Public Campsite 9
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	7,050	--	--	--	--	--	--
antimony	9.7	0.9	0.1	--	**36**	37	11.0
arsenic	72.2	**4.0**	**11**	**1.7**	**1.6**	18	5.3
barium	140	**1.3**	0.4	0.2	0.07	2	0.6
cadmium	1.2	0.04	0.009	**1.6**	**3.3**	5	1.5
chromium	10.5	--	**26**	0.4	0.3	27	8.0
cobalt	2.6	0.2	--	0.02	0.01	0.2	0.1
copper	111	**1.6**	**1.4**	**4.0**	**2.3**	9	2.7
iron	34,800	--	--	--	--	--	--
lead	1,330	**11**	0.8	**121**	**24**	157	46.7
manganese	365	**1.7**	0.8	0.08	0.09	3	0.8
mercury	0.16	0.005	**3.2**	**12**	0.09	16	4.7
molybdenum	14.2	**7.1**	--	0.8	**3.0**	11	3.3
selenium	3.5	**6.7**	0.9	**2.9**	**5.6**	16	4.8
silver	6.4	0.01	--	**1.5**	0.5	2	0.6
thallium	0.14	**2.8**	--	0.02	0.6	3	1.0
vanadium	23.1	0.4	--	**3.0**	0.08	3	1.0
zinc	540	**3.4**	**4.5**	**12**	**6.8**	26	7.9
					Total Risk	335	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.6 HQs for the Four Terrestrial Receptor Groups at Public Campsite 10
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	8,210	--	--	--	--	--	--
antimony	1.2	0.1	0.02	**--**	**4.4**	5	6.6
arsenic	22.7	**1.3**	**3.3**	0.5	0.5	6	8.1
barium	193	**1.8**	0.6	0.2	0.10	3	3.8
cadmium	0.2	0.006	0.001	0.2	0.5	0.7	1.1
chromium	4.1	**--**	**10**	0.2	0.1	11	15.2
cobalt	2.7	0.2	**--**	0.02	0.01	0.2	0.3
copper	31.3	0.4	0.4	**1.1**	0.6	3	3.7
iron	45,400	**--**	**--**	**--**	**--**	--	--
lead	73.6	0.6	0.04	**6.7**	**1.3**	9	12.5
manganese	202	0.9	0.4	0.05	0.05	1	2.1
mercury	0.00165	0.000	0.03	0.1	0.0	0.2	0.2
molybdenum	3.3	**1.7**	**--**	0.2	0.7	3	3.6
selenium	3.6	**6.9**	0.9	**3.0**	**5.7**	17	23.8
silver	0.014	0.00	**--**	0.003	0.001	0.0	0.0
thallium	0.25	**5.0**	**--**	0.04	**1.1**	6	8.9
vanadium	22.3	0.4	**--**	**2.9**	0.08	3	4.8
zinc	74.3	0.5	0.6	**1.6**	0.9	4	5.2
					Total Risk	69	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.7 HQs for the Four Terrestrial Receptor Groups at Public Campsite 11
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	11,300	--	--	--	--	--	--
antimony	0.82	0.07	0.01	**--**	**3.0**	3	2.1
arsenic	43.7	**2.4**	**6.4**	**1.0**	1.0	11	7.3
barium	80.8	0.7	0.2	0.10	0.04	1	0.8
cadmium	0.5	0.02	0.004	0.7	**1.5**	2	1.5
chromium	4.3	**--**	**11**	0.2	0.1	11	7.4
cobalt	5.5	0.4	**--**	0.05	0.02	0.5	0.3
copper	79.9	**1.1**	1.0	**2.9**	**1.6**	7	4.5
iron	48,100	**--**	**--**	**--**	**--**	--	--
lead	431	**3.6**	0.3	**39**	**7.7**	51	34.1
manganese	633	**2.9**	**1.4**	0.1	0.2	5	3.1
mercury	0.19	0.006	**3.8**	**15**	0.1	19	12.5
molybdenum	2.9	**1.5**	**--**	0.2	0.6	2	1.5
selenium	2.3	**4.4**	0.6	**1.9**	**3.7**	11	7.1
silver	0.98	0.002	**--**	0.2	0.07	0.3	0.2
thallium	0.18	**3.6**	**--**	0.03	0.8	4	3.0
vanadium	25.4	0.4	**--**	**3.3**	0.09	4	2.5
zinc	371	**2.3**	**3.1**	**8.1**	**4.7**	18	12.2
					Total Risk	149	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.8 HQs for the Four Terrestrial Receptor Groups at Public Campsite 12
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	10,100	--	--	--	--	--	--
antimony	0.7	0.06	0.009	--	**2.6**	3	2.0
arsenic	29.5	**1.6**	**4.3**	0.7	0.6	7	5.6
barium	136	**1.2**	0.4	0.2	0.07	2	1.4
cadmium	1.1	0.03	0.008	**1.4**	**3.1**	5	3.5
chromium	4.7	--	**12**	0.2	0.1	12	9.2
cobalt	7.1	0.5	--	0.06	0.03	0.6	0.5
copper	43.8	0.6	0.5	**1.6**	**1.6**	4	3.3
iron	35,300	--	--	--	--	--	--
lead	257	**2.1**	0.2	**23**	**4.6**	30	23.1
manganese	829	**3.8**	**1.8**	0.2	0.2	6	4.6
mercury	0.14	0.004	**2.8**	**11**	0.08	14	10.4
molybdenum	3.4	**1.7**	--	0.2	0.7	3	2.0
selenium	2.4	**4.6**	0.6	**2.0**	**3.8**	11	8.4
silver	0.65	0.001	--	0.2	0.05	0.2	0.2
thallium	0.18	**3.6**	--	0.03	0.8	4	3.4
vanadium	23.1	0.4	--	**3.0**	0.08	3	2.6
zinc	534	**3.3**	**4.5**	**12**	**6.8**	26	19.9
					Total Risk	131	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.9 HQs for the four Terrestrial Receptor Groups at Public Campsite 13
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	11,600	--	--	--	--	--	--
antimony	0.57	0.05	0.007	--	**2.1**	2	2.9
arsenic	19.9	**1.1**	**2.9**	0.5	0.4	5	6.7
barium	123	**1.1**	0.4	0.2	0.06	2	2.3
cadmium	0.8	0.03	0.006	**1.1**	**2.3**	3	4.6
chromium	7.1	--	**18**	0.3	0.2	18	24.7
cobalt	10.6	0.8	--	0.09	0.05	0.9	1.3
copper	22.5	0.3	0.3	0.8	0.5	2	2.5
iron	24,000	--	--	--	--	--	--
lead	100	0.8	0.06	**9.1**	**1.8**	12	15.9
manganese	936	**4.3**	**2.1**	0.2	0.2	7	9.2
mercury	0.00165	0.000	0.03	0.1	0.0	0.2	0.2
molybdenum	1.2	0.6	--	0.07	0.3	0.9	1.2
selenium	1.1	**2.1**	0.3	0.9	**1.7**	5	6.8
silver	0.58	0.001	--	0.1	0.04	0.2	0.2
thallium	0.0195	0.4	--	0.003	0.09	0.5	0.7
vanadium	20.8	0.3	--	**2.7**	0.07	3	4.2
zinc	250	**1.6**	**2.1**	**5.4**	**3.2**	12	16.6
					Total Risk	74	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.10 HQs for the Four Terrestrial Receptor Groups at Public Campsite 14
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	10,500	--	--	--	--	--	--
antimony	0.8	0.07	0.01	--	**3.0**	3	3.4
arsenic	18.7	**1.0**	**2.8**	0.4	0.4	5	5.1
barium	111	**1.0**	0.3	0.1	0.06	2	1.7
cadmium	1.1	0.03	0.008	**1.4**	**3.1**	5	5.0
chromium	4.8	--	**12**	0.2	0.1	12	13.7
cobalt	9.4	0.7	--	0.08	0.04	0.8	0.9
copper	20.4	0.3	0.3	0.7	0.4	2	1.9
iron	22,100	--	--	--	--	--	--
lead	252	**2.1**	0.1	**23**	**4.5**	30	33.0
manganese	1,400	**6.4**	**3.1**	0.3	0.4	10	11.3
mercury	0.00165	0.000	0.03	0.1	0.0	0.2	0.2
molybdenum	1.1	0.6	--	0.06	0.2	0.8	0.9
selenium	0.9	**1.7**	0.2	0.8	**1.4**	4	4.6
silver	0.89	0.002	--	0.2	0.06	0.3	0.3
thallium	0.02	0.4	--	0.003	0.09	0.5	0.5
vanadium	16.6	0.3	--	**2.1**	0.06	2	2.7
zinc	270	**1.7**	**2.3**	**5.9**	**3.4**	13	14.7
					Total Risk	90	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.11 HQs for the Four Terrestrial Receptor Groups at Public Campsite 15
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	13,200	--	--	--	--	--	--
antimony	1.4	0.1	0.02	--	**5.2**	5	3.2
arsenic	7.7	0.4	**1.1**	0.2	0.2	2	1.1
barium	131	**1.2**	0.4	0.2	0.07	2	1.1
cadmium	3.0	0.09	0.02	**3.9**	**8.3**	12	7.4
chromium	9.1	--	**23**	0.4	0.3	23	13.9
cobalt	5.7	0.4	--	0.05	0.02	0.5	0.3
copper	25	0.4	0.3	0.9	0.5	2	1.2
iron	19,000	--	--	--	--	--	--
lead	530	**4.4**	0.3	**48**	**9.5**	62	37.2
manganese	715	**3.3**	**1.6**	0.2	0.2	5	3.1
mercury	0.00185	0.000	0.04	0.1	0.001	0.2	0.1
molybdenum	1.5	0.8	--	0.09	0.3	1	0.7
selenium	0.69	**1.3**	0.2	0.6	**1.1**	3	1.9
silver	1.1	0.002	--	0.3	0.08	0.3	0.2
thallium	0.022	0.4	--	0.003	0.1	0.5	0.3
vanadium	30.6	0.5	--	**3.9**	0.1	5	2.7
zinc	874	**5.5**	**7.3**	**19**	**11**	43	25.5
					Total Risk	168	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.12 HQs for the Four Terrestrial Receptor Groups at Public Campsite 15a
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

COPEC	EPC (mg/kg)	Plant HQ	Invert. HQ	Bird HQ	Mammal HQ	Σ COPEC HQs	% of total risk
aluminum	12,800	--	--	--	--	--	--
antimony	0.6	0.05	0.008	**--**	**2.2**	2	0.5
arsenic	11.8	0.7	**1.7**	0.3	0.3	3	0.6
barium	90.3	0.8	0.3	0.1	0.05	1	0.3
cadmium	19.6	0.6	0.1	**25**	**54**	81	17.1
chromium	11.2	**--**	**28**	0.4	0.3	29	6.1
cobalt	29.7	**2.3**	**--**	0.2	0.1	3	0.6
copper	1,030	**15**	**13**	**37**	**21**	85	18.1
iron	31,500	**--**	**--**	**--**	**--**	--	--
lead	761	**6.3**	0.4	**69**	**14**	90	19.0
manganese	9,030	**41**	**20**	**2.1**	**2.3**	65	13.9
mercury	0.016	0.000	0.3	**1.2**	0.009	2	0.3
molybdenum	--	**--**	**--**	**--**	**--**	0.0	0.0
selenium	4.8	**9.2**	**1.2**	**4.0**	**7.6**	22	4.7
silver	3.3	0.006	**--**	0.8	0.2	1	0.2
thallium	0.28	**5.6**	**--**	0.04	**1.3**	7	1.5
vanadium	45	0.8	**--**	**5.8**	0.2	7	1.4
zinc	1,520	**9.5**	**13**	**33**	**19**	74	15.8
					Total Risk	472	100.0

EPC = exposure point concentration
ESV = ecological screening value
HQ = hazard quotient
shaded values identify the top 3 risk drivers

prepared by: SJP (1/24/17)
reviewed by: CC (1/30/17)

Table 7.3.13 Risk Ranking of the Public Camp Sites Based on the Top 3 Risk Drivers
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Risk Ranking	Public Campsite	Total Risk	Top 3 risk drivers						Fraction of total risk (%)[b]
			risk driver 1	ΣHQ[a]	risk driver 2	ΣHQ[a]	risk driver 3	ΣHQ[a]	
HIGHER-RISK SITES									
1	CMP4	7,607	lead	5,202	zinc	847	mercury	585	87.2
2	CMP7	2,007	lead	1,389	zinc	259	antimony	162	90.2
3	CMP2	557	lead	339	copper	57	zinc	36	77.5
MODERATE-RISK SITES									
4	CMP15a	472	lead	90	copper	85	cadmium	81	54.2
5	CMP9	335	lead	157	antimony	37	zinc	26	65.6
LOWER-RISK SITES									
6	CMP15	168	lead	62	zinc	43	chromium	23	76.7
7	CMP11	149	lead	51	mercury	19	zinc	18	58.8
8	CMP12	131	lead	30	zinc	26	mercury	13	53.4
9	CMP5	114	lead	24	mercury	20	chromium	18	54.2
10	CMP14	90	lead	30	zinc	13	chromium	12	61.3
11	CMP13	74	chromium	18	lead	12	zinc	12	57.1
12	CMP10	69	selenium	17	chromium	11	lead	9	51.4

[a] ΣHQ = sum of the plant, invertebrate, bird and mammal HQs for each risk driver
[b] fraction of total risk = sum of ΣHQ of top 3 risk drivers/total risk
higher-risk sites: total risk > 500
moderate-risk sites: total risk between 200 and 500
lower-risk sites: total risk < 200

Figures

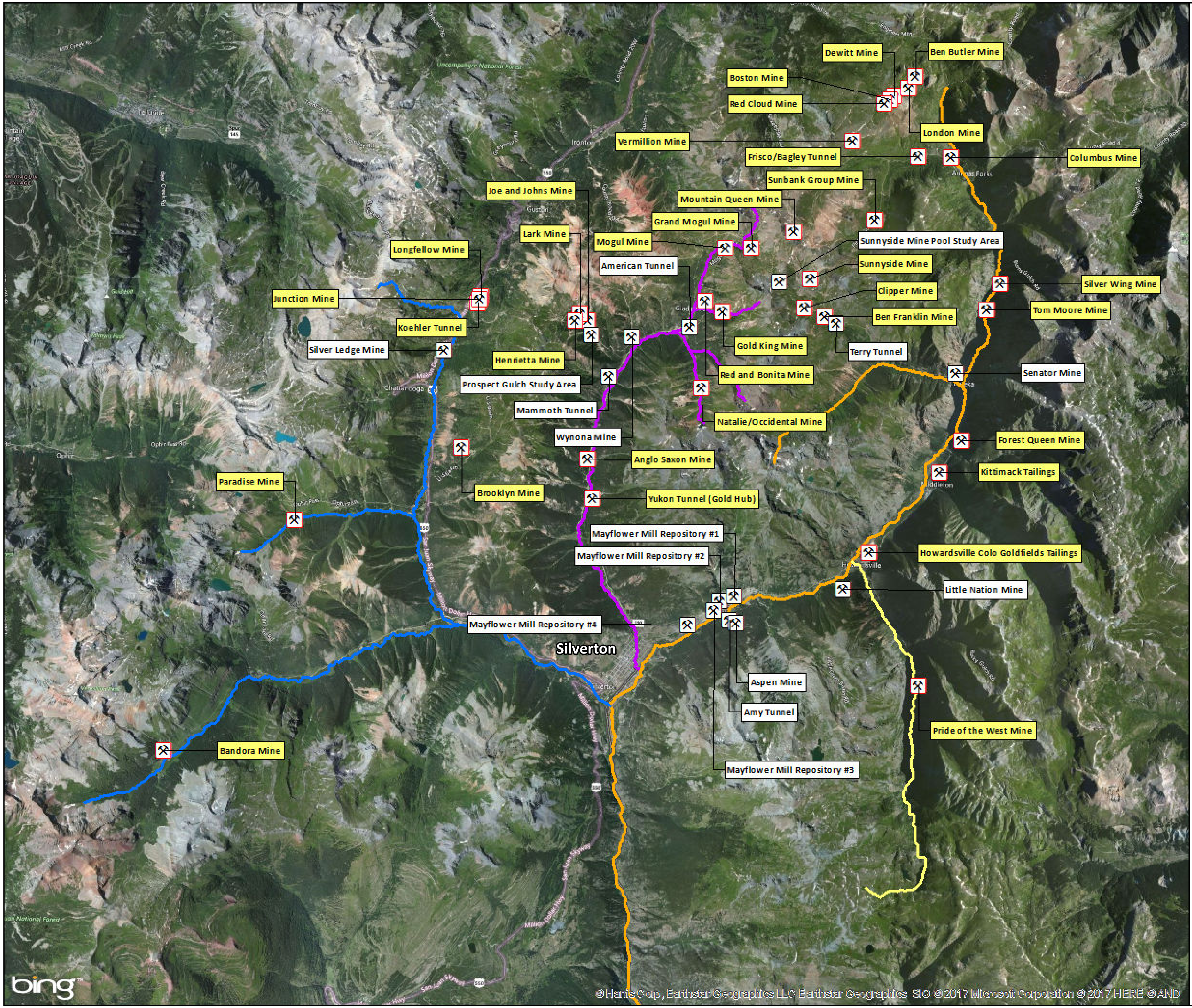


Figure 2.1
Bonita Peak Mining District
Mines Sampled For Soil
2015 - 2016

Mines of Interest

Mines Sampled in 2015 - 2016

Animas River

Cement Creek

Cunningham Creek

Mineral Creek

Note: Mines highlighed in Yellow were sampled in 2015 & 2016 sampling events.

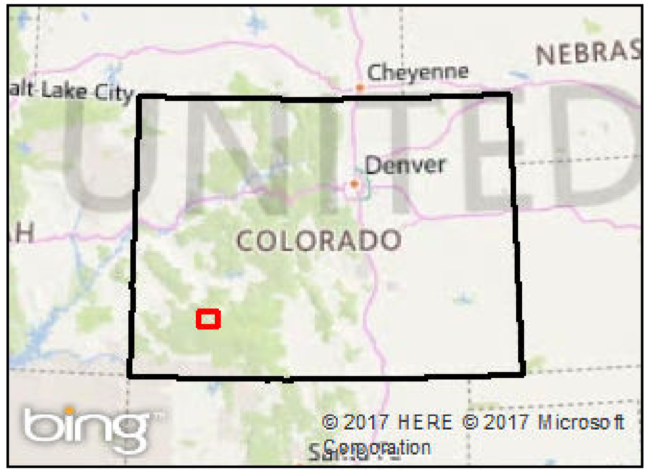
Map Date: February 15, 2017

Data Sources:
Rivers and Streams: CDOW (2004)
*Mines:*USGS (2000)
Image: Microsoft Bing Hybrid (2017)

Map Projection: UTM Zone 13 N, NAD83, Meters

TechLaw

0 1 2 Miles



Area of Interest

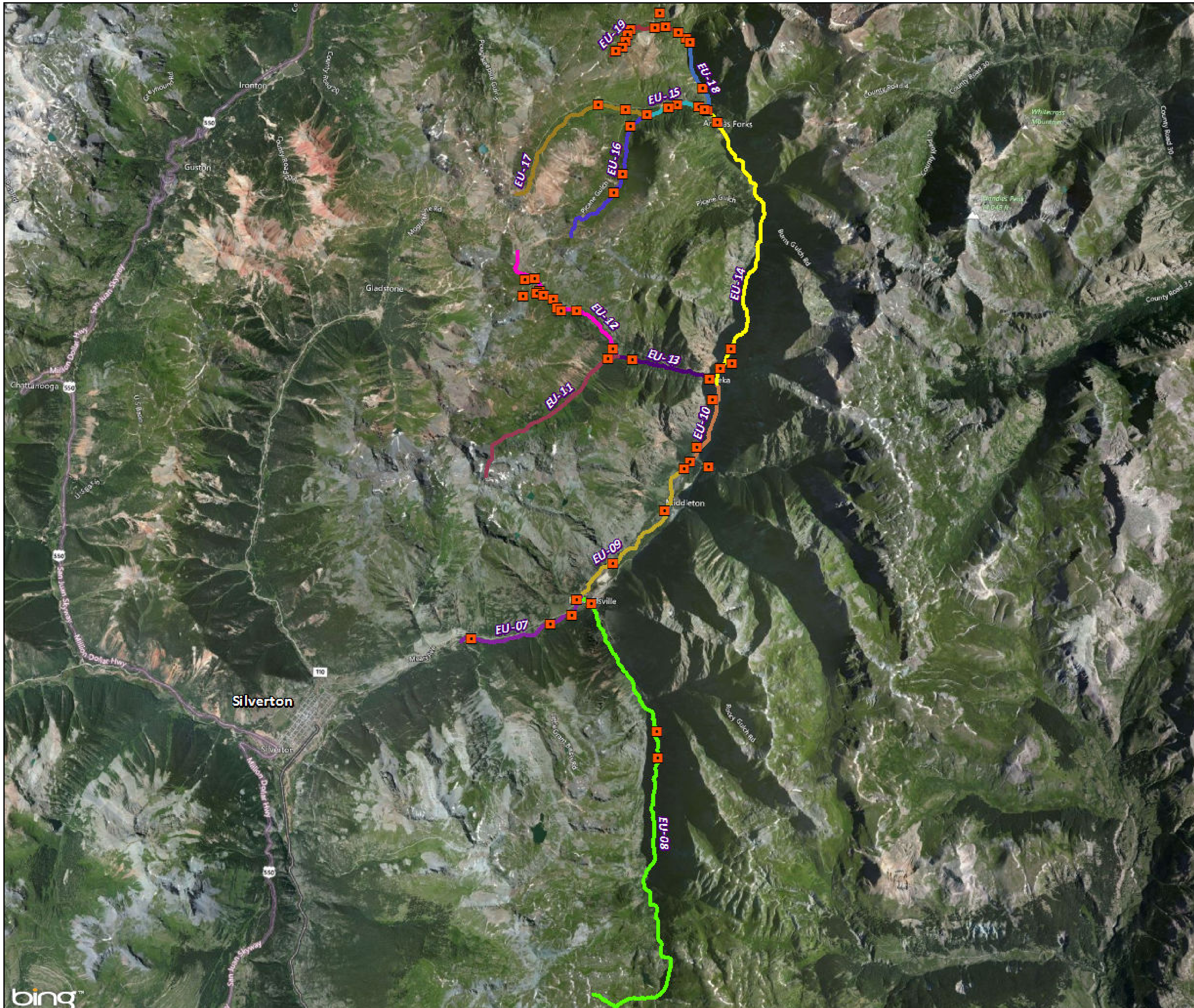


Figure 2.2
Bonita Peak Mining District
Animas River Exposure Units & Overbank Soil Sampling Locations

Overbank Soil Location

EU-07 *(Animas River)*

EU-08 *(Cunnigham Creek)*

EU-09 *(Animas River)*

EU-10 *(Animas River)*

EU-11 *(Upper South Fork of Animas River)*

EU-12 *(Eureka Gulch)*

EU-13 *(South Fork of Animas River)*

EU-14 *(Animas River)*

EU-15 *(West Fork of Animas River)*

EU-16 *(Placer Gulch)*

EU-17 *(Upper West Fork of Animas River)*

EU-18 *(North Fork of Animas River)*

EU-19 *(Burrows Creek)*

Map Date: February 15, 2017

Data Sources:
Overbank Soil Sample Locations: U.S. EPA (2015 - 2016)
Rivers & Streams: CDOW (2004)
Exposure Units: U.S EPA (2016)
Imagery: USDA NAIP (2015)

Map Projection: UTM Zone 13 N, NAD83, Meters

TechLaw

N
W E
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Area of Interest

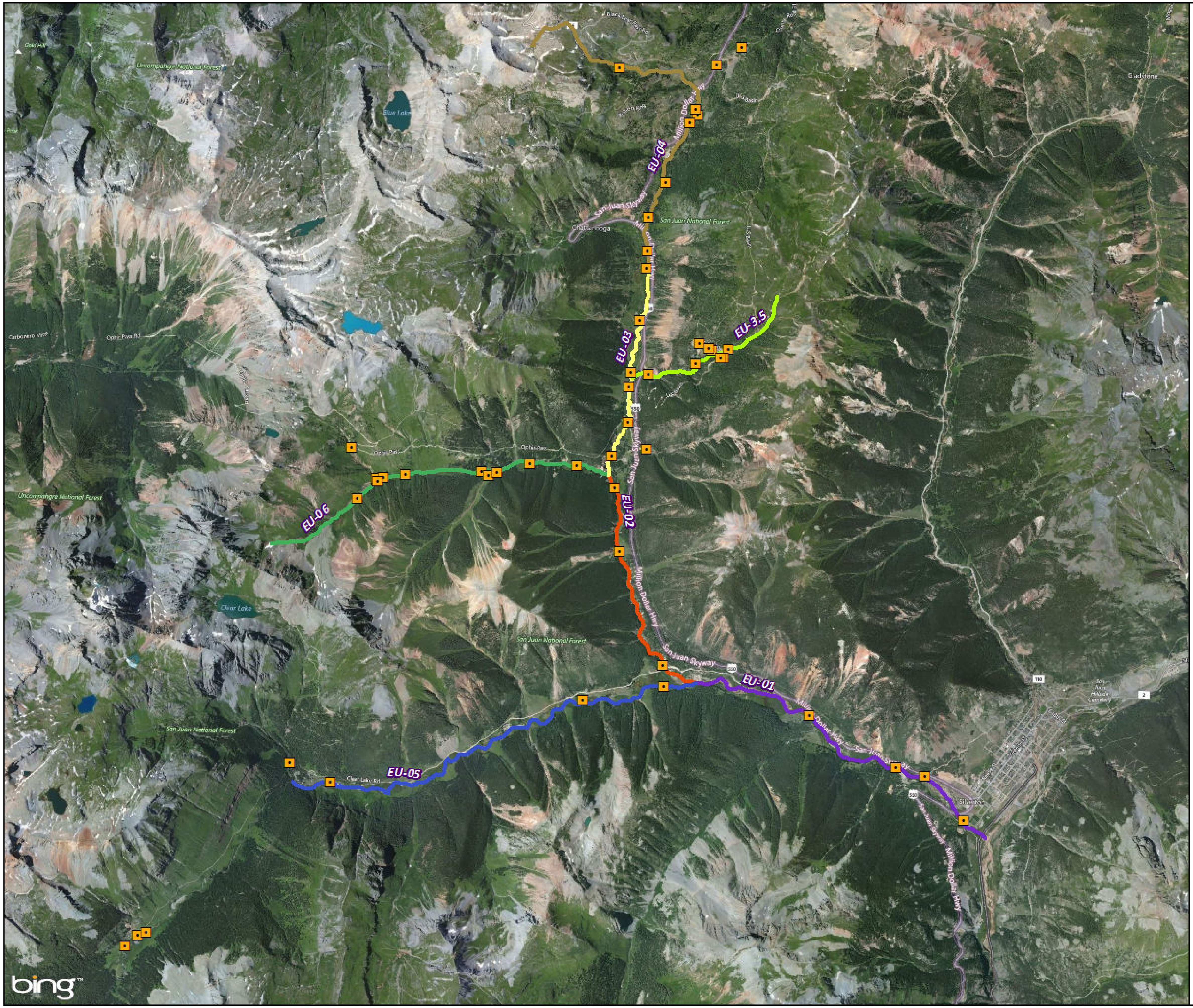


Figure 2.3
Bonita Peak Mining District
Mineral Creek Exposure Units & Overbank Soil Sampling Locations

- Overbank Soil Location
- *EU-01* *(Mineral Creek)*
- *EU-02* *(Mineral Creek)*
- *EU-03* *(Mineral Creek)*
- *EU-04* *(Mineral Creek)*
- *EU-05* *(South Fork of Mineral Creek)*
- *EU-06* *(Middle Fork of Mineral Creek)*
- *EU-3.5* *(Browns Gulch)*

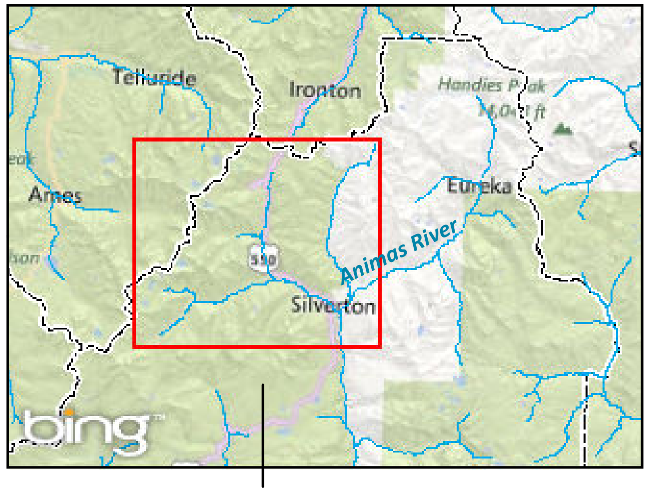
Map Date: February 15, 2017

Data Sources:
Overbank Soil Sample Locations: U.S. EPA (2015 - 2016)
Rivers & Streams: CDOW (2004)
Exposure Units: U.S EPA (2016)
Imagery: USDA NAIP (2015)

Map Projection: UTM Zone 13 N, NAD83, Meters

N W E S

0 1 2 Miles



Area of Interest

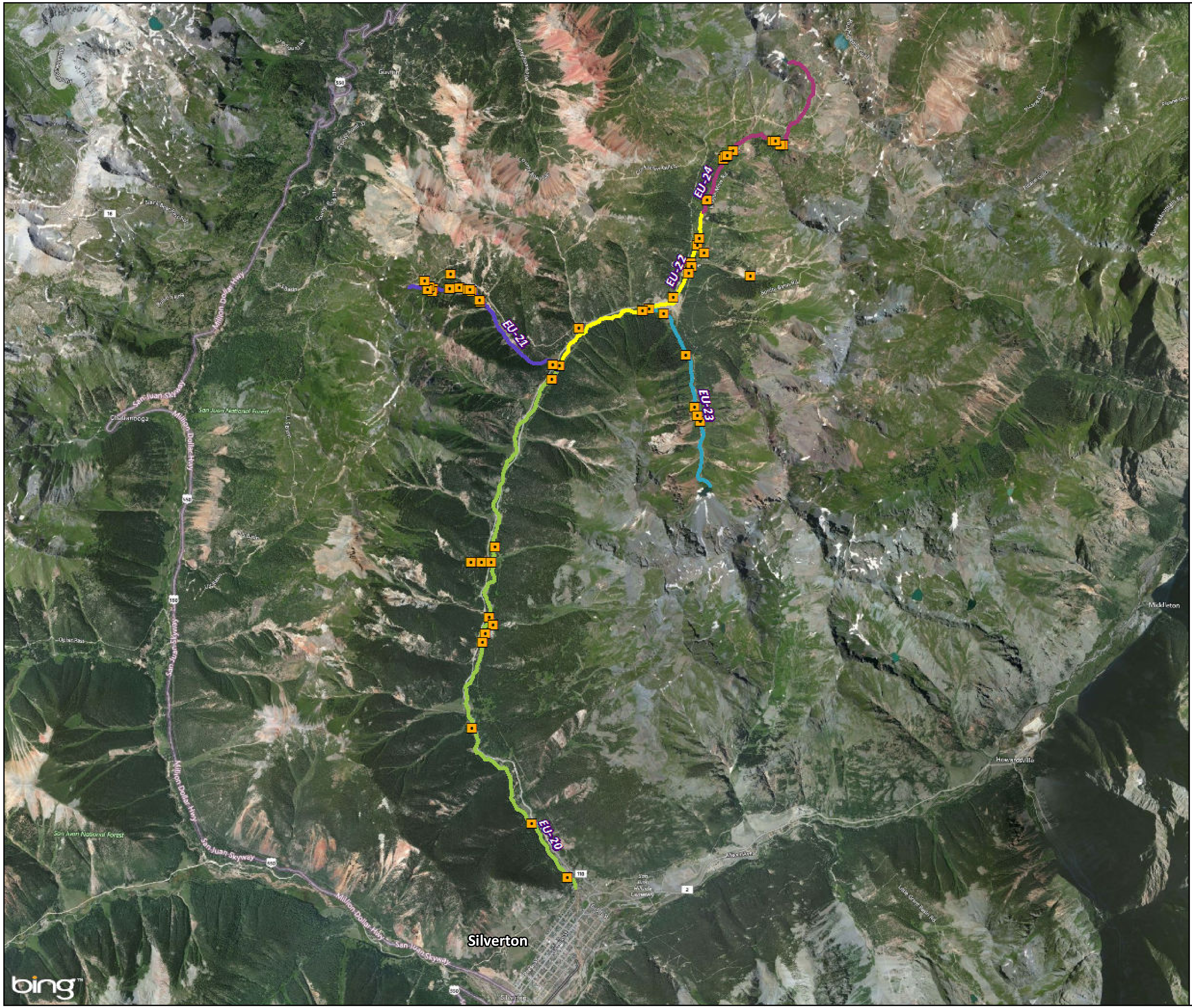


Figure 2.4
Bonita Peak Mining District
Cement Creek Exposure Units & Overbank Soil Sampling Locations

Overbank Soil Location

EU-20 *(Cement Creek)*

EU-21 *(Prospect Gulch)*

EU-22 *(Cement Creek)*

EU-23 *(Cement Creek South Fk)*

EU-24 *(Cement Creek)*

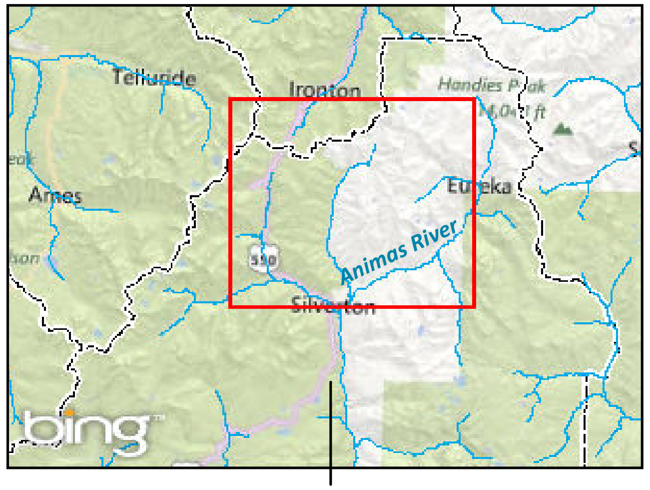
Map Date: February 15, 2017

Data Sources:
Overbank Soil Sample Locations: U.S. EPA (2015 - 2016)
Rivers & Streams: CDOW (2004)
Exposure Units: U.S EPA (2016)
Imagery: USDA NAIP (2015)

Map Projection: UTM Zone 13 N, NAD83, Meters

TechLaw

0 1 2 Miles



Area of Interest

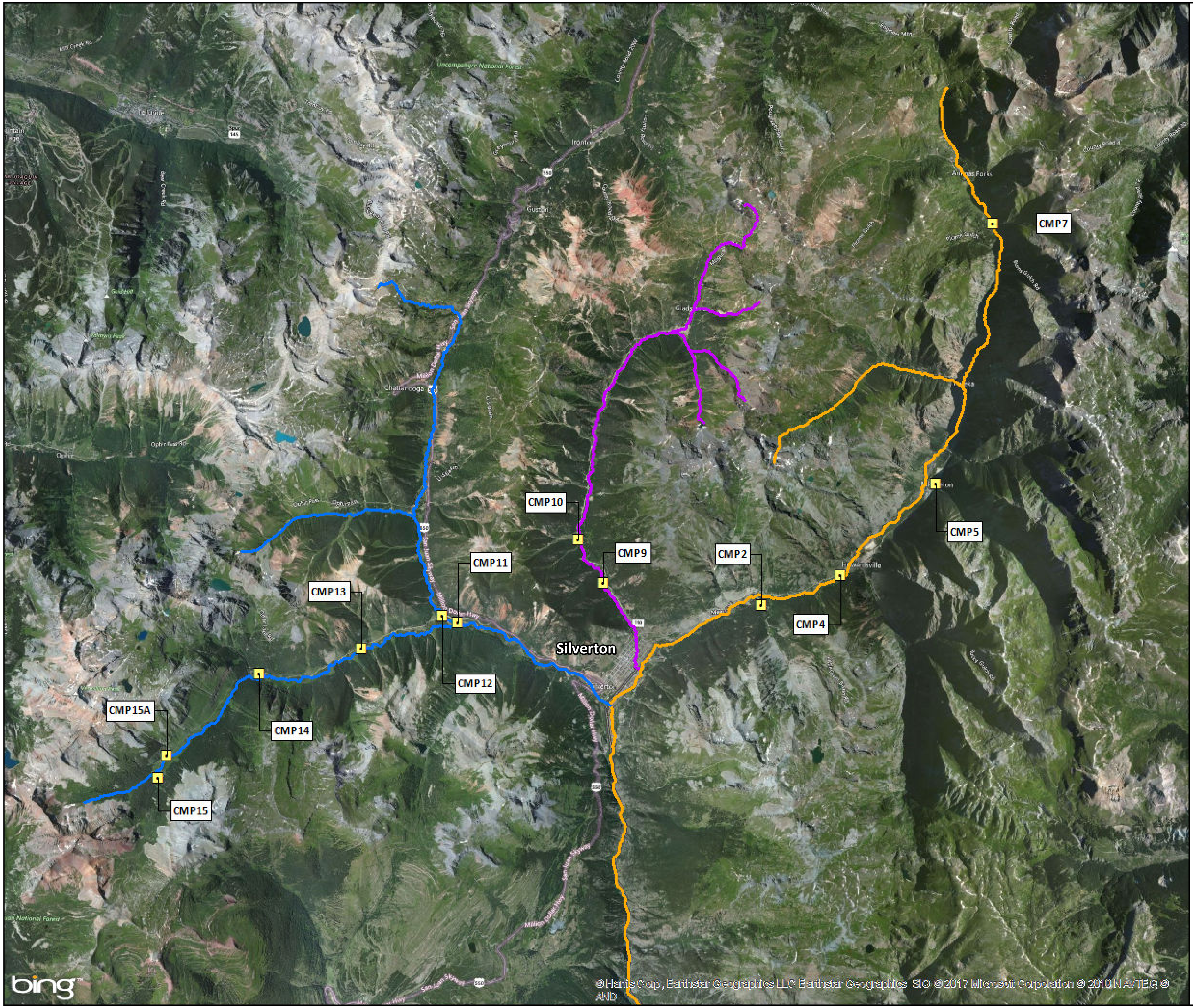


Figure 2.5
Bonita Peak Mining District
Public Camp Ground Locations
2016

Public Camp Ground Locations
Animas River
Cement Creek
Mineral Creek

Map Date: February 15, 2017

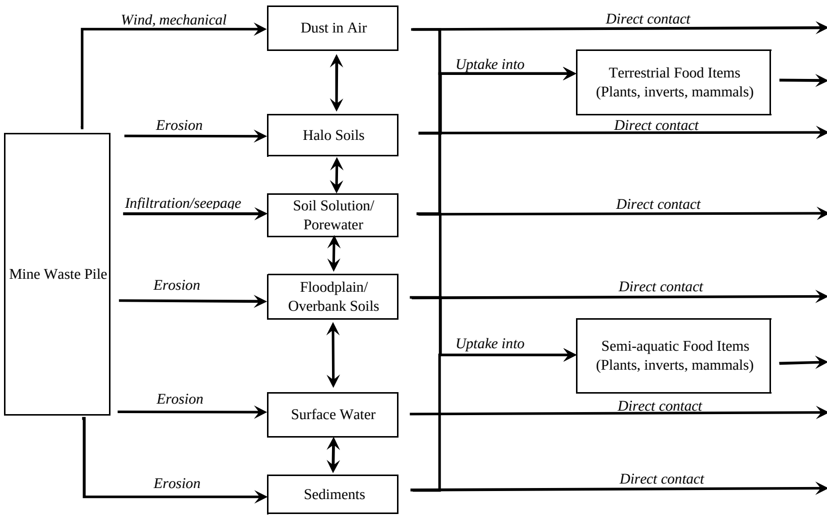
Data Sources:
Rivers & Streams: CDOW (2004)
Public Camp Ground Locations: USGS (2000)
Image: Microsoft Bing Hybrid (2017)

Map Projection: UTM Zone 13 N, NAD83, Meters

0 1 2 Miles

Area of Interest

Figure 3.1 - Baseline Ecological Risk Assessment Work Plan Site Conceptual Model



	Plants		Invertebrates		Semi-aquatic wildlife		Terrestrial wildlife	
	Semi-aquatic	Terrestrial	Semi-aquatic	Terrestrial	Birds	Mammals	Birds	Mammals
Inhalation							X	X
Direct contact		X		X			X	X
Ingestion				O			O	O
Ingestion				O			O	O
Direct contact		O		O			X	X
Ingestion								
Direct contact	O	O						
Ingestion			O		O	O		
Direct contact	O		X		X	X		
Ingestion			O		O	O		
Ingestion			O		O	O		
Direct contact	O		O		X	X		
Ingestion			O		O	O		
Direct contact	O		O		X	X		

Symbol key

O	Complete pathway and could be significant
X	Complete pathway but potentially minor
Blank	Incomplete pathway

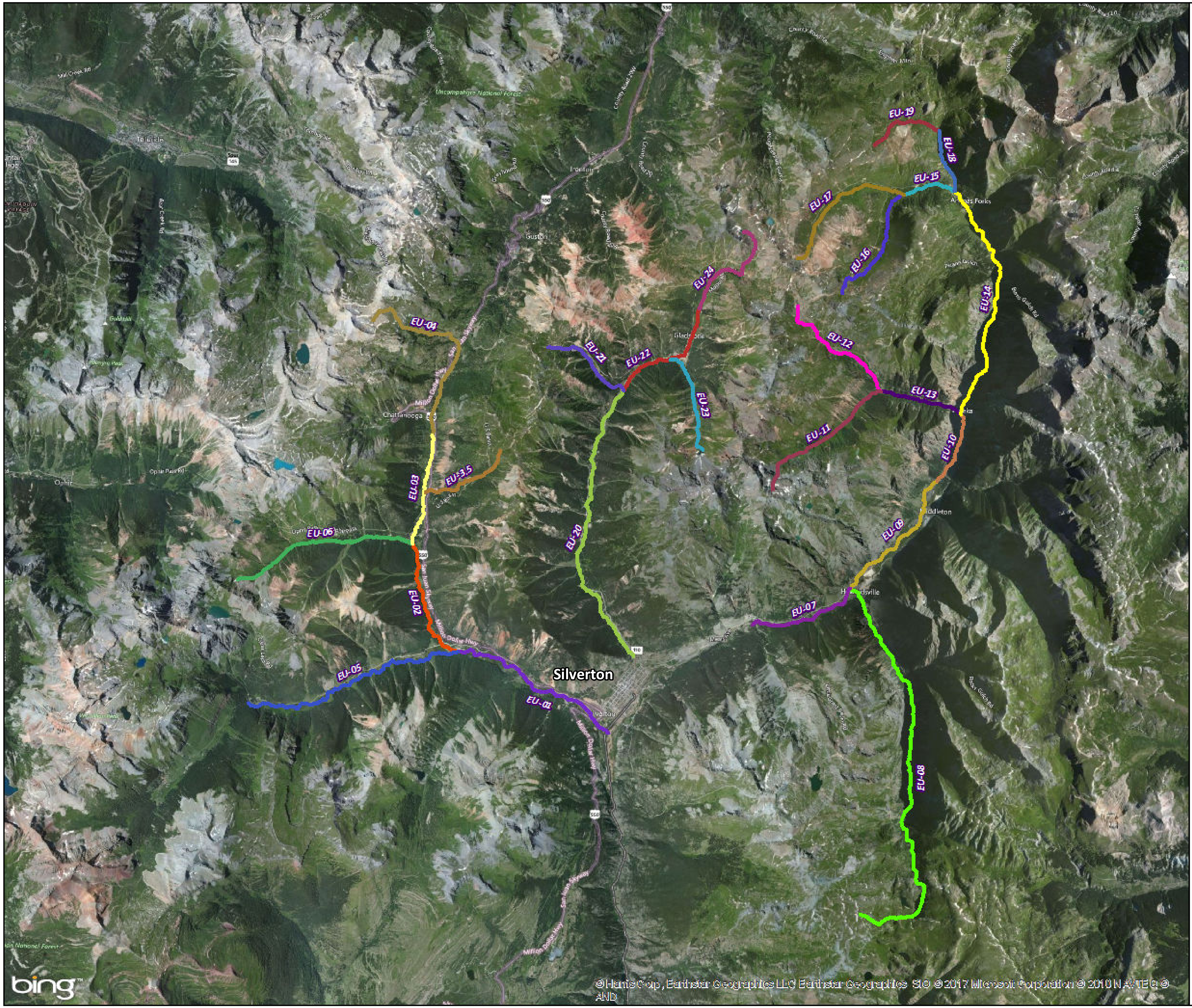


Figure 5.1
Bonita Peak Mining District
Aquatic Exposure Units

- EU-01 (Mineral Creek)
- EU-02 (Mineral Creek)
- EU-03 (Mineral Creek)
- EU-04 (Mineral Creek)
- EU-05 (South Fork of Mineral Creek)
- EU-06 (Middle Fork of Mineral Creek)
- EU-07 (Animas River)
- EU-08 (Cunnigham Creek)
- EU-09 (Animas River)
- EU-10 (Animas River)
- EU-11 (Upper South Fork of Animas River)
- EU-12 (Eureka Gulch)
- EU-13 (South Fork of Animas River)
- EU-14 (Animas River)
- EU-15 (West Fork of Animas River)
- EU-16 (Placer Gulch)
- EU-17 (Upper West Fork of Animas River)
- EU-18 (North Fork of Animas River)
- EU-19 (Burrows Creek)
- EU-20 (Cement Creek)
- EU-21 (Prospect Gulch)
- EU-22 (Cement Creek)
- EU-23 (Cement Creek South Fk)
- EU-24 (Cement Creek)
- EU-3.5 (Browns Gulch)

Map Date: February 15, 2017

Data Sources:
Rivers and Streams: CDOW (2004)
Exposure Units and Reference Areas: U.S. EPA (2016)
Image: Microsoft Bing Hybrid (2016)

Map Projection: UTM Zone 13 N, NAD83, Meters

TechLaw

0 1 2 Miles

Area of Interest

Appendices

Appendix 1: Total Recoverable Metals and pH in the Soil Samples Collected at the Mine Sites
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

NPL Mine Site Name	Sample Location	Soil pH	Aluminum	MDL	Antimony	MDL	Arsenic	MDL	Barium	MDL	Beryllium	MDL	Cadmium	MDL	Chromium	MDL	Cobalt	MDL	Copper	MDL	Iron	MDL	Lead	MDL	Manganese	MDL	Mercury	MDL	Molybdenum	MDL	Nickel	MDL	Selenium	MDL	Silver	MDL	Thallium	MDL	Vanadium	MDL	Zinc	MDL
Anglo Saxton Mine	WR-CC37	4.1	10400 J	1.5	3.3 J-	0.032	41.8	0.098	118	0.047	0.48	0.043	0.42 J-	0.045	4.4	0.088	35.5	0.032	71.4	0.044	87200 J	1.6	785	0.14	3780 J	0.071	0.002 U	0.004	10.9	0.049	3.6	0.049	4.5 J	0.073	4.0 J-	0.029	0.3	0.041	31.5	0.088	283	0.053
Anglo Saxton Mine	WR-CC38B	3.0	4230 J	1.5	58.7 J-	0.031	143	0.095	63.7	0.046	0.085 J	0.042	4.3 J-	0.044	1.2	0.086	1.2	0.031	283	0.043	61000 J	1.6	3340	0.41	300 J	0.023	0.42	0.003	22.6	0.047	0.67	0.047	10.1 J	0.071	14.2 J-	0.028	0.46	0.04	13.8	0.086	1650	0.051
Bandora Mine	WR1-M24	5.9	6580	1.5	59.3	0.032	85	0.098	149	0.047	1.6	0.086	86.3 J	0.09	3.9	0.088	20.4	0.065	1410	0.44	50200	5.4	14700 J	1.4	15700	0.24	0.37	0.003	38.8	0.097	11.8	0.097	3.0	0.073	92.4 J	0.058	0.16	0.041	11.8	0.088	12800	0.53
Bandora Mine	WR2-M24	6.2	8160	1.5	176	0.033	108	0.1	1110	0.19	0.47	0.044	10.7 J	0.046	5.1	0.09	3.7	0.033	1710	0.45	64700	5.5	24400 J	1.4	1040	0.024	0.49	0.004	36.9	0.05	1.6	0.05	7.7	0.075	40.4 J	0.03	0.18	0.042	19.7	0.09	11100	0.54
Bandora Mine	WR3-M24	6.7	4640	1.5	118 J	0.032	150	0.096	58.1 J	0.047	0.58	0.085	147 J	0.089	2.1	0.087	4.2 J	0.063	1610	1.1	23500	0.53	23200 J	3.4	15100	0.58	0.71	0.003	48.8 J	0.095	8.2 J	0.095	3.3	0.072	48.4 J	0.057	0.2	0.04	8.3	0.087	66800	1.3
Bandora Mine	WR4-M24	5.5	12700	2.2	4.5	0.092	33.9	0.14	184	0.14	4.0	0.062	160 J	0.065	7.1	0.13	117	0.046	2790	1.6	126000	19.3	2450 J	0.2	72100	0.85	0.002 U	0.005	25	0.069	34.6	0.069	3.0	0.1	5.9 J	0.042	0.33	0.12	20.6	0.13	16600	1.9
Ben Butler Mine	WR-BB	4.6	6720	1.5	128 J	0.033	207	0.1	58.6 J	0.048	0.14	0.044	29.3 J	0.046	2.1	0.09	0.97 J	0.033	435	0.045	35500	0.55	24000 J	2.1	194	0.024	0.77	0.004	49.8 J	0.05	0.97 J	0.05	1.2	0.075	93.7 J	0.059	2.3	0.042	10	0.09	20200	0.81
Ben Franklin Mine	BE4	2.3	3610 J	2.2	12.6 J	0.002	57.3 J	0.003	40.4 J	0.017	0.1 J	0.004	6.4 J	0.004	2.9 J	0.004	3.8 J	0.004	475 J	0.009	49100 J	1.4	6770 J	1.1	1130 J	0.15	0.47	0.011			2.6 J	0.007	1.7 J	0.081	34.8 J	0.001	0.37 J	0.003	15.6 J	0.004	2870 J	11.9
Boston Mine	WR-BSN	5.6	3270	1.5	81.1 J	0.033	245	0.099	191 J	0.048	0.11 J	0.087	15.8 J	0.046	1.3	0.09	0.5 J	0.033	81.8	0.045	25900	0.55	4660 J	0.43	122	0.024	1.7	0.01	118 J	0.049	0.68 J	0.049	0.99	0.074	22.4 J	0.029	2.3	0.041	4.5	0.09	4450	0.16
Brooklyn Mine	WR1-M12	3.4	6060	1.5	12.7	0.032	72.5	0.098	91.5	0.048	0.14	0.043	1.8 J	0.091	3.1	0.089	4.4	0.065	123	0.044	51400	1.1	2950 J	0.28	422	0.024	0.2	0.004	5.4	0.097	2.9	0.097	2.0	0.074	27 J	0.058	0.4	0.041	13.6	0.089	903	0.053
Brooklyn Mine	WR2-M12	3.6	11600	1.5	5.5	0.032	137	0.098	103	0.047	0.22	0.043	0.51 J	0.09	5.3	0.088	4.8	0.065	117	0.044	65100	1.6	1310 J	0.14	847	0.024	0.002 U	0.003	2.3	0.097	4.8	0.097	1.2	0.073	6.2 J	0.058	0.28	0.041	22.4	0.088	311	0.053
Brooklyn Mine	WR-M12	3.4	7610 J	1.5	2.7 J-	0.032	86.4	0.097	92.4	0.047	0.12 J	0.085	0.18 J-	0.09	9.9	0.088	2.2	0.064	47.4	0.044	47200 J	1.6	1920	0.14	571 J	0.023	0.14	0.003	6.5	0.096	4.3	0.096	1.9 J	0.073	14.3 J-	0.058	0.32	0.041	19	0.088	145	0.052
Clipper Mine	BE2	2.3	922 J	2.2	62.9 J	0.002	31.7 J	0.003	19.4 J	0.017	0.034 J	0.004	34.6 J	0.004	0.65 J	0.004	0.7 J	0.004	749 J	0.009	33000 J	1.3	28400 J	1.1	528 J	0.15	0.7	0.011			0.71 J	0.007	1.6 J	0.083	34.7 J	0.001	0.76 J	0.006	4.4 J	0.005	18300 J	11.5
Columbus Mine	AE13	3.9	6000 J	2.2	5.6 J-	0.002	91.9 J	0.004	38.3 J	0.018	0.002 U	0.004	6.4 J	0.005	5.0 J	0.004	5.8 J	0.004	512 J	0.009	41700 J	1.4	6060 J	1.1	1160 J	0.15	0.74	0.012			3.8 J	0.007	0.085 U	0.17	17.7 J	0.001	0.81 J	0.003	20.1 J	0.005	1750 J	1.2
Dewitt Mine	WR-DWT	5.0	9320 J	1.5	23.7 J-	0.033	169	0.1	37.3	0.049	0.56	0.088	1.1 J-	0.046	2.8	0.09	5.2	0.033	167	0.045	33300 J	0.55	5840	0.43	939 J	0.024	0.22	0.004	22.4	0.05	2.3	0.05	5.6 J	0.075	40.8 J-	0.03	0.71	0.042	8.6	0.09	589	0.054
Forest Queen Mine	FQ01	5.2	4370 J	2.4	19.5 J	0.002	32.7 J	0.004	56.6 J	0.019	1.7 J	0.004	13.1 J	0.005	4.1 J	0.005	4.5 J	0.005	1160 J	0.019	22900 J	1.4	6610 J	1.2	23500 J	1.6	0.53	0.012			2.4 J	0.007	0.89 J	0.089	26.8 J-	0.001	0.004 U	0.007	10.8 J	0.005	2330 J	1.3
Forest Queen Mine	FQ-TP01 0in-6in	5.8	4660 J	2.5	33.3 J	0.002	50.7 J	0.004	53.7 J	0.021	1.4 J	0.004	11 J	0.005	4.5 J	0.005	2.8 J	0.005	1670 J	0.54	26100 J	1.5	13700 J	1.3	49100 J	8.5	0.37	0.013			2.1 J	0.008	1.5 J	0.098	13.4 J-	0.001	0.002 U	0.004	10.7 J	0.005	2290 J	1.3
Forest Queen Mine	FQ-TP02 0in-6in	5.5	2730 J	2.3	22.8 J	0.002	38.3 J	0.004	33.7 J	0.019	0.87 J	0.004	14.4 J	0.005	4.5 J	0.005	2.4 J	0.005	1360 J	0.02	22400 J	1.4	6450 J	1.2	44400 J	7.9	0.12	0.012			1.9 J	0.007	1.3 J	0.091	13.1 J-	0.001	0.004 U	0.007	6.4 J	0.005	3480 J	12.5
Frisco/Bagley Tunnel	AE10	4.2	2910 J	2.2	13.8 J-	0.002	174 J	0.004	86.2 J	0.018	0.73 J	0.004	10 J	0.005	1.5 J	0.004	6.6 J	0.004	337 J	0.009	33800 J	1.3	7040 J	1.1	4040 J	1.5	1.2	0.012			2.4 J	0.007	0.085 U	0.17	27.1 J	0.001	1.4 J	0.003	8.1 J	0.005	1980 J	1.2
Frisco/Bagley Tunnel	AE10a	4.0	3810 J	2.2	7.6 J-	0.002	150 J	0.003	91.9 J	0.017	0.002 U	0.004	14.9 J	0.004	1.5 J	0.004	4.8 J	0.004	143 J	0.009	37600 J	1.3	3400 J	0.11	2640 J	1.5	0.82	0.012			1.2 J	0.007	0.042 U	0.083	17.3 J	0.001	1.1 J	0.003	7.4 J	0.005	3200 J	11.5
Gold King Mine	WR-CC06	5.7	11300 J	1.5	3.9 J-	0.064	22.8	0.096	51.9	0.047	0.74	0.042	0.97 J-	0.089	4.3	0.087	0.94	0.064	146	0.043	24000 J	0.53	2800	0.28	1130 J	0.023	0.14	0.003	9.4	0.095	1.5	0.095	4.7 J	0.072	11.1 J-	0.057	0.34	0.04	19.6	0.087	409	0.052
Grand Mogul Mine	WR-CC01C	5.2	4970	1.5	65.8 J	0.031	106	0.095	64.9 J	0.046	0.17 J	0.084	15.2 J	0.088	3.8	0.086	1.0 J	0.063	2050	0.86	40800	10.5	19900 J	2.7	977	0.023	1.4	0.01	6.3 J	0.094	1.1 J	0.094	4.0	0.071	32.1 J	0.056	0.44	0.04	19.8	0.086	17900	1
Grand Mogul Mine	WR-CC01C2	5.5	3550	1.4	64.6 J	0.031	81	0.19	66.1 J	0.046	0.27	0.083	20.1 J	0.087	2.2	0.17	0.59 J	0.062	758	0.042	30800	0.52	12800 J	1.3	670	0.023	1.5	0.007	15.4 J	0.093	0.78 J	0.093	4.4	0.14	26.2 J	0.056	0.45	0.039	10.4	0.17	14700	0.51
Henrietta Mine	WR-CC22	6.7	7330 J	1.5	12.9 J-	0.032	109	0.096	177	0.046	0.21	0.042	5.2 J-	0.044	3.1	0.087	2.7	0.032	264	0.043	27200 J	0.53	6700	0.41	366 J	0.023	0.31	0.003	0.91	0.048	3.7	0.048	4.8 J	0.14	13.8 J-	0.029	0.27	0.04	11.5	0.087	4320	0.16
Howardsville Colo Goldfields	PWMLP1		5210 J	2.1	31.9 J-	0.032	625	0.55	29.6 J-	0.047	0.021 U	0.042	12.1 J	0.044	4.6	0.087	4.9 J	0.032	995 J	0.054	48900 J	3.5	6580	0.47	4990	0.26	0.59	0.003	22.5	0.048	2.9 J	0.048	1.7 J	0.072	18.5 J	0.029	0.55 J-	0.04	11	0.087	3370	1.1
Howardsville Colo Goldfields	PWMLP2		7760 J	1.5	3.6 J	0.033	47.4	0.12	53.3	0.048	0.022 U	0.044	4.3	0.046	2.3 J	0.09	5.0	0.033	234 J	0.045	22700 J	0.55	1860	0.14	2310 J	0.024	0.1 J	0.004	9.5	0.049	2.6 J	0.049	0.8 J	0.075	8.0	0.03	0.021 U	0.042	10.7	0.09	1460 J	0.054
Joe and Johns Mine	WR-CC25	3.6	7160 J	1.5	6.6 J-	0.033	223	0.1	335	0.048	0.19	0.044	10.1 J-	0.046	7.2	0.09	1.5	0.033	64.7	0.045	34600 J	0.55	1350	0.14	136 J	0.024	0.37	0.004	4.3	0.05	2.0	0.05	7.3 J	0.075	7.5 J-	0.03	0.69	0.042	33.5	0.09	1040	0.054
Junction Mine	WR-M02D	4.0	8630 J	1.6	30.1 J-	0.35	1720	1.1	145	0.051	0.55 J	0.46	5.4 J-	0.49	16.5	0.095	5.0	0.35	487	0.047	75900 J	2.9	10200	0.75	388 J	0.025	7.6	0.055	1.7	0.52	10.3	0.52	6.0 J	0.079	35.9 J-	0.31	0.89	0.044	27.3	0.095	1980	0.28
Kittimack Tailings	1016BP-KMS-SO-00-BLM		3130	5.7	0.55 U	1.1	9.0	0.19	28.2	3.2	0.61	0.087	4.3	0.086	1.7	0.17	6.5	0.85	705	0.39	15400	2.1	3810	1.2	826	0.28	0.11	0.006			4.4	0.71	1.3 J	0.64	13.2 J-	0.17	0.25 U	0.5	7.0	0.91	1360	1.1
Kittimack Tailings	1016BP-KMT-SO-00-BLM		800	6.1	0.6 U	1.2	7.3	0.2	13.7 J	3.5	0.046 U	0.092	2.0	0.091	1.6	0.18	0.45 U	0.9	464	0.42	7220	2.2	4840	1.3	47.6	0.29	0.25	0.007			1.1 J	0.76	1.0 J	0.68	20.8 J-	0.18	0.27 U	0.54	2.3 J	0.97	426	1.2
Kittimack Tailings	KITTI MAC	6.0	1280	1.4	2.3	0.03	5.5	0.18	8.6	0.044	0.04 U	0.08	3.4 J	0.085	0.08 U	0.16	0.57	0.06	750	0.041	5690	0.5	4090 J	0.39	226	0.022	0.002 U	0.003	65.8	0.091	0.15 J	0.091	0.66	0.14	13.6 J	0.054	0.13	0.038	1.3 J	0.16	678	0.049
Kittimack Tailings	KMP1-SO-00		11200 D	19.8	0.25 U	0.494	7.8 D	0.494			0.49 U	0.989	2.1 D	0.099	4.1 D	0.989			652 D	0.494	27300 D	98.9	36.3 D	0.099	976 D	1.98	0.015 J	0.01			5.41 D	0.494	0.49 U	0.989	0.25 U	0.494	1.04 J	0.989			353 D	9.89
Kittimack Tailings	KMP2-SO-00		11400 D	19.9	0.25 U	0.497	8.7 D	0.497			0.50 U	0.995	2.2 D	0.1	4.4 D	0.995			709 D	0.497	30900 D	99.5	217 D	0.1	878 D	1.99	0.028 D	0.01			5.37 D	0.497	0.50 U	0.995	2.6 D	0.497	0.50 U	0.995			352 D	9.95
Kittimack Tailings	KMP3-SO-00		10000 D	20	0.25 U	0.5	14.3 D	0.5			0.5 U	1.0	1.5 D	0.1	4.9 D	1			546 D	0.5	39800 D	100	94.1 D	0.1	1190 D	2	0.024 D	0.01			5.0 D	0.5	0.5 U	1	1.1 D	0.5	0.5 U	1			301 D	10
Kittimack Tailings	KMP4-SO-00		8590 D	20	0.25 U	0.5	11 D	0.5			0.50 U	0.999	1.2 D	0.1	4.1 D	0.999			306 D	0.5	37500 D	99.9	677 D	0.1	387 D	2	0.039 D	0.01			4.7 D	0.5	0.50 U	0.999	1.6 D	0.5	0.50 U	0.999			305 D	9.99
Kittimack Tailings	KT03	4.0	2840 J	2.2	7.4 J	0.002	9.7 J	0.004	46.9 J	0.018	0.002 U	0.004	1.6 J	0.005	2.2 J	0.004	3.4 J	0.004	591 J	0.009	14800 J	1.3	5470 J	1.1	215 J	0.15	0.19	0.011			2.3 J	0.007	0.043 U	0.086	16 J	0.001	0.003 U	0.006	9.1 J	0.005	275 J-	1.2
Koehler Tunnel	WR-M02C	6.7	6300 J	1.6	18.5 J-	1.4	13700	4.2	101	0.05	0.9 U	1.8	3.3 J-	1.9	6.2	0.094	8.9	1.4	539	0.047	160000 J	5.7	3740	1.5	1700 J	0.025	3.0	0.011	4.6	2.1	1.05 U	2.1	3.0 J	0.078	14.6 J-	1.2	3.4	0.044	70.3	0.094	910	0.056
Lark Mine	WR-CC24	4.8	8050 J	1.5	7.3 J-	0.032	112	0.097	179	0.047	0.13	0.043	1.2 J-	0.045	4.0	0.087	2.3	0.032	67	0.044	35800 J	0.53	502	0.14	358 J	0.023	0.19	0.003	2.1	0.048	1.5	0.048	5.3 J	0.072	2.4 J-	0.029	0.31	0.04	18.4	0.087	248	0.052
London Mine	AE18 London Mine	2.7	1130 J	2	155 J-	0.002	119 J	0.003	48.1 J	0.017	0.002 U	0.004	34.7 J	0.004	0.76 J	0.004	0.75 J	0.004	197 J	0.009	14600 J	1.2	5660 J	1	107 J	0.14	0.66	0.011			1.2 J	0.007	2.2 J	0.082	47.4 J	0.001	2.0 J	0.006	4.5 J	0.004	9680 J	11
London Mine	WR1-LND	5.3	3240	1.5	99.3	0.033	94	0.099	73	0.048	0.085 J	0.043	17.8 J	0.046	2.3	0.089	0.74	0.033	166	0.045	28900	0.54	3300 J	0.28	161	0.024	0.6	0.004	16.2	0.049	1.0	0.049	2.9	0.074	16.9 J	0.029	0.63	0.041	5.7	0.089	2250	0.11
London Mine	WR2-LND	5.7	4980	1.5	87.9	0.032	169	0.098	52.5	0.047	0.19 J	0.086	33.3 J	0.09	1.7	0.088	2.1	0.064	143	0.044	25000	0.54	5490 J	0.7	713	0.024	0.53	0.003	48.9	0.096	1.3	0.096	1.4	0.073	35.4 J	0.058	2.0	0.041	12	0.088	7690	0.26
Longfellow Mine	WR-M02B	6.7	5920 J	1.5	49.2 J-	0.23	3160	0.68	133	0.047	0.15 U	0.3	4.8 J-	0.32	3.8	0.088	4.9	0.23	669	0.044	45700 J	1.6	3680	0.42	528 J	0.024	0.56	0.003	5.2	0.34	4.7	0.34	1.9 J	0.073	27.2 J-	0.2	0.54	0.041	11	0.088	1340	0.053
Mogul Mine	WR-CC02	5.3	3910	1.5	28.8 J	0.032	70.3	0.19	63.5 J	0.047	0.17 J	0.085	20.7 J	0.089	1.3	0.17	0.32 J	0.063	924	0.043	35600	0.53	21400 J	1.4	570	0.023	0.54	0.003	12.1 J	0.095	0.46 J	0.095	3.3	0.14	25.1 J	0.057	0.39	0.04	10.2	0.17	10200	0.52
Mogul Mine	WR-CC02A	5.5	4390 J	1.5	28.4 J-	0.032	72.9	0.096	132	0.047	0.21	0.042	4.7 J-	0.044	1.6	0.087	0.47	0.032	225	0.043	24300 J	0.53	5140	0.69	382 J	0.023	0.45	0.003	25	0.048	0.49	0.048	3.8 J	0.072	19.7 J-	0.029	0.39	0.04	9.9	0.087	3510	0.26
Mountain Queen Mine	AE1	2.2	1920 J	2.3	332 J-	0.004	227 J	0.003	182 J	0.017	0.002 U	0.004	95.8 J	0.004	1.0 J	0.004	0.26 J	0.004	664 J	0.009	32000 J	1.4	35700 J	1.1	54.3 J	0.15	1.5	0.012			0.35 J	0.007	32.3 J	0.081	16 J	0.001	0.0015 U	0.003	5.4 J	0.004	12400 J	12.1
Natalie/Occidental Mine	WR-CC14A	4.6	11200 J	1.5	0.81 J-	0.031	28.9	0.095	21.9	0.046	0.27	0.083	0.15 J-	0.088	6.2	0.085	4.4	0.062	48.3	0.043	38300 J	1	484	0.14	614 J	0.023	0.002 U	0.003	6.3	0.094	3.4	0.094	3.9 J	0.14	4.0 J-	0.056	0.21	0.04	30.5	0.085	310	0.051
Natalie/Occidental Mine	WR-CC14B	5.2	7390 J	1.5	2.5 J-	0.032	35.9	0.096	67.5	0.046	0.28	0.042	0.29 J-	0.044	3.7	0.086	6.7	0.032	71.4	0.043	59800 J	1.6	845	0.14	712 J	0.023	0.18	0.003	37.9	0.047	1.8	0.047	5.3 J	0.072	12.5 J-	0.028	0.24	0.04	24.9	0.086	223	0.052
Paradise Mine	WR1-M16	4.6	16100	1.5	16.8	0.033	61.5	0.099	174	0.048	0.27	0.087	0.85 J	0.091	3.8	0.089	8.0	0.065	38	0.044	80700	2.7	2370 J	0.14	1070	0.024	0.23	0.004	15	0.098	2.3	0.098	15.4	0.074	26.4 J	0.059	0.27	0.041	34.7	0.089	321	0.053
Paradise Mine	WR2-M16	3.6	9370	1.7	2.7	0.037	36	0.11	54.3	0.055	0.17	0.05	0.15 J	0.052	2.3	0.1	2.1	0.037	0.026 U	0.051	262000	5	16200 J	1.3	272	0.027	0.002 U	0.004	6.2	0.056	0.8	0.056	16.4	0.085	10.1 J	0.034	0.22	0.047	42	0.1	96.5	0.061
Paradise Mine	WR-M16	4.8	6710	1.5	0.57	0.032	3.7	0.098	81.3	0.048	0.052 J	0.043	0.023 U	0.045	1.2	0.089	0.71	0.032	0.022 UJ	0.044	53800	1.6	92.9	0.14	175 J	0.024	0.52	0.004	3.7	0.049	0.61	0.049	3.7	0.074	0.34 J	0.029	0.13	0.041	14.8	0.089	23.6	0.053
Pride of the West Mine	WR-PWN	6.8	7420	1.5	4.0	0.031	27.8	0.094	34.9	0.046	0.97	0.041	39.7	0.044	3.3	0.085	9.1	0.031	906 J	0.042	25200	0.52	13900	1.3	5450 J	0.23	0.002 U	0.003	101	0.047	4.5	0.047	3.0	0.07	12.9	0.028	0.23	0.039	9.0	0.085	9920	0.51
Pride of the West Mine	WR-PWS	6.7	9090	1.5	33.7	0.031	85.7	0.094	61.8	0.046	0.86	0.083	46.8	0.087	5.4	0.085	10.6	0.062	1640 J	0.043	42700	5.2	16300	1.3	5860 J	0.23	0.27	0.003	82.4	0.093	5.5	0.093	1.2	0.071	50.4	0.056	0.29	0.039	14	0.085	12100	0.51
Red and Bonita Mine	WR-CC03B	3.6	6340 J	1.8	1.1 J-	0.039	24.8	0.12	40.6	0.056	0.59	0.051	1.3 J-	0.054	1.6	0.11	0.69	0.039	104	0.053	257000 J	6.4	1970	0.17	350 J	0.028	0.22	0.004	6.3	0.058	1.0	0.058	2.1 J	0.087	3.1 J-	0.035	0.097 J	0.049	13.1	0.11	388	0.063
Red Cloud Mine	WR-RC	5.8	2440	1.5	209 J	0.033	369	0.2	300 J	0.048	0.12 J	0.087	22.1 J	0.091	0.8	0.18	0.31 J	0.065	251 J	0.044	32700	0.54	19100	1.4	43 J	0.024	3.6	0.035	18.3 J	0.098	0.61 J	0.098	3.7	0.15	34.4 J	0.059	1.5	0.041	3.3	0.18	10300	0.53
Silver Wing Mine	AE32a	2.1	1480 J	2.2	273 J-	0.002	702 J	0.18	24.6 J	0.018	0.002 U	0.004	10.5 J	0.005	2.7 J	0.004	2.2 J	0.004	3830 J	0.46	43400 J	1.3	7010 J	1.1	357 J	0.15	0.17	0.013			1.9 J	0.007	4.3 J	0.085	16 J	0.001	0.0015 U	0.003	12.4 J	0.005	1340 J	1.2
Silver Wing Mine	AE32b	2.4	1310 J	2.2	273 J-	0.002	729 J	0.18	86.3 J	0.018	0.002 U	0.004	8.6 J	0.005	0.97 J	0.004	0.84 J	0.004	2530 J	0.47	38600 J	1.3	4710 J	1.1	289 J	0.15	0.51	0.012			0.73 J	0.007	3.0 J	0.085	17.6 J	0.001	0.0015 U	0.003	10.7 J	0.005	1970 J	1.2
Sunbank Group Mine	AE44	3.7	5310 J	2.6	101 J-	0.002	148 J	0.004	77 J	0.019	0.64 J	0.004	1.1 J	0.005	4.9 J	0.005	18.7 J	0.005	422 J	0.01	47500 J	1.6	2040 J	0.13	3080 J	1.7	0.2	0.013			3.1 J	0.008	0.046 U	0.092	20.1 J	0.001	2.8 J	0.007	17.7 J	0.005	496 J	1.4
Sunbank Group Mine	AE45	3.8	6350 J	2.5	50 J-	0.003	109 J	0.004	93.4 J	0.021	0.49 J	0.005	2.7 J	0.005	4.1 J	0.005	21.5 J	0.005	270 J	0.011	55100 J	1.5	2210 J	0.12	8240 J	1.7	0.24	0.014			2.8 J	0.008	0.1 U	0.2	20.3 J	0.001	4.6 J	0.004	14.9 J	0.006	640 J	1.3
Sunnyside Mine	BE-01A	4.5	9240 J	2.2	20.5 J	0.002	55.1 J	0.004	64.2 J	0.02	0.68 J	0.004	12.2 J	0.005	7.4 J	0.005	18.9 J	0.005	773 J	0.01	46200 J	1.3	10500 J	1.1	11600 J	1.5	0.58	0.012			10 J	0.008	0.86 J	0.094	22.4 J	0.001	0.86 J	0.007	25.5 J	0.005	4030 J	11.7
Sunnyside Mine	BE-01C	4.9	6130 J	2.2	36.7 J	0.002	64.3 J	0.004	46.2 J	0.018	0.66 J	0.004	104 J	0.005	5.8 J	0.004	9.6 J	0.004	1400 J	0.018	42000 J	1.3	17100 J	1.1	18500 J	1.5	0.95	0.012			6.1 J	0.007	1.4 J	0.084	51.7 J	0.001	0.38 J	0.003	20.7 J	0.005	19900 J	11.7
Sunnyside Mine	BE1-B	4.8	1400 J	2.4	1.4 J	0.002	6.1 J	0.004	100 J	0.02	0.27 J	0.004	0.86 J	0.005	1.9 J	0.005	2.5 J	0.005	104 J	0.01	7110 J	1.5	119 J	0.12	167 J	0.16	0.026 J	0.012			4.0 J	0.008	0.57 J	0.094	0.48 J	0.001	0.43 J	0.004	8.2 J	0.005	127 J	1.3
Tom Moore Mine	WR-TM	4.7	4690	1.5	14.9 J	0.032	361	0.19	30.8 J	0.047	0.13 J	0.085	7.6 J	0.089	1.6	0.17	0.71 J	0.063	106 J	0.043	42400	2.6	8180	0.69	837 J	0.023	0.14	0.003	159 J	0.095	0.67 J	0.095	1.1	0.14	10.4 J	0.057	1.9	0.04	11.4	0.17	3080	0.26
Vermillion Mine	AE9A	5.6	2610	1.5	20 J	0.031	147	0.19	59.3	0.046	0.16	0.042	23.8 J	0.088	1.0	0.17	0.27	0.063	213	0.043	25800	0.52	10400 J	0.82	60.4	0.023	1.1	0.003	41.2	0.094	0.42	0.094	2.9	0.14	45.1 J	0.056	1.0	0.04	5.1	0.17	8520	0.31
Yukon Tunnel (Gold Hub)	WR-CC43	4.5	9750 J	1.5	13 J-	0.032	51.8	0.096	52.3	0.046	0.083 J	0.042	3.5 J-	0.044	3.4	0.086	4.2	0.032	2580	0.13	69800 J	1.6	3160	0.41	711 J	0.023	0.26	0.003	45.8	0.047	3.5	0.047	13.4 J	0.072	16.3 J-	0.028	0.38	0.04	23.8	0.086	844	0.052

Notes:
Calcium, potassium, sodium, and magnesium are excluded from this database because they are considered essential nutrients.
Empty spaces indicate that analytical data are not available for the target metal.

Appendix 2: Total Recoverable Metals in the Soil Samples Collected from the Overbank Soil Exposure Areas
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Sample Location	Aluminum	MDL	Antimony	MDL	Arsenic	MDL	Barium	MDL	Beryllium	MDL	Cadmium	MDL	Chromium	MDL	Cobalt	MDL	Copper	MDL	Iron	MDL	Lead	MDL	Manganese	MDL	Mercury	MDL	Molybdenum	MDL	Nickel	MDL	Selenium	MDL	Silver	MDL	Thallium	MDL	Vanadium	MDL	Zinc	MDL
M01	15700	1.9	1.3 UJ	0.04	12.3	0.15	103	0.059	0.78	0.053	0.67 U	0.056	4.2	0.11	5.2	0.04	8.2	0.055	25000	0.67	56.5	0.17	1100	0.029	0.036 J	0.0043	1.1	0.06	3.8	0.06	1.1 J	0.091	0.67 U	0.036	0.67 U	0.051	13.9	0.11	110	0.065
M02	20400	1.9	1.3 UJ	0.04	14.6	0.15	166	0.059	0.67 U	0.053	0.67 U	0.056	6.5	0.11	10.5	0.04	30.2	0.055	33900	0.67	53.7	0.17	981	0.029	0.092 J	0.0043	0.68	0.06	5.5	0.06	1.2 J	0.091	0.67 U	0.036	0.67 U	0.051	24.7	0.11	135	0.065
M02L	18600	1.8	1.3 UJ	0.038	10.4	0.14	183	0.055	0.68	0.05	0.63 U	0.053	4.2	0.1	11	0.038	35.4	0.051	32800	0.63	28.5	0.16	1470	0.028	0.039 J	0.004	0.52	0.056	5.3	0.056	1.6 J	0.085	0.63 U	0.034	0.63 U	0.048	19.8	0.1	121	0.061
M03	14200	1.7	1.2 UJ	0.036	13.6	0.13	92.9	0.052	0.59 U	0.047	0.59 U	0.05	2.6	0.097	8	0.036	55.9	0.049	46000	0.59	39.6	0.15	897	0.026	0.013 J	0.0038	0.42	0.053	3.2	0.053	0.76 J	0.081	0.59 U	0.032	0.59 U	0.045	15	0.097	71.4	0.058
M04	17700	1.8	1.3 UJ	0.039	22	0.14	127	0.058	0.66 U	0.052	1.3	0.055	4.2	0.11	9.2	0.039	175	0.054	29800	0.66	63.9	0.17	1110	0.029	0.022 J	0.0042	1	0.059	4.3	0.059	1.4 J	0.089	0.66 U	0.035	0.66 U	0.05	17.9	0.11	373	0.064
M05	18600	1.7	2.4 UJ	0.073	19.9	0.13	131	0.11	1.2 U	0.098	1.2 U	0.1	4.5	0.1	17.7	0.073	80.6	0.05	39200	0.61	56.5	0.16	978	0.027	0.015 J	0.0039	0.94	0.055	12.9	0.11	1.3 J	0.083	0.091 J	0.066	0.61 U	0.046	25.1	0.1	160	0.06
M07	11000 J	2	2.1 J-	0.042	135 J	0.15	65.4 J-	0.061	0.75	0.056	3.7 J-	0.059	4.6	0.11	3.2 J	0.042	139	0.057	38400 J	0.7	1960	0.18	258	0.031	0.67	0.0045	1.6	0.063	2.8 J	0.063	2.1 J	0.095	4.7 J-	0.038	0.7 U	0.053	16.7	0.11	1880 J	0.068
M10A	14800 J	2.4	3.4 UJ	0.1	831 J	0.38	59.5 J-	0.15	0.86 U	0.068	1.7 U	0.14	7.4	0.14	11.8 J	0.1	967	0.07	85000 J	1.7	1350	0.22	1070	0.038	0.45	0.0055	1.2	0.15	5.7 J	0.15	2.6 J	0.12	1.7 U	0.092	0.86 U	0.065	23.2	0.14	1320 J	0.084
M10B	11000 J	1.7	1.2 UJ	0.036	26.4 J	0.13	127 J-	0.053	0.61 U	0.049	1 J-	0.051	3.5	0.1	10.2 J	0.036	63.3	0.05	40100 J	0.61	271	0.16	1710	0.027	0.03 J	0.0039	2.5	0.055	4.5 J	0.055	1.4 J	0.083	1.2 J-	0.033	0.61 U	0.046	12.8	0.1	361 J	0.06
M11	14100 J	2.2	1.5 UJ	0.046	31.3 J	0.17	90.6 J-	0.068	0.77 U	0.062	2 J-	0.065	5.2	0.13	11.6 J	0.046	56.1	0.063	51800 J	0.77	222	0.2	2330	0.034	0.037 J	0.0049	2.7	0.069	3.9 J	0.069	2 J	0.1	1.5 J-	0.042	0.77 U	0.059	23.9	0.13	356 J	0.076
M12	15700 J	1.7	1.2 UJ	0.037	16.4 J	0.14	170 J-	0.054	0.62 U	0.049	1.9 J-	0.052	10.5	0.1	19.1 J	0.037	56.3	0.051	40900 J	0.62	241	0.16	3520	0.082	0.075 J	0.004	2.9	0.056	12.3 J	0.056	2.1 J	0.084	0.62 U	0.033	0.62 U	0.047	25.9	0.1	446 J	0.061
M12A	9880 J	1.9	1.4 UJ	0.041	36.8 J	0.15	161 J-	0.059	0.68 U	0.054	0.68 U	0.057	3.4	0.11	14.3 J	0.041	24.5	0.055	32300 J	0.68	62.5	0.18	764	0.03	0.035 J	0.0043	1.2	0.061	7.7 J	0.061	1.6 J	0.092	1 J-	0.036	0.68 U	0.051	22.8	0.11	88.3 J	0.066
M12B	8260 J	1.6	1.2 UJ	0.035	34.5 J	0.13	103 J-	0.051	0.58 U	0.047	0.58 U	0.049	1.1 J	0.096	4.8 J	0.035	15.9	0.048	27400 J	0.58	48.1	0.15	251	0.026	0.05 J	0.0037	0.7	0.053	1.8 J	0.053	1 J	0.079	0.58 U	0.032	0.58 U	0.044	10.1	0.096	55.6 J	0.057
M12C	10400	1.7	3.5 J	0.037	103 J	0.14	64.8 J	0.054	0.62 U	0.05	0.62 U	0.052	2.9	0.1	3.3	0.037	99.2 J	0.051	56200	1.2	3370	0.32	456	0.027	1.2 J+	0.012	3.8	0.056	2.6	0.056	2 J	0.084	18.2	0.033	0.62 U	0.047	18.6	0.1	763 J	0.061
M12D	6960	1.6	1.6 J	0.035	39.6 J	0.13	127 J	0.051	0.58 U	0.047	1.1	0.049	10.5	0.19	15.6	0.035	28.8 J	0.048	48500	1.2	405	0.15	1750	0.026	0.067 J+	0.0037	1.6	0.052	8.9	0.052	1.8 J	0.16	2.8	0.031	0.58 U	0.044	27.1	0.19	314 J	0.057
M12E	22600	1.6	1.1 UJ	0.034	7.2	0.13	106	0.051	0.57 U	0.046	0.57 U	0.048	4.6	0.094	9.3	0.034	23	0.047	41900	0.57	100	0.15	1900	0.025	0.011 J	0.0037	0.79	0.052	5.3	0.052	1 J	0.078	0.57 U	0.031	0.57 U	0.044	20.8	0.094	186	0.056
M12F	11400	1.6	2.7 J	0.035	77.3	0.13	115	0.052	0.59 U	0.047	0.59 U	0.049	2	0.096	2.6	0.035	34	0.048	49400	0.59	574	0.15	245	0.026	0.13	0.0038	1.1	0.053	1.6	0.053	1.5 J	0.08	2.2	0.032	0.59 U	0.045	18.7	0.096	129	0.058
M12G	10800 J	2.3	1.1 UJ	0.034	43.6	0.15	96 J	0.05	0.27 J	0.046	0.57 U	0.048	1.9	0.094	3.6 J	0.034	28.1 J	0.058	36300 J	0.95	44.3 J	0.13	352 J	0.07	0.11	0.0037	0.88	0.051	2.6 J	0.051	1.2 J	0.078	0.57 U	0.031	0.57 U	0.043	14.8	0.094	61.6 J	0.3
M13A	10400	1.7	1.2 UJ	0.036	70.9 J	0.13	79.5 J	0.053	0.6 U	0.048	0.74	0.05	12	0.098	5	0.036	127 J	0.049	63800	1.8	1040	0.16	1060	0.026	0.078 J+	0.0038	1.4	0.054	3.7	0.054	1.2 J	0.081	2.5	0.032	0.6 U	0.045	21.2	0.098	347 J	0.059
M13B	13900	1.6	1.2 UJ	0.035	24.1 J	0.13	177 J	0.051	0.58 U	0.046	0.58 U	0.049	4.3	0.095	9.4	0.035	29 J	0.047	51200	1.2	74.2	0.15	702	0.025	0.051 J+	0.0037	2.2	0.052	4.1	0.052	1.5 J	0.079	0.58 U	0.031	0.58 U	0.044	26.6	0.095	103 J	0.057
M13D	12800	3.3	2.3 UJ	0.07	26.7 J	0.26	227 J	0.1	1.2 U	0.094	2.3	0.098	4	0.19	9.1	0.07	60.5 J	0.096	31900	1.2	709	0.3	8120	0.15	0.15 J+	0.0075	1.8	0.11	5.8	0.11	1.5 J	0.16	1.2 U	0.063	1.2 U	0.089	15.3	0.19	577 J	0.11
M14	10500	1.5	1.1 UJ	0.032	10.6 J	0.12	124 J	0.047	0.54 U	0.043	0.54 U	0.045	1.7	0.088	1.2	0.032	14 J	0.044	32100	0.54	118	0.14	247	0.024	0.0044 J+	0.0034	1.9	0.048	0.86	0.048	1.9 J	0.073	0.54 U	0.029	0.54 U	0.041	14.1	0.088	63.6 J	0.053
M14A	11900	1.6	1.1 UJ	0.033	17.4 J	0.12	76.9 J	0.049	0.55 U	0.044	2	0.047	2.7	0.091	5.9	0.033	41.1 J	0.045	37500	0.55	157	0.14	890	0.024	0.011 J+	0.0035	2.3	0.05	2.5	0.05	1.6 J	0.075	0.97	0.03	0.55 U	0.042	17.3	0.091	145 J	0.054
M14B	5190	1.8	1.3 UJ	0.038	1.3 U	0.14	10.7 J	0.056	0.63 U	0.051	0.63 U	0.053	1.6	0.1	0.71	0.038	3.2 UJ	0.052	317000	6.3	0.92 J	0.16	85.1	0.028	0.029 J+	0.0041	0.24	0.057	0.59	0.057	0.5 J	0.086	0.63 U	0.034	0.63 U	0.048	8.2	0.1	51.9 J	0.062
M15	23900	3.5	2.5 UJ	0.076	9.2 J	0.28	225 J	0.11	1.3 U	0.1	1.3 U	0.11	4.1	0.21	36.9	0.076	10.4 J	0.1	70700	1.3	44.3	0.33	1480	0.056	0.068 J+	0.0081	4.5	0.11	9.9	0.11	5.5 J	0.17	1.3 U	0.068	1.3 U	0.096	25	0.21	234 J	0.12
M16A	19800 J	2.2	1.6 UJ	0.048	3.6	0.17	97.5 J	0.07	1.4 J	0.063	3 J	0.067	3.1	0.13	69.8 J	0.048	5	0.065	118000	3.2	113	0.21	5780	0.14	0.035 J	0.0051	6	0.071	7.2 J	0.071	7	0.11	0.79 U	0.043	0.79 UJ	0.06	29.7	0.13	430	0.078
M16E	18800 J	2.8	2 UJ	0.06	4.9	0.22	103 J	0.088	1 U	0.08	1 U	0.084	3.5	0.16	14.9 J	0.06	11.5	0.082	60200	1	78.8	0.26	2230	0.044	0.08 J	0.0064	2.3	0.09	3.2 J	0.09	4.1 J	0.14	1.2	0.054	1 UJ	0.076	25.4	0.16	133	0.098
M16F	16600 J	1.8	1.3 UJ	0.038	11.6	0.14	111 J	0.056	0.64 J	0.051	0.63 U	0.053	2.4	0.1	31 J	0.038	11.4	0.052	75200	1.9	75.5	0.16	2810	0.084	0.014 J	0.0041	3.6	0.057	3.5 J	0.057	3.4	0.086	0.63 U	0.034	0.63 UJ	0.048	20.7	0.1	188	0.062
M16G	22200 J	1.9	1.4 UJ	0.041	10.1	0.15	109 J	0.061	0.69 U	0.055	0.69 U	0.058	4.2	0.11	19 J	0.041	19.5	0.056	55900	2.1	174	0.18	1350	0.03	0.039 J	0.0044	2.9	0.062	3 J	0.062	2.7 J	0.094	0.69 U	0.037	0.69 UJ	0.052	29.9	0.11	138	0.067
M16H	24400 J	2.2	1.6 UJ	0.047	6.8	0.17	82.5 J	0.069	0.96 J	0.063	0.78 U	0.066	5	0.13	11.2 J	0.047	9.7	0.064	50700	0.78	103	0.2	936	0.035	0.054 J	0.005	2.4	0.071	3.6 J	0.071	4	0.11	0.78 U	0.042	0.78 UJ	0.06	39.1	0.13	124	0.077
M17	21200 J	2	1.4 UJ	0.043	12.9	0.16	131 J	0.063	0.85 J	0.058	1.1 J	0.06	3.1	0.12	45.8 J	0.043	11.6	0.059	99200	2.9	158	0.19	4200	0.13	0.026 J	0.0046	5.4	0.065	5.2 J	0.065	4.9	0.098	0.72 U	0.039	0.72 UJ	0.055	29.4	0.12	336	0.071
M17A	8300 J	1.6	1.2 UJ	0.035	26.4	0.13	90.9 J	0.051	0.58 U	0.046	0.58 U	0.049	1.8	0.095	6.3 J	0.035	15.1	0.048	37700	0.58	112	0.15	968	0.026	0.029 J	0.0037	18.8	0.052	1.8 J	0.052	2.1 J	0.079	0.82	0.031	0.58 UJ	0.044	10.3	0.095	101	0.057
M18	19100 J	2.2	1.6 UJ	0.048	8.4	0.18	182 J	0.071	0.8 U	0.064	0.8 U	0.067	4.6	0.13	3.3 J	0.048	24	0.066	44600	0.8	81.2	0.21	461	0.035	0.065 J	0.0051	6.6	0.072	3.3 J	0.072	3.5 J	0.11	0.8 U	0.043	0.8 UJ	0.061	34.8	0.13	75	0.079
M19	10300 J	1.7	1.2 UJ	0.037	25.8	0.14	102 J	0.055	0.62 U	0.05	0.63 J	0.052	1.9	0.1	8.1 J	0.037	12.3	0.051	25900	0.62	161	0.16	1660	0.027	0.017 J	0.004	1.7	0.056	2.2 J	0.056	1.4 J	0.085	0.62 U	0.034	0.62 UJ	0.047	9.8	0.1	198	0.061
M20	15600	2.1	0.41 J	0.045	7.1	0.17	72 J	0.066	0.33 J	0.06	0.22 J	0.063	2.4	0.12	12.4 J	0.045	13.2	0.062	104000 J	2.3	114	0.2	1200 J	0.033	0.015 J	0.0048	6.1	0.068	1.6 J	0.068	2.6 J	0.1	0.75 U	0.041	0.75 U	0.057	44.3 J	0.12	126	0.074
M22	13900	3.1	0.89 J	0.066	17.3	0.24	42.4 J	0.096	0.2 J	0.087	0.22 J	0.092	1.6 J	0.18	5.1 J	0.066	21.2	0.09	58700 J	1.1	128	0.28	608 J	0.048	0.077 J	0.007	5.8	0.098	1.6 J	0.098	3.9 J	0.15	1.1 U	0.059	1.1 U	0.083	12.7 J	0.18	119	0.11
M23	14600	1.8	0.13 J	0.039	4	0.14	76.7 J	0.057	0.3 J	0.052	0.21 J	0.055	5.9	0.11	5.8 J	0.039	13.9	0.053	23700 J	0.65	19	0.17	380 J	0.029	0.026 J	0.0042	2.2	0.059	7.1 J	0.059	1.2 J	0.088	0.65 U	0.035	0.65 U	0.049	26.1 J	0.11	88.7	0.064
M24D	21300	1.5	0.85 J	0.033	8.9	0.12	93.8 J	0.048	0.79	0.044	21.1	0.046	5.4	0.09	11.1 J	0.033	197	0.045	31300 J	0.55	349	0.14	6020 J	0.12	0.039 J	0.0035	2.5	0.05	10.2 J	0.05	1.5 J	0.075	1.6	0.03	0.55 U	0.042	22.5 J	0.09	4120	0.27
M25	18200	1.9	0.31 J	0.04	27.9	0.15	141 J	0.059	0.47 J	0.054	1.1	0.056	6.7	0.11	5.8 J	0.04	12	0.055	17300 J	0.67	55.3	0.17	709 J	0.03	0.039 J	0.0043	1	0.06	5.5 J	0.06	0.96 J	0.091	0.67 U	0.036	0.67 U	0.051	23.1 J	0.11	174	0.066
M26	12400	1.7	0.13 J	0.035	7	0.13	80.4 J	0.052	0.33 J	0.047	0.2 J	0.05	4	0.097	5.2 J	0.035	9.3	0.048	21300 J	0.59	133	0.15	966 J	0.026	0.0063 J	0.0038	0.28	0.053	5.5 J	0.053	0.98 J	0.08	0.59 U	0.032	0.59 U	0.045	10.1 J	0.097	79.1	0.058
M26B	9460	1.5	0.27 J	0.032	12.2	0.12	92.2 J	0.047	0.33 J	0.042	1.2	0.045	2.2	0.087	6.9 J	0.032	11.7	0.043	19200 J	0.53	144	0.14	1040 J	0.023	0.011 J	0.0034	0.55	0.048	6.1 J	0.048	1.1 J	0.072	0.53 U	0.029	0.53 U	0.04	7.8 J	0.087	278	0.052
M26D	13400 J	2	1.4 UJ	0.042	17.4 J	0.15	165	0.062	0.7 U	0.056	0.7 U	0.059	5.3 J	0.12	4.7	0.042	16.3	0.058	61800	1.4	46.4	0.18	256 J	0.031	0.056 J	0.0045	3.8	0.063	4.2	0.063	6.6 J	0.095	0.7 U	0.038	0.7 U	0.053	19.4 J	0.12	57.9 J	0.069
M27	12300	1.5	0.47 J	0.033	27	0.12	88.1 J	0.049	0.24 J	0.044	0.44 J	0.046	2.2	0.09	6.6 J	0.033	46.8	0.045	54900 J	1.7	270	0.14	705 J	0.024	0.021 J	0.0035	3.9	0.05	1.4 J	0.05	1.7 J	0.075	0.55 U	0.03	0.55 U	0.042	16.6 J	0.09	288	0.054
M27A	12100	2.1	0.34 J	0.032	5.7 J	0.14	170	0.047	0.21 J	0.043	0.11 J	0.045	2.6	0.087	2.3	0.032	22.4 J	0.054	35800	0.88	20.4 J	0.12	192 J	0.065	0.03 J	0.0034	1	0.048	1.5	0.048	1.4 J	0.072	0.53 U	0.029	0.53 U	0.04	17.6	0.087	45.1 J	0.28
M27A2	11500	2.4	0.74 J	0.036	10.1 J	0.16	202	0.053	0.2 J	0.048	1.6	0.051	3.5	0.099	2.2	0.036	26.3 J	0.062	22600	1	177 J	0.13	434 J	0.074	0.024 J	0.0039	5.6	0.054	2.2	0.054	1.6 J	0.082	0.61 U	0.033	0.61 U	0.046	13.9	0.099	446 J	0.31
M28	10100	2.8	0.71 J	0.061	23	0.22	53.2 J	0.089	0.27 J	0.081	0.17 J	0.085	4.5	0.17	5.3	0.061	4.5 J	0.083	167000 J	3	72.2	0.26	286 J	0.045	0.23	0.0065	1.2	0.091	4.5 J	0.091	1.7 J	0.14	1 U	0.055	1 U	0.077	54.7 J	0.17	94.1	0.099
M29	11200	2.7	0.94 J	0.041	45.4 J	0.18	63.1	0.06	0.47 J	0.054	1	0.057	3.2	0.11	10.6	0.041	72 J	0.069	51300	2.3	295 J	0.15	702 J	0.083	0.086 J	0.0044	3	0.061	4.2	0.061	2.1 J	0.092	0.71	0.037	0.68 U	0.052	21.4	0.11	484 J	0.35
M32	9450	2.3	0.68 J	0.034	28.4 J	0.15	64.1	0.05	0.27 J	0.045	0.67	0.047	3	0.093	7.1	0.034	60.3 J	0.058	52100	2.8	176 J	0.12	706 J	0.069	0.053 J	0.0036	2.8	0.051	3.2	0.051	1.5 J	0.077	0.56 U	0.03	0.56 U	0.043	20.4	0.093	492 J	0.29
M33	17000	2.3	1.8 J	0.035	7.7 J	0.15	143	0.051	0.34 J	0.046	0.47 J	0.049	7.1	0.095	3	0.035	77.2 J	0.059	132000	4.8	112 J	0.13	350 J	0.071	0.037 J	0.0037	1.8	0.052	2.5	0.052	1 J	0.079	0.58 U	0.031	0.58 U	0.044	76.1	0.095	154 J	0.3
M34	17200	3	9.9 J	0.046	36.4 J	0.2	167	0.067	0.53 J	0.061	2	0.064	7.7	0.12	9.4	0.046	356 J	0.078	41800	1.3	581 J	0.17	2130 J	0.093	0.37	0.0049	3.6	0.068	4.8	0.068	3 J	0.1	2.2	0.041	0.76 U	0.058	29.7	0.12	486 J	0.4
M38	10700	2.7	9 J	0.04	39.1 J	0.17	163	0.059	0.55 J	0.053	4	0.056	4.7	0.11	12.5	0.04	125 J	0.068	34500	1.1	673 J	0.15	1860 J	0.082	0.22	0.0043	4.8	0.06	6.1	0.06	3 J	0.091	3.9	0.036	0.67 U	0.051	23.4	0.11	816 J	0.35
LFK9	11700	1.5	2.5 J	0.033	125	0.12	100	0.048	0.55 U	0.044	2.5	0.046	3.4	0.09	7.1	0.033	175	0.045	28200	0.55	217	0.14	668	0.024	0.11	0.0035	0.95	0.049	4.3	0.049	1.3 J	0.075	0.98	0.03	0.55 U	0.042	17.7 Y	0.09	405	0.054
A07	15900	1.6	2.4 UJ	0.071	57.8	0.13	78.8	0.1	1.9	0.047	14.1	0.049	2.8	0.096	26.1	0.035	95.9	0.048	32800	0.59	470	0.15	1440	0.026	0.016 J	0.0038	13.7	0.053	7.7	0.053	1.7 J	0.08	1.1	0.032	1.5	0.089	12.1	0.096	1070 J	0.058
A07A	30700	3.2	4.6 UJ	0.14	55.4	0.25	94.8	0.2	3.3	0.092	15.2	0.097	3.7	0.19	46	0.069	325	0.095	41600	1.2	638	0.3	14400	0.25	0.14 J	0.0074	14.8	0.1	8.9	0.1	3.5 J	0.16	2.7	0.062	2.3 U	0.18	11.6	0.19	1070 J	0.11
A07B	48300	3.8	3.2 J	0.081	34.7	0.3	41.9	0.12	2.9	0.11	7	0.11	1.7 J	0.22	25	0.081	208	0.11	36800	1.4	561	0.35	10700	0.18	0.056 J	0.0086	7.4	0.12	3.8	0.12	2.4 J	0.18	1.9	0.073	1.4 U	0.1	4.6 J	0.22	546 J	0.13
A07D	21700 J	3	1.5 UJ	0.045	59.2	0.2	80.1 J	0.066	1	0.06	3.2	0.063	5.4	0.12	8.8 J	0.045	59.2 J	0.077	23000 J	1.2	487 J	0.17	2710 J	0.092	0.051 J	0.0048	3.7	0.068	5.2 J	0.068	1.9 J	0.1	2	0.041	0.75 U	0.057	16.7	0.12	818 J	0.39
A07E	13600 J	2.6	5.4 J	0.039	114	0.17	85 J	0.057	1.2	0.052	3.3	0.055	6.6	0.11	36.2 J	0.039	175 J	0.067	106000 J	3.3	505 J	0.14	7540 J	0.24	0.054 J	0.0042	29.1	0.059	3.4 J	0.059	2.5 J	0.089	4.1	0.035	3.3	0.05	12.4	0.11	434 J	0.34
A07F	15600 J	3.3	1.7 J	0.049	112	0.21	59.7 J	0.072	0.34 J	0.065	0.81 U	0.068	2.6	0.13	2.5 J	0.049	34.5 J	0.083	29000 J	1.3	280 J	0.18	410 J	0.099	0.062 J	0.0052	6.5	0.073	1.9 J	0.073	1.4 J	0.11	2.8	0.044	0.81 U	0.062	11.2	0.13	156 J	0.42
A07G	9890 J	2.5	5 J	0.037	115	0.16	60.4 J	0.054	0.24 J	0.049	0.62 U	0.052	3.5	0.1	2.6 J	0.037	21.8 J	0.063	24600 J	1	1490 J	0.14	347 J	0.075	0.049 J	0.0039	8.7	0.055	2.5 J	0.055	0.77 J	0.084	6.6	0.033	0.62 U	0.047	12.3	0.1	107 J	0.32
A08	9340	1.8	0.67 J	0.038	34.9	0.14	29.6	0.055	0.59 J	0.05	1.5	0.053	2.6	0.1	4.6	0.038	20.9	0.052	17100	0.63	163	0.16	2490	0.055	0.046 J	0.004	4.7	0.057	2.4	0.057	1 J	0.086	1.3	0.034	0.63 U	0.048	10.4	0.1	270 J	0.062
A09	18600 J	2.2	1.1 UJ	0.033	32.8 J	0.14	98.9 J	0.048	0.66	0.044	1.1	0.046	12 J	0.09	6.5 J	0.033	28.6 J+	0.056	24200 J	0.91	276 J	0.12	2660 J	0.067	0.02 J	0.0035	4.4	0.049	4.4 J	0.049	1 J	0.074	0.9	0.029	0.55 U	0.041	17.2	0.09	430 J	0.28
A10	12800 J	2.2	3.9 J	0.033	60.2 J	0.14	72 J	0.048	0.38 J	0.044	1.3	0.046	5.9 J	0.089	6.3 J	0.033	141 J+	0.056	40500 J	0.91	1870 J	0.12	2350 J	0.067	0.64	0.0035	16.3	0.049	3.6 J	0.049	1.2 J	0.074	5.9	0.029	0.55 U	0.041	20.3	0.089	404 J	0.28
A11	16100	2.2	1.7 J	0.047	57.8 J	0.17	102 J	0.069	1.8	0.063	4 J	0.066	6.4 J	0.13	16.1 J	0.047	65.6 J-	0.064	25700 J	0.79	500	0.2	5490 J	0.069	0.13 J	0.005	32.4	0.071	6.8 J	0.071	3.9 J	0.11	3.2	0.042	0.79 U	0.06	27.1	0.13	413	0.077
A13	15800	2.3	12 J	0.049	41.2 J	0.18	113 J	0.072	1.7	0.066	15.9 J	0.069	4.1 J	0.13	6.5 J	0.049	466 J-	0.067	28900 J	0.82	6000	0.86	14800 J	0.14	2.6	0.011	12.9	0.074	4.6 J	0.074	2.1 J	0.11	21.8	0.044	0.82 U	0.063	14.9	0.13	2100	0.081
A14	12100	1.5	5.8 J	0.064	43.6 J	0.12	47.1 J	0.094	1.1 U	0.086	3.1 J	0.09	4.3 J	0.088	3.9 J	0.064	92.9 J-	0.044	17700 J	0.54	1250	0.14	2130 J	0.024	0.56	0.0034	3.1	0.097	3.1 J	0.097	2.1 J	0.073	3.7	0.058	0.54 U	0.041	14.3	0.088	907	0.053
A15	18000	1.9	1.4 UJ	0.042	31.4 J	0.15	57.5 J	0.061	2.8	0.056	1.1 J	0.058	5.9 J	0.11	9.3 J	0.042	67.5 J-	0.057	29700 J	0.69	150	0.18	4800 J	0.061	0.034 J	0.0044	4.4	0.063	5.6 J	0.063	1.9 J	0.095	0.75	0.038	0.69 U	0.053	22.5	0.11	432	0.068
A20	20100	2.1	1.5 UJ	0.044	52.5 J	0.16	144 J	0.065	1.8	0.059	2.6 J	0.062	4.7 J	0.12	12.7 J	0.044	98.1 J-	0.061	27400 J	0.74	491	0.19	14700 J	0.13	0.092 J	0.0047	3.2	0.067	6.2 J	0.067	1.9 J	0.1	1.4	0.04	0.79	0.056	15.9	0.12	976	0.073
A21	17000	2	5.8 J	0.086	79.3	0.16	87.9	0.13	2.2	0.057	5.7	0.06	4.2	0.12	12.3	0.043	518	0.059	37000	0.72	3390	0.19	4270	0.16	0.86	0.0046	7.8	0.065	3.6	0.065	3.4 J	0.098	10.4	0.039	1.4 U	0.11	13.8	0.12	1460 J	0.07
A22	21200	1.8	3.1 J	0.04	44.8 J	0.15	169 J	0.058	2.8	0.053	9.8 J	0.055	6.7 J	0.11	13.4 J	0.04	318 J-	0.054	24000 J	0.66	1500	0.17	19600 J	0.2	0.16	0.0042	4.7	0.059	6.5 J	0.059	2.6 J	0.09	4.2	0.036	0.78	0.05	21.4	0.11	1600	0.065
A31	10900	2.6	9.6 J	0.038	93.8	0.17	60.8	0.056	1.5	0.051	7.9	0.054	4.7 J	0.1	10.8	0.038	330 J	0.065	25800	1.1	1180	0.14	6810	0.23	0.031 J	0.0041	6.8	0.058	6.7	0.058	1.6 J	0.087	2.2	0.035	0.64 U	0.049	21.5	0.1	1770 J	0.33
A32	7920	2.2	1.1 UJ	0.032	16.3	0.14	27.6	0.047	0.8	0.043	1	0.045	4.9 J	0.088	6.9	0.032	77 J	0.055	16600	0.9	182	0.12	1240	0.066	0.11 U	0.0035	5.6	0.049	3.3	0.049	1.3 J	0.073	1.2	0.029	0.54 U	0.041	13.8	0.088	192 J	0.28
A33	9690	2.2	4.3 J-	0.032	71.3	0.14	75.6 J	0.048	2	0.043	10.9 J	0.045	4.4	0.089	10.9 J	0.032	405 J	0.055	21200	0.9	874 J	0.12	10200 J	0.66	0.028 J	0.0035	7.4	0.049	6.8 J	0.049	1.9 J	0.073	3.1 J	0.029	0.54 U	0.041	19.6	0.089	2190	2.8
A34	11700	2.2	10.1 J-	0.033	23.7	0.14	113 J	0.048	0.61	0.043	14.8 J	0.046	27	0.089	18.8 J	0.033	485 J	0.055	95800	4.5	4390 J	0.6	5300 J	0.33	1.9	0.0069	7.4	0.049	63.7 J	0.049	1.6 J	0.074	11.9 J	0.029	0.54 U	0.041	25.1	0.089	3770	1.4
A35	11800 J	2.1	3.8 J-	0.031	51	0.14	70.9 J-	0.046	1.7 J-	0.042	9.1 J	0.044	3.6	0.085	12.1 J	0.031	316 J	0.053	26200 J	0.86	1490	0.11	10800	0.51	0.065 J	0.0033	7.7	0.047	7.6 J	0.047	1.6 J	0.071	3.9 J	0.028	0.52 UJ	0.039	16.8	0.085	2230	2.2
A36	11100	2.1	1.1 UJ	0.032	24.5	0.14	72.3 J	0.047	0.48 J	0.043	0.64 J	0.045	8	0.088	10.6 J	0.032	74.5 J	0.055	52000	2.7	164 J	0.12	1250 J	0.065	0.0096 J	0.0034	5.4	0.048	6.1 J	0.048	2.5 J	0.073	0.85 J	0.029	0.54 U	0.041	27.4	0.088	247	0.28
A37	14800	2.2	1.3 J-	0.033	20.4	0.14	159 J	0.049	0.87	0.044	12 J	0.046	5.5	0.09	17.9 J	0.033	237 J	0.056	36100	0.92	838 J	0.12	10000 J	0.54	0.093 J	0.0035	4.3	0.05	9.6 J	0.05	2.1 J	0.075	2.2 J	0.03	0.55 U	0.042	23.5	0.09	1940	2.3
A39	17700	2.2	2 J-	0.033	18.6	0.14	70.1 J	0.048	0.98	0.044	12.2 J	0.046	5.9	0.09	15.7 J	0.033	456 J	0.056	60100	5.5	1010 J	0.12	9450 J	0.4	0.055 J	0.0035	9.5	0.049	11.5 J	0.049	3	0.075	7.6 J	0.03	0.55 U	0.042	25.9	0.09	3640	1.7
A40	13800 J	2.7	26.5 J-	0.041	50.3	0.18	164 J-	0.06	0.93 J-	0.054	10.2 J	0.057	4.8	0.11	4.9 J	0.041	879 J	0.069	31000 J	1.1	10500	3.7	43000	2.1	0.67	0.0044	18.1	0.061	1.9 J	0.061	2.2 J	0.093	47.9 J	0.037	0.68 U	0.052	13.1	0.11	2530	8.8
A40A	10900 J	2.1	3.2 J-	0.031	44	0.14	79.2 J-	0.046	1.5 J-	0.042	10.1 J	0.044	4.2	0.085	9.8 J	0.031	378 J	0.053	26200 J	0.86	2180	0.11	12900	0.64	0.069 J	0.0033	7.4	0.047	6 J	0.047	1.5 J	0.071	4.6 J	0.028	0.52 UJ	0.04	14.7	0.085	2130	2.7
A41A	10700 J	2.2	1.1 U	0.032	16.1	0.14	75 J-	0.048	1.7 J-	0.043	2 J	0.045	2.6	0.089	8.9 J	0.032	90.5 J	0.055	26900 J	0.9	433	0.12	2980	0.2	0.032 J	0.0035	3.1	0.049	4.4 J	0.049	1.4 J	0.074	2 J	0.029	0.54 U	0.041	15.7	0.089	584	0.28
A42	9930 J	2.2	1.1 U	0.032	5.1	0.14	67.8 J-	0.047	0.68 J-	0.043	0.54 U	0.045	3.2	0.088	7.7 J	0.032	77 J	0.055	30000 J	0.89	98.3	0.12	964	0.066	0.011 J	0.0034	3.3	0.049	4.4 J	0.049	1.2 J	0.073	0.71 J	0.029	0.54 UJ	0.041	18.9	0.088	183	0.28
A45	10500 J	2.3	2.7 J-	0.035	26.7	0.15	104 J-	0.051	1.2 J-	0.047	10.8 J	0.049	3.6	0.096	11.2 J	0.035	331 J	0.06	25600 J	0.97	1860	0.13	12200	0.71	0.049 J	0.0037	6.6	0.053	6.5 J	0.053	1.5 J	0.079	4.9 J	0.032	0.58 UJ	0.044	16.6	0.096	2660	3
A47	13600 J	1.4	1 UJ	0.031	6.9	0.11	48.9	0.045	0.83	0.041	2.5	0.043	5.1 J	0.085	12.1	0.031	130 J	0.042	28500 J	0.52	236	0.13	1590 J	0.023	0.013 J	0.0033	4.3	0.046	7 J	0.046	1.6 J	0.07	0.84	0.028	0.52 U	0.039	20.6	0.085	506 J	0.051
A48	11100 J	1.5	1 UJ	0.031	6	0.12	45.6	0.046	0.52 U	0.042	0.52 U	0.044	2.8 J	0.086	4	0.031	52.6 J	0.043	24900 J	0.52	258	0.14	918 J	0.023	0.1 U	0.0034	1.8	0.047	2.5 J	0.047	0.75 J	0.071	0.52 U	0.028	0.52 U	0.04	14.2	0.086	294 J	0.051
A55	12400 J	1.5	1.1 UJ	0.032	15	0.12	64.4	0.047	0.54 U	0.043	1	0.045	3.4 J	0.088	9	0.032	47.8 J	0.044	41200 J	0.54	192	0.14	1320 J	0.024	0.0076 J	0.0034	1.9	0.048	4 J	0.048	1.2 J	0.073	0.54 U	0.029	0.54 U	0.041	20.5	0.088	412 J	0.053
A55a	19000 J	1.6	1.2 UJ	0.035	9.8	0.13	92.7	0.051	1.2	0.046	2.5	0.049	8.8 J	0.095	25.1	0.035	79.8 J	0.047	33900 J	0.58	328	0.15	1810 J	0.025	0.041 J	0.0037	6.3	0.052	9.7 J	0.052	3	0.079	1.3	0.031	0.58 U	0.044	31.4	0.095	559 J	0.057
A56	15400 J	1.5	1.1 UJ	0.032	10.1	0.12	34	0.047	0.54 U	0.043	0.68	0.045	7 J	0.088	9.7	0.032	90 J	0.044	37500 J	0.54	508	0.14	1200 J	0.024	0.018 J	0.0034	2.5	0.048	5.9 J	0.048	0.91 J	0.073	1.1	0.029	0.54 U	0.041	23.7	0.088	275 J	0.053
BB2	14700 J	2.5	1.3 UJ	0.038	60.1	0.16	75 J	0.055	0.46 J	0.05	0.99	0.053	4.9	0.1	4.4 J	0.038	21.9 J	0.064	22900 J	1	473 J	0.14	910 J	0.077	0.028 J	0.004	2.2	0.057	4 J	0.057	0.92 J	0.085	1.2	0.034	0.63 U	0.048	19.5	0.1	328 J	0.33
BG1A	5910 J	2.5	7.6 J	0.038	101	0.16	80.1 J	0.056	0.2 J	0.051	0.63 U	0.053	2	0.1	3 J	0.038	28.8 J	0.065	13000 J	1.1	1350 J	0.14	484 J	0.077	0.061 J	0.0041	39.6	0.057	1.6 J	0.057	1.4 J	0.086	5.1	0.034	0.63 U	0.048	6.9	0.1	123 J	0.33
BG4	19600 J	3.4	1.7 UJ	0.051	36.2	0.22	78 J	0.075	0.91	0.068	1.3	0.072	5.6	0.14	7.2 J	0.051	38.3 J	0.087	21500 J	1.4	180 J	0.19	1870 J	0.1	0.065 J	0.0055	5.5	0.077	4.9 J	0.077	1.3 J	0.12	1.2	0.046	0.86 U	0.065	19.6	0.14	338 J	0.44
CG11	15500	1.7	4 J	0.037	41.7 J	0.14	59.3 J	0.054	1	0.049	5.9 J	0.052	5.2 J	0.1	8.8 J	0.037	182 J-	0.051	29300 J	0.62	1300	0.16	6080 J	0.082	1.2	0.004	6.3	0.056	4.6 J	0.056	1.8 J	0.084	5.2	0.033	0.62 U	0.047	19.5	0.1	857	0.061
CG6	25400	2.2	1.6 UJ	0.047	29.9 J	0.17	39.9 J	0.069	6.1	0.063	1.6 J	0.066	5.8 J	0.13	15.2 J	0.047	156 J-	0.064	40100 J	0.79	162	0.2	7020 J	0.1	0.038 J	0.005	4.7	0.071	7.4 J	0.071	2.5 J	0.11	0.79 U	0.042	0.79 U	0.06	32.5	0.13	813	0.077
CG9	16900	4.2	6.1 J	0.09	176 J	0.33	357 J	0.13	9	0.12	216 J	0.13	3.4 J	0.25	63.6 J	0.09	2890 J-	0.12	69700 J	1.5	1730	0.39	55900 J	0.66	0.2 J	0.0096	81.8	0.14	53.1 J	0.14	5.9 J	0.2	5.9	0.081	1.5 U	0.11	8.6	0.25	30200	1.5
CU4	10500 J	1.6	1.2 UJ	0.035	23.4	0.13	28.9	0.052	0.59 U	0.047	2.2	0.049	2.4 J	0.096	5	0.035	105 J	0.048	21800 J	0.59	1760	0.15	2210 J	0.026	0.015 J	0.0038	7.1	0.053	2.3 J	0.053	1 J	0.08	2	0.032	0.59 U	0.045	9.3	0.096	665 J	0.057
CU4a	13000 J	1.7	3.8 J	0.037	9.2	0.13	115	0.054	0.61 U	0.049	2	0.051	4.8 J	0.1	9.3	0.037	47.2 J	0.05	30200 J	0.61	820	0.16	1260 J	0.027	0.012 J	0.0039	4.4	0.055	3.9 J	0.055	1.9 J	0.083	2.4	0.033	0.61 U	0.046	32.1	0.1	458 J	0.06
EG1	23500 J	2.4	1.2 UJ	0.036	13.5 J	0.16	64.4 J	0.053	0.5 J	0.048	0.6 U	0.051	9.7 J	0.099	5.8 J	0.036	25.2 J+	0.062	32500 J	1	97.7 J	0.13	1210 J	0.074	0.021 J	0.0039	1.5	0.054	6.2 J	0.054	0.92 J	0.082	0.6 U	0.033	0.6 U	0.046	28.1	0.099	187 J	0.31
EG2	22800 J	2.1	1.1 UJ	0.032	14.7 J	0.14	49.2 J	0.047	0.73	0.043	0.57	0.045	6.7 J	0.088	17.2 J	0.032	59.3 J+	0.054	48000 J	0.89	130 J	0.12	1880 J	0.065	0.036 J	0.0034	0.88	0.048	8 J	0.048	2 J	0.073	0.7	0.029	0.53 U	0.041	46	0.088	366 J	0.28
EG2A	20900 J	2.2	1.1 UJ	0.033	26.6 J	0.14	51 J	0.048	0.76	0.043	1.3	0.046	7.8 J	0.089	11.8 J	0.033	76.3 J+	0.055	44900 J	0.9	321 J	0.12	3410 J	0.2	0.064 J	0.0035	1.8	0.049	7.4 J	0.049	1.6 J	0.074	1.5	0.029	0.54 U	0.041	30.8	0.089	892 J	0.28
EG3	19200 J	2.3	1.1 UJ	0.034	8.8 J	0.15	54.4 J	0.05	0.59	0.046	0.57 U	0.048	6 J	0.093	13.7 J	0.034	37.6 J+	0.058	39200 J	0.95	89.6 J	0.13	1300 J	0.069	0.021 J	0.0036	0.62	0.051	8.4 J	0.051	1.5 J	0.077	0.57 U	0.031	0.57 U	0.043	29.2	0.093	178 J	0.3
EG3A	17300 J	2.1	1.2 J	0.032	17.4 J	0.14	48 J	0.047	0.74	0.043	0.71	0.045	8.8 J	0.088	18 J	0.032	96.9 J+	0.055	55600 J	2.7	605 J	0.12	1620 J	0.065	0.23	0.0034	2.1	0.048	10 J	0.048	2.2 J	0.073	4.9	0.029	0.53 U	0.041	39.2	0.088	282 J	0.28
EG4	18300 J	2.3	1.1 UJ	0.034	23.8 J	0.15	55.7 J	0.05	0.69	0.046	2.4	0.048	6.1 J	0.093	13.4 J	0.034	180 J+	0.058	47500 J	0.94	673 J	0.13	3550 J	0.21	0.12	0.0036	1.2	0.051	7.9 J	0.051	1.8 J	0.077	2	0.031	0.57 U	0.043	29.1	0.093	688 J	0.3
EG5	18100	2.1	1.2 J-	0.032	42.4	0.14	108 J	0.046	0.84	0.042	4.9 J	0.044	7.7	0.086	14 J	0.032	192 J	0.054	65400	4.4	730 J	0.12	5830 J	0.32	0.046 J	0.0034	6.1	0.047	8.8 J	0.047	2.8	0.071	4.9 J	0.028	0.53 U	0.04	32.7	0.086	1050	0.27
EG6	16000	2.3	2.4 J-	0.035	31.7	0.15	85.3 J	0.051	0.86	0.046	11 J	0.049	6.3	0.095	17.3 J	0.035	439 J	0.059	67000	9.6	1770 J	0.13	15100 J	0.71	0.11 J	0.0037	5.2	0.052	9.2 J	0.052	2.3 J	0.079	5.8 J	0.031	0.58 U	0.044	27.8	0.095	3450	3
EG9	15800	2.5	1.5 J-	0.037	38.6	0.16	140 J	0.054	0.97	0.049	10.2 J	0.052	7.4	0.1	20.8 J	0.037	331 J	0.063	63500	10.2	913 J	0.14	11100 J	0.75	0.071 J	0.0039	6.7	0.055	11.6 J	0.055	3.2	0.084	2.8 J	0.033	0.61 U	0.047	29.7	0.1	2790	3.2
LA3	9630 J	2.2	1.6 J-	0.032	19.8	0.14	98.3 J-	0.048	0.91 J-	0.043	5.2 J	0.045	2.8	0.089	10 J	0.032	169 J	0.055	28500 J	0.9	810	0.12	4320	0.33	0.036 J	0.0035	3.3	0.049	5.3 J	0.049	1.6 J	0.074	2.1 J	0.029	0.54 U	0.041	15.9	0.089	1020	0.28
MC0	20700	3.2	2.9 J-	0.047	31.9	0.21	223 J	0.07	1.8	0.063	20.8 J	0.066	8.3	0.13	20 J	0.047	571 J	0.081	44000	1.3	1390 J	0.17	13400 J	0.67	0.32	0.0051	5.4	0.071	15.9 J	0.071	5.2	0.11	7.6 J	0.043	0.79 U	0.06	34.2	0.13	3690	2.9
UA5	11200	3.1	1.5 UJ	0.046	27.7	0.2	85.7	0.068	0.77 U	0.061	2	0.065	6.7 J	0.13	4.9	0.046	19.1 J	0.078	13700	1.3	142	0.17	868	0.094	0.04 J	0.0049	4.5	0.069	5.5	0.069	1.6 J	0.1	1.1	0.042	0.77 U	0.058	19	0.13	293 J	0.4
CC01C	10400	2.6	3.3 J	0.039	41.4 J	0.17	30.7	0.057	0.65 U	0.052	0.91	0.055	4	0.11	4.9	0.039	191 J	0.067	32700	1.1	1150 J	0.14	1560	0.08	0.31 J+	0.0042	4.8	0.059	3.3 J	0.059	1 J	0.089	3.1	0.035	0.65 U	0.05	17.4	0.11	280 J	0.34
CC01C1	11400	3.2	1.6 UJ	0.048	36.6 J	0.21	99.5	0.07	0.8 U	0.064	3.9	0.067	4.1	0.13	5.3	0.048	192 J	0.081	26000	1.3	1080 J	0.17	2460	0.097	0.1 J+	0.0051	1.8	0.072	4.1 J	0.072	1.1 J	0.11	2.9	0.043	0.8 U	0.06	12.6	0.13	737 J	0.41
CC01C2	25300	3	1.5 UJ	0.046	36.3 J	0.2	136	0.067	1.7	0.061	54.5	0.064	6.6	0.12	39.5	0.046	995 J	0.077	33600	1.3	1650 J	0.17	35900	1.9	0.041 J+	0.0049	3.2	0.068	19 J	0.068	3.3 J	0.1	3.4	0.041	1	0.058	19.8	0.12	5560 J	7.9
CC01F	12300	2.6	1.3 UJ	0.039	23 J	0.17	57.7	0.057	0.65 U	0.052	0.65 U	0.054	5.8	0.11	10.2	0.039	59.5 J	0.066	27200	1.1	462 J	0.14	1670	0.079	0.062 J+	0.0041	4.5	0.058	4.9 J	0.058	1 J	0.088	1.2	0.035	0.65 U	0.049	16.9	0.11	173 J	0.34
CC01H	16800	2.9	1.5 UJ	0.044	41.3 J	0.19	62.8	0.064	0.83	0.059	6.5	0.062	5.5	0.12	19.5	0.044	549 J	0.075	34000	1.2	896 J	0.16	6960	0.36	0.059 J+	0.0047	2.5	0.066	7.2 J	0.066	1.8 J	0.1	1.8	0.04	0.73 U	0.056	18.1	0.12	629 J	0.38
CC01S	7670	2.4	1.6 J	0.035	22.4 J	0.15	74.4	0.052	0.59 U	0.047	3.4	0.05	3.9	0.097	8	0.035	86.3 J	0.06	19900	0.98	287 J	0.13	3600	0.22	0.025 J+	0.0038	2.9	0.053	4.5 J	0.053	1.2 J	0.08	1.7	0.032	0.59 U	0.045	12.7	0.097	349 J	0.31
CC01T	20400 J	2	1.6 J	0.042	31.3	0.15	196	0.062	1.2	0.056	18.4 J	0.059	9.3 J	0.12	29.6	0.042	307	0.058	32300 J	0.7	812	0.18	15500	0.25	0.034 J	0.0045	3.6	0.063	13.1	0.063	2.7 J	0.096	2.4	0.038	0.7 U	0.054	30.4 J	0.12	1410	0.069
CC01U	13000 J	1.8	7.2 J	0.038	50.5	0.14	126	0.056	0.9	0.05	2.5 J	0.053	5.6 J	0.1	10.8	0.038	241	0.052	39400 J	0.63	711	0.16	4130	0.083	0.038 J	0.004	7.9	0.057	5	0.057	2.4 J	0.086	4.2	0.034	0.63 U	0.048	21.4 J	0.1	642	0.062
CC02	13800 J	1.7	0.086 J	0.037	32.8	0.14	6.2 U	0.054	0.62 U	0.049	0.62 U	0.052	0.12 J	0.1	0.62 U	0.037	161	0.051	37400 J	0.62	572	0.16	2740	0.054	0.013 J	0.004	0.11	0.056	0.62 U	0.056	3.1 U	0.084	0.07 J	0.033	0.62 U	0.047	0.52 J	0.1	440	0.06
CC02C	15000 J	1.6	2 J	0.034	47.5	0.12	73.3	0.05	0.68	0.045	1.8 J	0.047	5.9 J	0.093	10.7	0.034	370	0.046	46900 J	1.7	819	0.15	3640	0.075	0.02 J	0.0036	3.6	0.051	5.2	0.051	2 J	0.077	2.9	0.031	0.57 U	0.043	22.8 J	0.093	2490	0.17
CC02I	15000 J	2	2.5 J	0.042	28.4	0.15	129	0.061	0.7 U	0.056	3.2 J	0.059	8.2 J	0.11	17.5	0.042	131	0.057	36100 J	0.7	930	0.18	3910	0.092	0.055 J	0.0045	2.8	0.063	6.2	0.063	1.3 J	0.095	1.6	0.038	0.7 U	0.053	27.7 J	0.11	567	0.068
CC03	10400 J	1.6	1.7 J	0.034	22.9	0.12	87.4	0.049	0.56 U	0.045	1.2 J	0.047	6.8 J	0.092	13.2	0.034	104	0.046	43200 J	1.1	504	0.15	2470	0.049	0.14	0.0036	3.9	0.051	4.6	0.051	2.5 J	0.076	2.3	0.03	0.56 U	0.043	32.2 J	0.092	349	0.055
CC03A	17200 J	2.3	5 J	0.05	52.9	0.18	119	0.073	1.2	0.067	5.1 J	0.07	11.4 J	0.14	15.4	0.05	427	0.068	51700 J	0.83	964	0.22	3920	0.073	0.022 J	0.0053	6.9	0.075	7.4	0.075	3.2 J	0.11	5.2	0.045	0.83 U	0.063	37.9 J	0.14	737	0.082
CC03B	13300 J	1.6	1.5 J	0.069	37.5	0.13	49.3 J	0.1	0.57 U	0.046	1.4 J	0.096	5.1 J	0.094	11.4 J	0.069	137	0.047	45200 J	1.7	707	0.15	3370	0.075	0.011 J	0.0037	3.5 J	0.1	4.8 J	0.1	1.8 J	0.078	1.3 J	0.062	0.57 U	0.043	26.3 J	0.094	343	0.056
CC03BF	14400 J	2.7	1.7 J	0.04	29.8 J-	0.17	51	0.059	0.67 U	0.053	1.7	0.056	3.9	0.11	10.8	0.04	195 J	0.068	44300 J	1.1	579 J	0.15	3800 J	0.16	0.042 J	0.0043	3.4	0.06	4	0.06	1.2 J	0.091	2 J	0.036	0.67 U	0.051	19.3	0.11	501 J	0.35
CC03D	5970 J	2.9	2.5 J	0.044	1.5 R	0.19	16.1	0.064	0.73 U	0.058	0.73 U	0.061	2.9	0.12	1.5	0.044	53.8 J	0.074	292000 J	12	247 J	0.16	207 J	0.089	0.12 J	0.0046	2.2	0.065	1.1	0.065	1.1 J	0.099	1.9 J	0.039	0.73 U	0.055	19.2	0.12	385 J	0.38
CC04	11400 J	2.4	1.2 UJ	0.036	9.2 J-	0.15	47.8	0.052	0.59 U	0.048	0.59 U	0.05	5	0.098	7.2	0.036	41.4 J	0.061	33700 J	0.99	294 J	0.13	409 J	0.073	0.032 J	0.0038	2.8	0.054	3.8	0.054	1.6 J	0.081	1.3 J	0.032	0.59 U	0.045	23.7	0.098	62.9 J	0.31
CC07	10200 J	2.2	1.8 J	0.033	53.5 J-	0.14	48.6	0.049	0.56 U	0.044	0.56 U	0.047	4.5	0.091	3.2	0.033	82.7 J	0.057	82300 J	2.8	1950 J	0.12	489 J	0.068	0.056 J	0.0036	6.9	0.05	2.1	0.05	2.1 J	0.076	2.4 J	0.03	0.56 U	0.042	25.4	0.091	577 J	0.29

Appendix 2: Total Recoverable Metals in the Soil Samples Collected from the Overbank Soil Exposure Areas
Terrestrial Screening-Level Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Sample Location	Aluminum	MDL	Antimony	MDL	Arsenic	MDL	Barium	MDL	Beryllium	MDL	Cadmium	MDL	Chromium	MDL
CC15	9570 J	2.4	1.2 UJ	0.035	14.8 J-	0.15	68	0.052	0.59 U	0.047	0.59 U	0.049	2.6	0.097
CC15A	8220 J	2.3	1.2 UJ	0.035	20.5 J-	0.15	51.2	0.051	0.58 U	0.046	0.58 U	0.049	2.6	0.095
CC16	10300 J	2.2	1.1 UJ	0.033	13.4 J-	0.14	59.6	0.049	0.56 U	0.045	0.56 U	0.047	4.3	0.091
CC16B	11600 J	2.4	1.2 UJ	0.035	26.3 J-	0.15	48.5	0.052	0.59 U	0.047	0.59 U	0.05	3.3	0.097
CC17	8960 J	2.5	3.2 J	0.037	12.5 J	0.16	79.3 J	0.055	0.12 J	0.05	0.62 U	0.052	4.5	0.1
CC18	12500 J	2.3	3.5 J	0.034	27.6 J	0.15	54.9 J	0.05	1.1	0.045	2	0.047	7	0.093
CC18B	10800 J	2.1	1.5 J	0.032	30.1 J	0.14	47.5 J	0.047	0.22 J	0.043	0.66	0.045	6	0.087
CC20	11800 J	2.4	1.6 J	0.036	27.1 J	0.16	76.2 J	0.053	0.52 J	0.048	0.96	0.051	6.2	0.099
CC21	9640 J	2.4	3.6 J	0.036	31.2 J	0.16	56.6 J	0.054	0.38 J	0.049	4.7	0.051	7.1	0.1
CC21B	9310 J	2.6	7.4 J	0.039	22.4 J	0.17	40.6 J	0.057	0.2 J	0.052	3.4	0.054	5.7	0.11
CC21D	6200 J	2.1	2.8 J	0.031	24.2 J	0.13	65.9 J	0.045	0.083 J	0.041	0.52 U	0.043	3.9	0.084
CC22	3920 J	2.1	6.9 J	0.032	65.9 J	0.14	118 J	0.047	0.11 J	0.043	0.54 U	0.045	5.5	0.088
CC22B	8670 J	2.3	6.2 J	0.034	77.5 J	0.15	148 J	0.05	0.13 J	0.046	0.84	0.048	3.8	0.094
CC22D	6880 J	2.2	2.1 J	0.032	63.3 J	0.14	35.2 J	0.048	0.17 J	0.043	3.5 J	0.045	1.9	0.089
CC23	4180 J	2.3	1.2 UJ	0.035	40.9 J	0.15	114 J	0.051	0.58 U	0.047	0.58 U	0.049	2	0.096
CC23B	7620 J	2.4	1.3 J	0.036	31.3 J	0.16	78.3 J	0.053	0.6 U	0.048	0.6 U	0.05	2.6	0.098
CC23C	9430 J	2.5	1.3 UJ	0.038	36.1 J	0.16	111 J	0.055	0.63 U	0.05	0.63 U	0.053	3.7	0.1
CC23D	10700 J	2.4	1.2 UJ	0.036	13.1 J	0.15	84.1 J	0.052	0.59 U	0.048	0.59 U	0.05	3.2	0.097
CC23I	5330 J	1.7	4.7 J	0.037	35.1 J	0.13	118 J	0.054	0.16 J	0.049	0.61 U	0.051	4	0.1
CC24	4990 J	1.7	3 J	0.037	55 J	0.14	82.7 J	0.055	0.16 J	0.05	2	0.052	2.7	0.1
CC24B	5430 J	1.8	2.8 J	0.038	59.8 J	0.14	224 J	0.056	0.12 J	0.051	0.63 U	0.053	3.8	0.1
CC24C	5930 J	1.6	3.5 J	0.033	61.8 J	0.12	268 J	0.049	0.19 J	0.044	0.56 U	0.047	5.6	0.091
CC25	2280 J	1.5	9 J	0.032	41.7 J	0.12	240 J	0.047	0.051 J	0.042	0.53 U	0.045	2.1	0.087
CC25B	6590 J	1.6	2.5 J	0.034	26.5 J	0.13	116 J	0.05	0.061 J	0.046	0.57 U	0.048	3.2	0.094
CC26	5350 J	1.5	6.4 J	0.032	91 J	0.12	99.2 J	0.047	0.067 J	0.042	1.6	0.044	3.3	0.087
CC27	6950 J	1.5	5.7 J	0.033	36.3 J	0.12	58.6 J	0.048	0.11 J	0.044	2	0.046	4	0.089
CC38	11000 J	1.5	0.82 J	0.033	46.3 J	0.12	106	0.048	0.27 J	0.044	0.66	0.046	2.7	0.089
CC38C	11200 J	1.8	2.7 J	0.075	73.5 J	0.14	95.3	0.11	0.3 J	0.05	1.7	0.053	1.4	0.1
CC38D	9870 J	1.5	1.1 J	0.032	48.8 J	0.12	87.2	0.047	0.27 J	0.043	3.7	0.045	2.2	0.088
CC39	9170 J	1.5	2.2 J	0.032	36.4 J	0.12	48.8	0.047	0.14 J	0.043	1	0.045	4.5	0.087
CC39B	9290 J	1.8	2.8 J	0.038	42.8 J	0.14	50.2	0.055	0.26 J	0.05	2.7	0.053	5.1	0.1
CC25	2280 J	1.5	9 J	0.032	41.7 J	0.12	240 J	0.047	0.051 J	0.042	0.53 U	0.045	2.1	0.087
CC41	9410 J	1.6	3.5 J	0.035	45.2 J	0.13	60.3	0.051	0.22 J	0.046	2.1	0.049	4.4	0.095
CC42	8230 J	1.6	1.8 J	0.033	7.3 J	0.12	106	0.049	0.11 J	0.044	0.47 J	0.047	4	0.091
CC43D	14800 J	1.6	1 J	0.035	31.8 J	0.13	109	0.051	0.29 J	0.046	0.29 J	0.049	9.2	0.095
CC43E	8380 J	1.6	3.7 J	0.034	57.2 J	0.12	63	0.05	0.16 J	0.045	0.82	0.048	5	0.093
CC46B	9870	2.3	1.7 J	0.035	36.2 J	0.15	41.2	0.051	0.58 U	0.046	2.1 J	0.048	3.9	0.095
CC47C	9420	2.4	1.4 J	0.036	43.7 J	0.15	35.7	0.052	0.6 U	0.048	1.2 J	0.05	4.6	0.098
CC48	13200	2.2	5.1 J	0.033	41.9 J	0.14	153	0.049	0.56 U	0.045	1.1 J	0.047	4.8	0.091
FD-1	19700 J	3.4	1.9 J	0.051	26.6 J-	0.22	204	0.075	0.92	0.068	10.2	0.071	4.6	0.14
MTD-4	12100 J	2	2.2 J	0.043	54.3	0.16	82.5	0.063	0.71 U	0.057	1.6 J	0.06	8 J	0.12

Sample Location	Cobalt	MDL	Copper	MDL	Iron	MDL	Lead	MDL	Manganese	MDL	Mercury	MDL
CC15	4.1	0.035	25.2 J	0.06	41900 J	0.98	78.6 J	0.13	453 J	0.072	0.012 J	0.0038
CC15A	3.9	0.035	29.9 J	0.059	37700 J	0.96	259 J	0.13	359 J	0.071	0.027 J	0.0037
CC16	3.3	0.033	35.5 J	0.057	56900 J	2.8	103 J	0.12	408 J	0.068	0.012 J	0.0036
CC16B	4.8	0.035	43.9 J	0.06	99300 J	2.9	94.9 J	0.13	420 J	0.072	0.024 J	0.0038
CC17	3.2 J	0.037	41.8 J	0.063	30200 J	1	541	0.14	491 J	0.076	0.057 J	0.004
CC18	5.5 J	0.034	234 J	0.058	78200 J	4.7	2070	0.12	1230 J	0.069	0.056 J	0.0036
CC18B	7.1 J	0.032	84.4 J	0.054	63500 J	4.4	498	0.12	1180 J	0.065	0.027 J	0.0034
CC20	11.4 J	0.036	127 J	0.062	57600 J	4	487	0.13	1320 J	0.074	0.025 J	0.0039
CC21	7.1 J	0.036	156 J	0.062	66300 J	4	1330	0.13	1230 J	0.074	0.028 J	0.0039
CC21B	4.5 J	0.039	98.9 J	0.066	56100 J	4.3	580	0.14	1080 J	0.079	0.026 J	0.0041
CC21D	0.69 J	0.031	21.6 J	0.053	30400 J	0.86	302	0.11	259 J	0.063	0.028 J	0.0033
CC22	1.1 J	0.032	22.2 J	0.055	33400 J	0.89	275	0.12	83.6 J	0.065	0.058 J	0.0034
CC22B	2.3 J	0.034	46.7 J	0.058	46500 J	3.8	617	0.13	204 J	0.07	0.12	0.0037
CC22D	2.1 J	0.032	61.4 J	0.055	42100 J	0.9	568 J	0.12	289 J	0.066	0.096 J	0.0035
CC23	0.65 J	0.035	20.5 J	0.06	29900 J	0.97	101 J	0.13	73.3 J	0.071	0.045 J	0.0037
CC23B	0.94 J	0.036	13.4 J	0.061	25200 J	1	72.5 J	0.13	147 J	0.073	0.025 J	0.0038
CC23C	2.4 J	0.038	25.1 J	0.064	26800 J	1	169 J	0.14	189 J	0.076	0.081 J	0.004
CC23D	8.7 J	0.036	49.6 J	0.061	27300 J	0.99	211 J	0.13	467 J	0.073	0.028 J	0.0038
CC23I	1.9	0.037	22.5 J	0.05	22500 J	0.61	577 J	0.16	190 J	0.027	0.036 J	0.0039
CC24	2.8	0.037	47.8 J	0.051	27600 J	0.62	483 J	0.16	136 J	0.027	0.14	0.004
CC24B	2.4	0.038	28 J	0.052	26900 J	0.63	165 J	0.16	190 J	0.028	0.028 J	0.0041
CC24C	1.2	0.033	43.2 J	0.046	37300 J	1.1	205 J	0.14	161 J	0.024	0.075 J	0.0036
CC25	0.66	0.032	18.3 J	0.044	25800 J	0.53	334 J	0.14	84.5 J	0.023	0.048 J	0.0034
CC25B	1.2	0.034	14.9 J	0.047	42800 J	1.1	364 J	0.15	360 J	0.025	0.024 J	0.0037
CC26	1.8	0.032	67.2 J	0.043	43300 J	1.1	398 J	0.14	200 J	0.023	0.25	0.0034
CC27	3.4	0.033	86.7 J	0.045	49600 J	1.1	755 J	0.14	538 J	0.024	0.26	0.0035
CC38	3.4 J	0.033	54.3 J	0.045	40300 J	1.6	540	0.14	585 J	0.024	0.047 J	0.0035
CC38C	8.1 J	0.038	93.9 J	0.051	40500 J	0.63	1480	0.16	1150 J	0.028	0.031 J	0.004
CC38D	5.5 J	0.032	76.5 J	0.044	42700 J	1.6	890	0.14	926 J	0.023	0.073 J	0.0034
CC39	3.1 J	0.032	61.7 J	0.044	57400 J	2.1	414	0.14	650 J	0.023	0.02 J	0.0034
CC39B	5.1 J	0.038	122 J	0.051	70500 J	2.5	626	0.16	764 J	0.028	0.042 J	0.004
CC25	0.66	0.032	18.3 J	0.044	25800 J	0.53	334 J	0.14	84.5 J	0.023	0.048 J	0.0034
CC41	4.9 J	0.035	77.9 J	0.047	56600 J	2.3	621	0.15	575 J	0.025	0.041 J	0.0037
CC42	3.2 J	0.033	58.2 J	0.045	27200 J	0.55	422	0.14	385 J	0.024	0.29	0.0035
CC43D	8.8 J	0.035	93.3 J	0.047	65700 J	2.3	205	0.15	960 J	0.025	0.028 J	0.0037
CC43E	3.5 J	0.034	48.9 J	0.046	53100 J	1.7	343	0.15	583 J	0.025	0.032 J	0.0036
CC46B	4.5	0.035	90	0.059	58800	2.9	438	0.13	703 J	0.07	0.038 J	0.0037
CC47C	3.8	0.036	48.2	0.061	58800	3	279	0.13	597 J	0.073	0.013 J	0.0038
CC48	6.1	0.033	163	0.057	43400	1.9	392	0.12	778 J	0.068	0.061 J	0.0036
FD-1	81.5	0.051	124 J	0.087	31900 J	1.4	442 J	0.19	26500 J	1	0.095 J	0.0054
MTD-4	7.5	0.043	235	0.058	66300 J	2.1	2140	0.19	1250	0.031	0.049 J	0.0046

Sample Location	Molybdenum	MDL	Nickel	MDL	Selenium	MDL	Silver	MDL	Thallium	MDL	Vanadium	MDL	Zinc	MDL
CC15	3.1	0.053	1.4	0.053	2 J	0.08	0.59 U	0.032	0.59 U	0.045	18.8	0.097	53.7 J	0.31
CC15A	6.7	0.052	1.9	0.052	2.4 J	0.079	1.5 J	0.031	0.58 U	0.044	17.1	0.095	146 J	0.3
CC16	4	0.05	1.9	0.05	2.1 J	0.076	0.64 J	0.03	0.56 U	0.042	27	0.091	71.9 J	0.29
CC16B	4.1	0.053	1.9	0.053	2.1 J	0.08	0.71 J	0.032	0.59 U	0.045	23.3	0.097	143 J	0.31
CC17	4.2	0.056	2.3 J	0.056	2.2 J	0.085	3.4 J	0.034	0.62 U	0.047	22.6	0.1	176	0.32
CC18	7.2	0.051	3.6 J	0.051	2.8	0.077	3.8 J	0.03	0.56 U	0.043	35.1	0.093	1060	0.29
CC18B	3.6	0.048	3.9 J	0.048	2 J	0.072	1.9 J	0.029	0.53 U	0.04	32.1	0.087	338	0.28
CC20	4.2	0.054	4.1 J	0.054	3.3	0.082	1.8 J	0.033	0.6 U	0.046	37.4	0.099	397	0.31
CC21	5.2	0.055	7 J	0.055	2.5 J	0.083	2.8 J	0.033	0.61 U	0.046	29.6	0.1	5300	1.3
CC21B	4.4	0.058	3.4 J	0.058	2 J	0.088	2 J	0.035	0.64 U	0.049	31.6	0.11	765	0.33
CC21D	6.7	0.046	0.94 J	0.046	4.7	0.07	1.2 J	0.028	0.52 U	0.039	17.5	0.084	64.4	0.27
CC22	4.5	0.048	1.1 J	0.048	4	0.073	2.2 J	0.029	0.54 U	0.041	16	0.088	18.7	0.28
CC22B	1.7	0.052	1.6 J	0.052	2.9	0.078	5.8 J	0.031	0.57 U	0.044	19.8	0.094	352	0.3
CC22D	0.91	0.049	1.3	0.049	1.6 J	0.074	1.3	0.029	0.54 U	0.041	12.1	0.089	898 J	0.28
CC23	2.6	0.053	0.92	0.053	2.4 J	0.079	0.62	0.032	0.58 U	0.044	11.4	0.096	33.6 J	0.3
CC23B	1.1	0.054	0.84	0.054	1.5 J	0.082	0.6 U	0.032	0.6 U	0.046	11.4	0.098	47.5 J	0.31
CC23C	1.2	0.056	1.9	0.056	1.4 J	0.085	0.88	0.034	0.63 U	0.048	17.9	0.1	77.7 J	0.33
CC23D	0.75	0.054	4.5	0.054	1.6 J	0.081	0.59 U	0.032	0.59 U	0.045	18.1	0.097	142 J	0.31
CC23I	1.7	0.055	1.4	0.055	1.9 J	0.083	3.3	0.033	0.61 U	0.046	21.3	0.1	102 J	0.06
CC24	1.1	0.056	1.5	0.056	2.1 J	0.085	2	0.034	0.62 U	0.047	13.2	0.1	638 J	0.061
CC24B	1.7	0.057	1.8	0.057	2.4 J	0.086	0.9	0.034	0.63 U	0.048	20.4	0.1	35 J	0.062
CC24C	1.4	0.05	1.1	0.05	2.6 J	0.076	1	0.03	0.56 U	0.042	27.2	0.091	48.9 J	0.054
CC25	2.5	0.048	0.58	0.048	3.5	0.072	3	0.029	0.53 U	0.04	10.8	0.087	23.5 J	0.052
CC25B	1.9	0.052	0.88	0.052	3.4	0.078	0.7	0.031	0.57 U	0.044	25.3	0.094	33.6 J	0.056
CC26	2.8	0.048	1.3	0.048	2.9	0.072	3.1	0.029	0.53 U	0.04	21.8	0.087	382 J	0.052
CC27	4.9	0.049	2.2	0.049	2.4 J	0.074	4.9	0.029	0.55 U	0.041	25.7	0.089	656 J	0.053
CC38	1.8	0.049	2.3 J	0.049	1.3 J	0.074	1.5	0.029	1.1 U	0.083	17.3	0.089	285 J	0.053
CC38C	1.8	0.056	1.9 J	0.056	2.6 J	0.085	3.5	0.034	0.63 U	0.048	16.7	0.1	546 J	0.061
CC38D	1.5	0.048	2 J	0.048	1.7 J	0.073	2.3	0.029	0.53 U	0.041	16.6	0.088	638 J	0.052
CC39	2.6	0.048	2.3 J	0.048	1.4 J	0.072	1.6	0.029	0.53 U	0.04	27.2	0.087	577 J	0.052
CC39B	4.9	0.056	2.9 J	0.056	2.2 J	0.085	2.6	0.034	0.63 U	0.048	34.6	0.1	904 J	0.061
CC25	2.5	0.048	0.58	0.048	3.5	0.072	3	0.029	0.53 U	0.04	10.8	0.087	23.5 J	0.052
CC41	3.9	0.052	3 J	0.052	2.2 J	0.079	2.5	0.031	0.58 U	0.044	29.6	0.095	502 J	0.057
CC42	4.8	0.05	3.2 J	0.05	3.8 J	0.075	1.3	0.03	0.55 U	0.042	21.4	0.091	101 J	0.054
CC43D	3	0.052	6.5 J	0.052	2.1 J	0.079	0.99	0.031	0.58 U	0.044	20.9	0.095	177 J	0.057
CC43E	2.7	0.051	2.3 J	0.051	1.7 J	0.077	5.1	0.031	0.57 U	0.043	27.8	0.093	765 J	0.055
CC46B	3.3	0.052	2.5 J	0.052	1.9 J	0.078	1.7	0.031	0.58 U	0.044	25.9	0.095	841 J	0.3
CC47C	3.2	0.054	3.1 J	0.054	1.5 J	0.081	1.1	0.032	0.6 U	0.045	30.7	0.098	282 J	0.31
CC48	2	0.05	4.1 J	0.05	1.7 J	0.076	1.6	0.03	0.56 U	0.042	24.1	0.091	286 J	0.29
FD-1	5.2	0.077	15.7	0.077	2.9 J	0.12	2.3 J	0.046	1.1	0.065	17.5	0.14	1120 J	0.44
MTD-4	6.2	0.064	4.2	0.064	1.9 J	0.097	4.7	0.039	0.71 U	0.054	30.4 J	0.12	467	0.07

Appendix 3: Total Recoverable Metals in the Soil Samples Collected at the Public Camp Sites
Terrestrial Baseline Ecological Risk Assessment
Bonita Peak Mining District Superfund Site
San Juan County, CO

Location	Aluminum	MDL	Antimony	MDL	Arsenic	MDL	Barium	MDL	Beryllium	MDL	Cadmium	MDL
CMP2	11300	2.4	4.2	0.04	18.8 J-	0.11	134	0.052	0.44	0.047	4.0	0.05
CMP4	8550	2.2	46.8	0.03	62.9 J-	0.099	75.7	0.048	0.32	0.044	94.3	0.046
CMP5	14100	2.3	0.76	0.03	13.6 J-	0.1	163	0.05	0.74	0.046	0.99	0.048
CMP7	13300	2.2	42.5	0.03	86.9 J-	0.098	180	0.048	0.8	0.043	10.6	0.045
CMP9	7050	2.1	9.7	0.06	72.2 J-	0.095	140	0.092	0.19	0.042	1.2	0.088
CMP10	8210	2.1	1.2	0.03	22.7 J-	0.094	193	0.045	0.24	0.041	0.18	0.043
CMP11	11300	2.2	0.82	0.03	43.7 J-	0.1	80.8	0.049	0.38	0.044	0.54	0.047
CMP12	10100	2.1	0.7	0.03	29.5 J-	0.094	136	0.045	0.35	0.041	1.1	0.043
CMP13	11600	2.1	0.57	0.03	19.9 J-	0.094	123	0.045	0.7	0.041	0.83	0.043
CMP14	10500	2.1	0.8	0.03	18.7 J-	0.095	111	0.046	0.68	0.042	1.1	0.044
CMP15	13200	2.3	1.4	0.04	7.7 J-	0.11	131	0.051	0.44	0.046	3.0	0.049
CMP15a	12800	6.4	0.6 U	1.2	11.8 J	0.22	90.3	3.7	1.4	0.096	19.6 J	0.095

Location	Chromium	MDL	Cobalt	MDL	Copper	MDL	Iron	MDL	Lead	MDL	Manganese	MDL
CMP2	5.4	0.097	8.0	0.036	683	0.06	22000 J	0.98	2880	0.13	3110	0.05
CMP4	4.3	0.089	9.0	0.033	2510	0.89	37400 J	0.9	44200	2.8	910	0.07
CMP5	6.9	0.094	9.3	0.034	41.3	0.058	25200 J	0.95	200	0.13	1050	0.07
CMP7	8.1	0.089	5.9	0.032	339	0.055	23500 J	0.9	11800	1.4	1560	0.07
CMP9	10.5	0.086	2.6	0.063	111	0.054	34800 J	0.87	1330	0.12	365	0.06
CMP10	4.1	0.085	2.7	0.031	31.3	0.053	45400 J	1.5	73.6	0.11	202	0.06
CMP11	4.3	0.091	5.5	0.033	79.9	0.057	48100 J	1.7	431	0.12	633	0.07
CMP12	4.7	0.084	7.1	0.031	43.8	0.053	35300 J	1.5	257	0.11	829	0.06
CMP13	7.1	0.084	10.6	0.031	22.5	0.053	24000 J	0.85	100	0.11	936	0.06
CMP14	4.8	0.086	9.4	0.031	20.4	0.053	22100 J	0.87	252	0.11	1400	0.06
CMP15	9.1	0.095	5.7	0.035	25.0	0.059	19000 J	0.96	530	0.13	715	0.07
CMP15a	11.2	0.18	29.7	0.94	1030	0.44	31500 J	2.3	761	0.28	9030	3.1

Location	Mercury	MDL	Molybdenum	MDL	Nickel	MDL	Selenium	MDL	Silver	MDL	Thallium	MDL	Vanadium	MDL	Zinc	MDL
CMP2	0.15	0.004	23.4	0.053	4.1	0.053	1.3	0.081	11.8	0.032	0.17	0.045	17.6	0.097	740	0.31
CMP4	6.0	0.028	118 J	0.049	2.8	0.049	7.1	0.074	96.9	0.059	0.3	0.041	15.4	0.089	17300	1.1
CMP5	0.21	0.004	2.0	0.052	5.8	0.052	1.3	0.078	0.72	0.031	0.15	0.044	25.9	0.094	252	0.3
CMP7	0.29	0.004	6.4	0.049	5.1	0.049	2.9	0.073	26.7	0.029	0.43	0.041	24.4	0.089	5290	0.53
CMP9	0.16	0.003	14.2	0.094	2.2	0.094	3.5	0.071	6.4	0.057	0.14	0.04	23.1	0.086	540	0.27
CMP10	0.00165 U	0.003	3.3	0.046	2.5	0.046	3.6	0.07	0.014 U	0.028	0.25	0.039	22.3	0.085	74.3	0.27
CMP11	0.19	0.004	2.9	0.05	2.5	0.05	2.3	0.076	0.98	0.03	0.18	0.042	25.4	0.091	371	0.29
CMP12	0.14	0.003	3.4	0.046	2.5	0.046	2.4	0.07	0.65	0.028	0.18	0.039	23.1	0.084	534	0.27
CMP13	0.00165 U	0.003	1.2	0.046	9.1	0.046	1.1	0.07	0.58	0.028	0.0195 U	0.039	20.8	0.084	250	0.27
CMP14	0.00165 U	0.003	1.1	0.047	6.1	0.047	0.9	0.071	0.89	0.028	0.02 U	0.04	16.6	0.086	270	0.27
CMP15	0.00185 U	0.004	1.5	0.052	6.2	0.052	0.69	0.079	1.1	0.031	0.022 U	0.044	30.6	0.095	874	0.3
CMP15a	0.016 J-	0.006	NA	NA	18.6	0.78	4.8	0.71	3.3	0.18	0.275 R	0.55	45	1	1520	1.3

Attachments

Attachment 1.
Biological Technical Assistance Group Draft Screening Level Ecological Risk Assessment Comments and EPA Responses and Actions

United States Bureau of Land Management (BLM) Comments

BLM #1 General Comment: The terrestrial SLERA [Screening Level Ecological Risk Assessment] is a well-organized document that accomplishes its primary goals of identifying COPECs [Contaminants of Potential Ecological Concern], performing a screening level risk analysis, and ranking the mine-impacted exposure areas. BLM concurs with approaches used, comparisons made, and conclusions. More specifically, the selection of exposure units, measurement and assessment endpoints, and risk questions have all been developed to support the primary goals of the assessment.

> *EPA Response #1: No action items associated with this comment.*

BLM #2 General Comment: The report conclusions regarding the exposure units posing the greatest risk, along with the identification of the most important COPECs and wildlife, are supported by the data and site analysis discussed in this SLERA. It is expected that this information will provide useful support for further risk analysis and site decision making.

> *EPA Response #2: No action items associated with this comment.*

BLM #3 General Comment: BLM agrees with the observation made at the April 2017 BTAG [Biological Technical Assistance Group] meeting, that the step to select COPECs resulted in nearly all analytes being included. The development of a less conservative and more efficient screening step was discussed at the meeting but not confirmed. BLM supports future efforts to make the COPEC selection a more effective process than in this SLERA.

> *EPA Response #3: No action items associated with this comment.*

BLM #4 General Comment: The rationale for the identification of "public campsites" as a primary ecological exposure unit is not defined particularly well. By definition, the phrase "public campsites" suggests human health exposure areas. The SLERA noted that terrestrial screening risks for this exposure area were generally the lowest of the three overall exposure areas, so perhaps this is a meaningful finding. Recommend more discussion as to how "public campsites" are sufficiently important to be identified as a primary ecological exposure unit (as compared to something more clearly ecological, such as "open field" or "forest glade" or something similar).

> *EPA Response #4: This comment was addressed by adding a new paragraph to Section 2.1.3, Campsite sampling. This paragraph describes the ecological setting of and types of natural features in campsite sampling areas. Added text also explains reasoning for assessing public campsites as individual exposure areas which is to characterize risk to receptors exposed to soils in areas that are more upland than overbank areas but still influenced by floodplain contamination.*